Application of Ergonomic Interventions in Informal Sectors of West Bengal.

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Abstract:

Introduction:

Informal economy has a tremendous potential in job as well as income generation. The final report of the National Commission for Enterprises in the Unorganized Sector (NCEUS) showed that the workers in the unorganized (informal) sector constitute more than 93 percent of the total workforce of India.

The informal sector is characterized by minimum personal relationship between the employer and the employee. The most of the employees are contractual or casual. The labor laws are mostly, not applicable in the informal sector. There is lack of occupational safety & health awareness among them. Moreover, this tremendous work force directly links with work pressure. Here, time is calculated as accumulation of money. Work and time will become the stress to these workers. Production has great importance than safety and health, so, human comfort is greatly neglected.

Demand for investigation on health and safety is a common and genuine demand of informal sectors. In 2001, in International Labor Conference, the challenge for integration of Informal economy with formal economy was greatly discussed. We should include another challenge: the applications of work comfort in informal sectors.

Objectives or Hypothesis:

Musculoskeletal disorders (MSDs) are one of the most predominant forms of occupational health problems that are increasingly affecting the global working populations. The work-related musculoskeletal disorders (WMSDs) among informal workers can be prevented. It is essential and important to find out and apply the exact interventions which will efficiently reduce WMSDs. By changing the existing workstation, design of tools, mechanical devices and by application of aids, training, proper job rotation and stress management the WMSD can be decreased and productivity of concerned informal organization may be increased. The maintenance and evaluation part will start after the application of intervention. Maintenance depends on the acceptability of the intervention. Again, acceptability is the outcome of behavioral approach of the users. This behavioral approach may be considered as the market demand or societal demand. This will vary according to the socio-economic status of the user. So, everyone should be more precise and judgmental during the selection, application and maintenance of interventions.

Materials and Methods:

Ergonomic interventions are commonly classified as engineering, administrative or behavioral. Engineering interventions are physical manipulations of hazards whereas administrative interventions concentrate on changing the design of the job. Behavioral interventions focus on the individual worker's behaviors or capacity.

For the present research, workers from five different informal sectors were randomly selected. A detailed questionnaire study was done to find out the reasons behind the prevalence of MSDs among these workers. On the basis of the response, a strategic plan was drawn on the implementation of interventions for the prevention of WMSDs. A post intervention study was formulated to find out the effect of the implemented interventions.

There are many possible outcomes by which ergonomic interventions may be evaluated. In the present investigation, efficacy was determined under ideal conditions on selected groups in real field study.

Results:

From the result of the study, it is observed that workers in the informal sectors are compelled to work in a low wage condition with maximum amount of physical effort and minimum amount of safety as they belong to the low socio-economic strata of the society and are deprived of the basic facilities enjoyed by their counterparts working in the organized sector. Consequently, these people perform strenuous manual tasks for prolonged periods and suffer from musculoskeletal disorders afflicting different body parts. For them Ergonomic-Interventions are the best solutions for the prevention of MSDs. Efficacy of the interventions are detected from the improvement of productivity, health and safety. It is observed that these implemented health interventions are highly efficient for preventing them from health, productivity and safety deprivation.

Conclusions:

It is concluded that despite various constraints, the informal workers of West Bengal are highly benefited by the modified low-cost interventions.

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For the present research, workers from five different informal sectors (manual material handling job at central market area; hand embroidery at chikankari sector; sand core making work at foundry; wood cutting job during carpentry in construction work and child worker during ridging activity at agricultural work) were randomly selected.

3.1. Job descriptions of five informal sectors

a) Manual material handling job at central market area

There are approximately 300 local male delivery porters working daily in the Central Wholesale Market of Vegetables (Kolay Market) in Calcutta, India. The porters routinely and repeatedly balance and carry loads on their heads that weigh more than 100-120 kg without mechanical assistance, resulting in high levels of MSDs, LBP, severe injury, and sometimes death.

All available full-time porters were eligible to participate in the study. After several site visits and preliminary interviews, survey questionnaires were administered to 100 porters who showed a high level of interest in participating.

b) Hand embroidery at Chikankari sector

Chikan embroidery is one of the most pristine handicrafts, usually carried out by women living in rural areas in West Bengal, India. While, there are no reliable approximations of the number of embroiderers worldwide, Wilkinson-Weber estimates that there are between 30,000 to 1, 00,000 in India (Wilkinson-Weber CM, 1997). The embroiderer uses printed outlines of designs on the cloth as a pattern and guide. These designs are embroidered by various stitches. No hooks or frames are used while embroidering. The left hand has to continually stretch the cloth gently weft ways and warp ways to avoid puckering. Chikan embroidery entails repetitive movements of the wrists and forearms while maintaining a static sitting posture with a curved upper back and the head bent over the fabric. These working conditions predispose the occurrence of musculoskeletal discomfort in different body regions in seated workers.

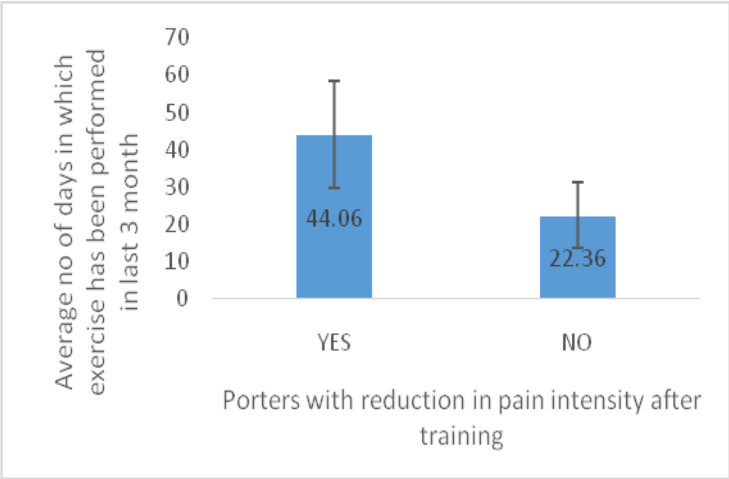
c) Sand core making work at foundry

Sand core making is a hazardous process wherein a large number of workers are directly involved. The entire core making operation is performed manually. Two types of sand cores are prepared in the core-manufacturing factory—carbon dioxide sand core and chemical sand core. In carbon dioxide sand core making, the entire core making process involves four steps—(a) preparing a core box; (b) filling the core with sand; (c) spreading and fitting the sand; (d) passing carbon dioxide gas for hardness and (e) storage of the core. Dry sand is mixed with sodium silicate and this mixture is poured into a wooden core box and hammered for fixing the sand. Sometimes the workers stand over the box and press the sand with their feet. The excess sand is then removed by stick and thrown out. After that a hole is made in the sand by a rod and carbon dioxide gas is passed through the hole from a cylinder. This gas is used for hardening of the sand. Finally, the core box is hammered for loosening and turned upside down manually. The core thus prepared, is shifted for storage. In chemical sand core making, dry sand is mixed with resin, accelerator and catalyst. Then the mixture is poured into a wooden core box manually and left for hardening. Finally, the core box is turned upside down manually, in both the cases. In chemical sand core making, work process is slow and the overall productivity is low. Moreover, workers adopt awkward work postures, with potential risks of low-back pain.

d) Wood cutting job during carpentry in construction work

Carpenters are involved in many different kinds of construction, from the building of highway to the installation of kitchen cabinets.

Figure 1: Relation between pain intensity and training



Carpenters first do the layout measuring, marking and arranging materials. They cut and shape the wood, plastic, fibre glass using hand tools and power tools, such as chisels, planes, saws, drills and sanders. They join the material with nails, screw samples of adhesives.

Carpentry works some time is stressful. Prolonged standing, bending and kneeling often are necessary. Carpenters face risk in injury while working with sharp materials, using sharp tools and power equipment.

The existing handheld tools used by the carpenters cause non-linear postures of the wrist. This nonlinear posture can lead to the development of musculoskeletal problems of wrist.

e) Ridging activity at agricultural work

The pre-adolescent agricultural workers are mainly involved in different agricultural activities related to potato cultivation.

For this they have to adopt some undesirable postures that may lead to Musculoskeletal disorder (MSD) in the near future. Among their tasks, which mainly involve land preparation for crop production, are: weeding, ridging. During crop production, the activities are, carrying seeds, planting seeds, spading and sprinkling water. After crop production the activities are picking up crops and carrying crops.

3.2. Questionnaire

The modified Nordic questionnaire (Kuorinka et al, 1987) was used in this study. The questionnaire consists of a series of objective-type questions with multiple-choice responses. The questions were grouped into sections dealing with general information of the workers, work organization and work behavior, assessment of stress at work and detailed question on work-related pain.

3. Intervention and Post intervention study: On the basis of the response, a strategic plan was drawn on the implementation of

interventions for the prevention of WMSDs. A post intervention study was formulated to find out the effect of the implemented interventions.

There are many possible outcomes by which ergonomic interventions may be evaluated. In the present investigation, efficacy was determined under ideal conditions on selected groups in real field study.

Results and Discussions

4.1. Study of the effect of Interventions in five different informal sectors

a) MMH and training as intervention

The module of the training program is designed to alleviate the work-related pain and discomfort at different body parts by the introduction of exercise regimes specifically meant for different body parts such as the neck, the shoulder, the upper back, the lower back, the knees and the leg regions.

Every porter was asked to perform the entire exercise regimen twice daily for three months at a stretch and upon completion; a comprehensive questionnaire analysis (post training) was carried on upon them on a one to one basis. 100 porters, who participated in the training program, have been interviewed regarding the post training effects by means of the newly structured post intervention questionnaire. The mean value of the 10-point pain scale data prior to training was about 7.0 and post training it reduced to 6.0.

Definitely training has been a healing factor in diminishing the discomfort feeling of the diligent trained porters.

b) Chikankari-proper work-rest cycle

The two rest break schedules assessed in this study were proposed as "Rest break schedule 1" and "Rest break schedule 2". The "Rest break schedule 1" was designed as 30-minute work/5- minute rest and the "Rest break schedule 2" was designed as 60-minute work/10-minute rest. The outcome variables were the scores on Body part discomfort (BPD) scale (Reynolds et al, 1994).

The significant effects of the rest break schedules on BPD scale scores of the different body parts are represented graphically in Figure 2. It was observed that Rest break schedule 1 had more significant improvement on the BPD scale ratings of low back, neck/shoulder and wrist/forearm than Rest break schedule 2.

c)Core making - work station redesign (Gangopadhyay et al. 2006)

In the chemical sand core making process, workers had to bring the mixed sand from a long distance repeatedly (Figure 3). A new workstation was designed and implemented where an additional storage site for storing mixed sand was selected near the chemical core making area (Figure 4). From the modified method study and by designing a new workstation, the total time spent for one core making reduced by 56 s from 237 s to 181 s (ILO, 1981). As the workers made

50 cores/day, the total time saved was 2800 s. Since each core making process took 181 s, additional 15 cores could be prepared in a day, with an overall increase in productivity of 30%.

Core making operations are performed in awkward postures, with the potential risks of musculo-skeletal disorders primarily affecting the low-back region. The existing processes of core making involved some unnecessary steps, which reduced the rate of work and increased ineffective time. The modified process eliminated these steps like reducing distance of transport (raw material) and process delay and thus reorganized work and enhanced productivity in both types of core making processes.

A change in the existing workstation design of chemical core making for storing mixed sand near the work area, resulted in reduction in the distance traveled from the storage site of raw material to the chemical core making site, and thus increased productivity in chemical sand core making.

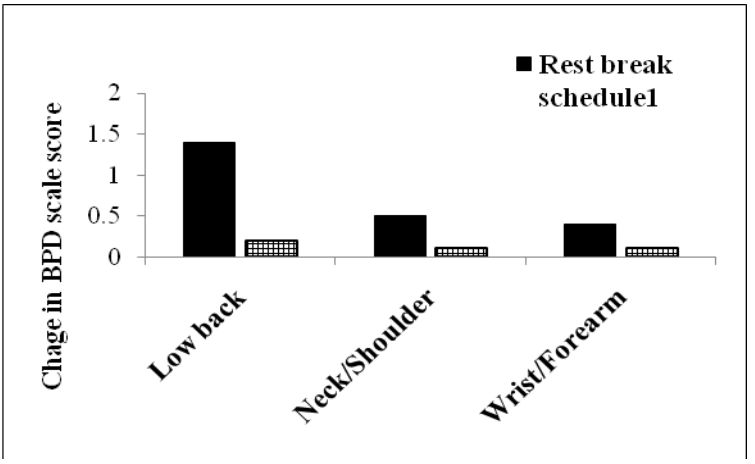


Figure 2: Significant effects of two Rest-break schedules on ratings of musculoskeletal discomfort

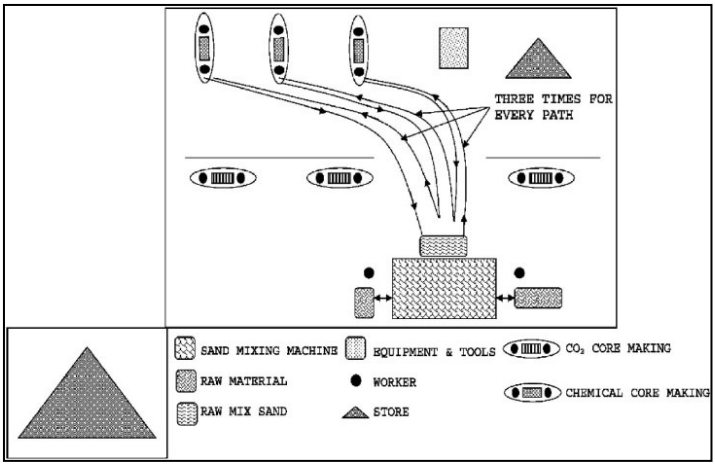


Figure 3:

Existing workstation of a sand core making unit

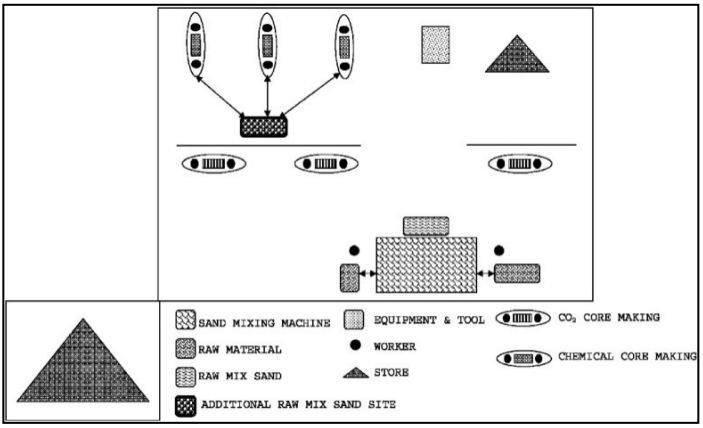


Figure 4: Modified workstation of a sand core making unit

d) Carpenter –modified hand saw

Carpenters are exposed to a huge amount of physical stress during cutting and designing the woods with hand saw. They have to bend their wrists (in nonlinear wrist postures) during holding of the handle of the tools. As carpenters are using the tools repetitively by holding the straight handle they experience discomfort as pain at upper extremities (Gangopadhyay et al, 2003; Keyserling et al, 1993).

Modified handles of hand saw:

To correct the posture of the wrist, some modifications were done in the existing handle of the hand saw. The handle is modified to pistol from straight. On the basis of the changes some experiments were conducted with 9 differently modified hand saws to find out the efficacy of the modified handle and to select the best one.

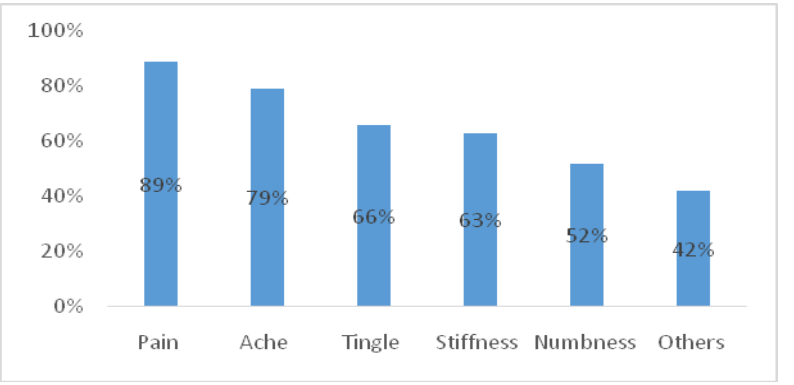


Figure 5: Kind of Discomfort Experienced by Workers during use of hand saws

Figure 6: Modified handles of hand saw

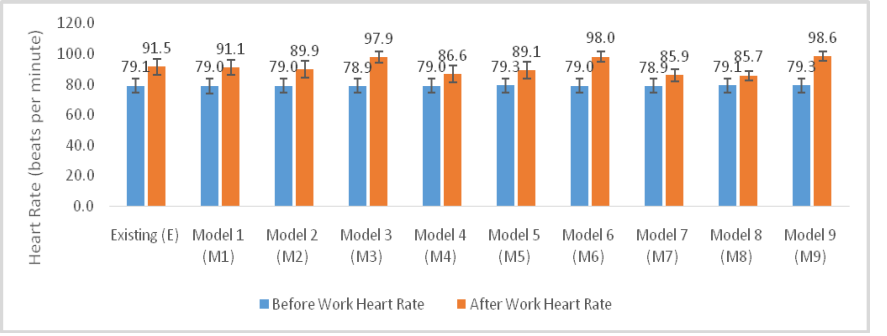


Figure 7: Before and after work Heart rate of the subjects while working with hand saws with existing and modified handles

Figure 7 represents the before and after work heart rate of the subjects while working with hand saws with existing and modified handles. Significant difference was observed only for model 7 and model 8 hand saws.

Figure 8 represents the mean time to cut a piece of plywood with different models of hand saw. The minimum time was required using model-7 followed by model-8.

Most accepted modified handles of hand saw:

According to the response of subjects, Model 7 (Figure 9) appears to be the most accepted design.

- Model 7 bears pistol – shaped handle.
- Wrists are well supported and in liner postures
- There is an additional benefit in this design where in safety guard has been introduced in this model.
- In terms of Heart Rate, it also can be concluded that 7 is better than other models.

e) **Child agricultural workers-Back support**

The back support (Figure 10) was mainly designed for pulling the two spiked ploughing tool during ridging activities. The back support was mainly designed with nylon clothes, nylon straps, plastic fibre& sponge to decrease discomfort feeling and to increase individual productivity. The back support has a belt on the abdominal region of the subject, so that it can support the body from the front. Two nylon straps were introduced from the middle part of the back support and attached with the handle of two spiked ploughing tool. During ridging activity, the subjects were asked to wear the newly designed back support. The support mainly covers the upper back and lower back region of the body for betterment of work. During ridging activity, the subjects exerted full body support to the newly designed work aid (Figure 11). Previously during ridging activity, the subjects used to

pull the iron spike bearing ploughing tool, which may lead to severe discomfort feeling (pain) to the subjects. It is evident from this study that although the agricultural workers are very young (10 to 14 years old) the type of task they perform is very strenuous. This may eventually lead to MSD (Musculo-Skeletal Disorder) among them. It was observed from that the discomfort feeling of the workers during ridging activity has reduced considerably after using the back support. Prior to the use of the back support, 74% male and 82% female reported about discomfort feeling, whereas, after using it only 20% male and 26% female complained of discomfort feeling.

Figure 8: Mean time taken to cut a piece of ply wood (min)

Figure 9: Model 7- The most accepted model of the hand saw

Figure 10: The designed back support

5. Conclusions:

From the result of the study, it is observed that workers in the informal sectors are compelled to work in a low wage condition with maximum amount of physical effort and minimum amount of safety as they belong to the low socio-economic strata of the society and are deprived of the basic facilities enjoyed by their counterparts working in the organized sector. Consequently, these people perform strenuous

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6. References

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Figure 11: Agricultural worker using the designed harness