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The Ergonomics Edge for Small Enterprises – Case Studies from the State of Telangana, India

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ABSTRACT

Terms like Ergonomic Fit, Ergonomic design, ergonomically correct / incorrect, etc have become synonymous with the term 'Ergonomics' and anyone interested in increasing output / productivity without compromising on comfort. But the word 'Ergonomics' has a great mystic around it because of its link with engineering and industry especially when it comes to small industries. While an increased emphasis on this concept, research data generated over the past few years has shown that minor / minimum changes can amount to major benefits. This paper gives the details of all such research interventions done in some unorganised and informal sectors like weaving, metal and basketry works etc, in Telangana, India in the last 15 years by the PG and PhD students in the department of Resource Management and Consumer Science (RMCS), College of Community Science (previously Home Science) and how the cost-effective ergonomic edge was obtained or can be obtained and further demystify ergonomics for all.

Keywords: Ergonomics, Ergonomics edge, Small enterprises, Low cost interventions

INTRODUCTION

Ergonomics can be described as a "Study of Work and Work Place". In particular, ergonomics is the science of creating a job that fits the worker rather than forcing the workers' body to work. Adjusting the workplace, workplace, equipment and resources for the employee can help reduce physical stress on the employee's body and help eliminate work-related muscle disorders (MSDs). Healthy workers promise to increase costs and reduce shortages as productivity increases.

Ergonomic interventions in any workplace should not be expensive to reduce the risk of workplace injuries in either existing and or new workplaces. A safe and good workplace is only as expensive as the rest of the repairs. The difference is that the long-term benefits of making thoughtful and trained decisions and creating a healthy environment are ergonomically far beyond the initial cost. Early works of Van Wely (1970), Corlett and Bishop (1976), Boussenna et al. (1982), Bendix et al. (1985) and Westgaard et al. (1988) are important in the field of musculoskeletal discomfort,

anthropometry and cognition. Other noteworthy contributions of Kee and Karwowski (2004), Chung and Wang (2009), Messing et al. (2008), Genaidy et al. (2007), Karwowski et al. (2006) and Layer et al. (2009) have all formed the basic theoretical background for these research studies.

These and other research results have provided a basis for the degree of emphasis and diversification of interventions as provided by Chikhaoui and Pigot (2010), Maldonado-Macias et al. (2009), Kee and Lee (2012), Danuta (2010), Bendy and Karwowski (2006), Seidler et al. (2010), Godard and Fiori (2010), Reid et al. (2010) and Kim et al. (2009).

Today Work-related musculoskeletal disorders (WMSDs) have become a major concern in industry, especially in the unorganised or informal sector. The application of ergonomic interventions can help unorganised / informal sector industries in achieving a proper balance between task demands and characteristics of workers. Research emphasises the positive effect of application of ergonomic principles in work system design, work environment, job design and occupational health and safety, and reduce the postural risks. However in the case studies mentioned below classified under unorganised / informal sectors; the application and awareness of ergonomics is negligible.

All the case studies mentioned form a major part of workforce under unorganized or informal sector and are characterized by poorly designed workplace and work environment, manual work, heavy loading, awkward postures and the prevalence of WMSDs is significant. Application of ergonomic principles and low cost ergonomic interventions are sure solutions to overcome these deficiencies in the workplaces, however financial constraints and other factors are an issue. The main aim of this paper is to highlight the efforts by the department of Resource Management and Consumer Science (RMCS), College of Community Science (previously Home Science) to identify and formulate some strategies for applying ergonomics in the MSMEs, and suggest low cost interventions for improvement. In most of these case studies women are the major players. Support from governments like training, upgradation of equipment are almost nonexistent. Workers unions are not present. In most cases the interventions suggested have to be taken up either by the individuals or the managers only. That is why cost and easy availability of the interventions was a major factor considered in all the above cases. Experts contribute by ensuring that human capabilities and limitations are considered but continued growth in technology has not delivered desired results in the unorganized sector as needed.

The following is a brief about the interventions and subsequent benefits available and experienced.

SUMMARY OF RESEARCH FOCUS AND ERGONOMICS INTERVENTIONS

Case Studies related to Handicraft and Handloom Sector

1. Researchers Name and Title of research

Ms. Akshata Matapati (2019) Workload Analysis of Female Basket Weavers for recommending Ergonomic Interventions (PG)

Problems identified

Work hours: More than 8 hours per day of continuous work. Medium and severe pain in the body parts like wrist, lower back, shoulder, upper arm etc., while using the tools. Heavy weight of the Knife (Kathi).

Work done

Observed the existing work environment of female basket weavers and examined the concerns and factors leading to work related health hazards. The workload of female basket weavers was assessed. The existing tools and gadget used by them were analysed for ergonomic compatibility and recommend.

Ergonomics solutions suggested and implemented

Use of appropriate and affordable equipment like light weight tools like Knife (Kathi), hack. Sheathing the handle, Taking rest breaks and Provision of low stools with back rest and arm rest.

User Responses

Sheathing the handle of the knife was very well accepted as it will not cost anything as it can be done by wrapping the handle with any piece of cloth. This was immediately implemented and gave a very positive feedback. Purchasing low weight knives with good sharpness was also welcomed but not done immediately as it involved some cost.

2. Researchers Name and Title of research

MsGayathri Devi (2019) Ergonomic Interventions to improve Work Environment in Durrie Weaving Units (PhD).

Problems identified

Weavers were using pinch grip to operate the reed frame which causes more stress on finger muscles. While weaving durrie weaver has to throw shuttle from one side to another side of warp threads and there is more likely hood of the shuttle falling down into the pit hurting the legs and take time to retrieve it.

Work done

An experimental study was conducted on in Warangal city on 120 sample and a sub-sample of 30 was drawn to gather information on work environment viz., dust level, lighting, noise, temperature, weavers health viz., grip strength, lung functioning capacity. Based on the study results and the need reported by the weavers, the ergonomic interventions were developed and interventions were given for a period of two months.

Ergonomics solutions suggested and implemented

A handle was designed and attached on the reed frame to eliminate the pinch grip. The newly designed reed frame handles with rubber coating at the gripping area for and comfortable grip. A moveable tray was placed over the pit of work to address the problem of shuttle falling down while weaving. The cost was about Rs 5000.00 $66.

User Responses

Handle designed and attached on the reed frame eliminated the pinch grip. The newly designed reed frame handle made sure the power grip in cushion. It was modified with rubber coating at the grip area. This provides easy and comfortable grip.

3. Researchers Name and Title of research

Ms. S Logeswari (2017)Enterprise viability and Ergonomic Interventions on Dhokra tribal craft.

Problems identified

The problems identified were poor respiratory health and heat stress problems like excessive sweating, fatigue, vertigo and heat rashes. Leg and hand were the majorly affected parts due to injury. Low back and neck were the regions affected by MSD. It was time consuming and tedious work process. No mechanization at work. Product finishing was low grade and dull finish. The tools used was Hand blower, small tongs and cleaning tool (file tool).

Work done

Exploratory and experimental design on a sample of 120 craftsmen belonging to Adilabad District. Observation study was conducted on Occupational health and safetyof30 craftsmen and Intervention study was conducted for 3 months.

Ergonomics solutions suggested and implemented

A mechanized blower (available in the market at a cost of Rs 1800.00 $24.00), Insulated tongs with long handle was convenient for workers to remove hot core and metal from kiln without injury and a commercially available polishing tool (Rs 2000.00.00 $27.00).

User Responses

Reduced heat stress and no direct contact to heat so the respondents were happy. The Craftsmen were satisfied with the tool.

4. Researchers Name and Title of research

Mrs. D Esther (2016) Ergonomic Evaluation and Development of a Fixed Frame Workstation Design for Fabric Embellishment Workers (PhD).

Problems identified

Aari workers faced musculoskeletal issues due to their continuous seating posture on the floor and vision problems due to continuous focus on work.

Work done

The focus of the research was to provide an ergonomically compatible workstation for aari workers, who work for long hours sitting in kneeling and crossed leg posture and were undergoing drudgery implicit. Therefore, an attempt to find a solution to overcome the drudgery for existing aari frame, an elevated seating workstation was designed and developed.

Ergonomics solutions suggested and implemented

Two levels of workstation designs one with chair level seating and the other floor level seating were evolved using Auto CAD 2010 software. Ergonomically compatible features included in the designs were flexibility in workstation height, stainless steel frame to prevent rust, screw to hold the frames tight in position and spool for holding thread; wooden chair with inbuilt draws for storage of tool and materials, low back rest and foot rest for posture comfort. A prototype model was fabricated with the mentioned features and was evaluated over the existing by six users. The post evaluation results revealed that workers' perceived compatibility with modified workstation was significantly more over the existing.

User Responses

The study concluded that work station was improved with due consideration to the users' needs and anthropometrics contributed to comfort in working.

These four case studies related to handicraft and handloom sector highlighted the need for replacement of the existing tools which are used by the artisans. These should be substituted with new and modern tools that will make their work easier. Tools should be given prime importance as the workers do the work mainly with the hands for a longer duration. Postures also need to be checked and corrected, as most of these works require to sit for a longer time period, which takes a toll on the health and musculoskeletal issues of the workers. Improvements in tool design can surely make the workers' work easy, in turn protecting their health and well - being. Cost ranged between $30 to 80.

Case Studies Related to Street Vendors and Their Workstation Design

1. Researchers Name and Title of research

Ms Deepika Pandey (2013) Performance Efficiency of Improved Barbecue for Roasting Maize/ Corn cobs (PG).

Problems identified

Controlling of fire when air blow vigorously, Danger of burns in different body part, Direct heat to lower body part, Lower efficiency, Stress at wrist muscles due to continuous fanning.

Work done

Designed and tested the performance efficiency of the improved barbecue stove in comparison to the conventional roasting stove. Elicited the opinion of maize/corncob vendors on the improved barbecue stove.

Ergonomics solutions suggested and implemented

Barbecue stove was designed in cubical shape and was provided with insulations to avoid direct contact of heat to the body. Separate ash tray for collecting excess ash, and a hand operated blower Estimated cost of the barbecue stove Rs. 2350.00 $ 31,00 (traditional roasting stove is assembled with whatever is available and may cost about a Rs 100.00, $ 1.5).

User Responses

No injuries and problems were reported by vendors during roasting process.

Improved Stove provided flexibility in use as they could use in either standing or sitting positions and it was also portable with sturdy base.

Prevention of direct heat to abdominal area due to insulations provided in the stove design. Coal tray at bottom was useful in collecting excess ash helping in easy disposal of ash.

2. Researchers Name and Title of research

Mrs J Deepika (2019) Ergonomic study of plant nursery workers and interventions to reduce drudgery (PhD).

Problems identified

Frequent wounds and lacerations. Dizziness, weakness and numbness of fingers as the nature of work involves abnormal postures and working with wet soil and seeds.

Work done

Exploratory cum field experimental research design was adopted for the study. A total of 25 plant nurseries and 120 plant nursery workers from twin cities of Telangana i.e., Hyderabad and Secunderabad were selected as a sample for the study. A sub - sample of 30 nursery workers were selected to study the impact of the interventions on the reduction of drudgery for a period of thirty days.

Ergonomics solutions suggested and implemented

A tray for holding the soil, christened as 'Agri tray box' and seed dropper were developed which can be placed at elevated levels and the seed dropper is used to make the hole and drop the seed without contacting the wet soil. This reduces the problem of awkward postures and also protects the hands from exposure to wet soil continuously. Cost was Rs. 2500.00 i.e. 34.7$.

User Responses

Nursery workers expressed working with the improved technology helped in completing the work faster, reduced heartbeat, perspiration, increased work productivity and also was user friendly. Cost justified as it is a one time expenditure and the plant nursery owners were willing to invest.

3. Researchers Name and Title of research

Ms D Krishna Priya (2009) Ergonomic evaluation of work and workstation design of sugarcane juice vendors (PG).

Problems identified

Pain in different parts of the body like shoulder, neck, due to the frequent raise of it while feeding the machine with sugarcane and while collecting the bagasse from the other side of the machine.

Work done

This study has been conducted on the vendors who were working on table top two roller extractors. Exploratory research design was adopted to conduct the study. Considering the lacunae found in the evaluation, various new designs were proposed to mitigate problems faced by vendors.

Ergonomics solutions suggested and implemented

Proposed machine design was evolved by incorporating facilities like portability, storage for money, double storied sugarcane storage, provision for storing glasses, decrease of height of the workstation at machine by providing stepped work surface and usage of materials like wood, steel, acrylic and mesh.

These three case studies related to Street Vendors and their Workstation design depicted that there is a need to modify the workstations of the street vendors in a way that they will be safe, convenient and comfortable to work. One has to design workstations which maximize the efficiency of the workers. The workstations or environments which the workers are using or working must be updated with improved technologies so that they can help the workers to complete their work faster and increase their work productivity. These latest technologies should not ignore the human object in them i.e., they should promote good postures, lessen the work related musculo -skeletal disorders and promote the overall health of the workers.

Case studies related to Product/ Space/ Equipment Design for commercial worers

1. Researchers Name and Title of research

Ms P Rajya Lakshmi (2012) Indian bread making tools - Consumer Evaluation and Design Modification (PG).

Problems identified

While making Indian bread, while rolling decreased grip strength and muscle fatigue were identified. Because the dough is sticky it sticks to the rolling pin and rolling board while rolling and frequent dusting with dry flour is needed. The rolling board not having a stable base leads to pressure on palm area while rolling.

Work done

A rolling board and pin with non-stick coating was designed and developed.

Ergonomics solutions suggested and implemented

Barrel shaped handles with long handles and more grip diameter of the rolling pin were designed. The rolling board was designed with stoppers underneath to avoid application of high force as the board can be fixed to a position and roll. The rolling board and pin were coated with a non - stick finish.

User Responses

These were given to 10 people who make Indian breads commercially for 10 days.

Fatigue of palms was reduced considerable while grip strength was maintained, although they expressed that the weight of the rolling pin needs to reduced.

2. Researchers Name and Title of research

Ms E Shirin Himabindu (2009) Designing Ergonomic Interventions for Cooks in Commercial Kitchens (PG).

Problems identified

Pain (neck, shoulder, upper limb, back and lower limb, back and lower limb) was the main musculoskeletal symptom experienced by workers. There was an increased physiological discomfort leading to health issues and postural risk factors causing work related musculoskeletal disorders.

Work done

Based on standards and recommendations suggested by various authors, an ergonomically designed commercial kitchen layout was developed and executed with an aim to achieve a work area that creates maximum efficiency and safety to cooks and keeps wastage of labour, energy and material to a minimum.

3. Researchers Name and Title of research

Mrs K Swetha (2018)Occupational Health and Safety Concern of Workers Engaged in Manufacturing Units of Precast Building Products and Coping Strategies.

Problems identified

- Adoption of wrong working postures
- Absence of usage of PPE and Presence of Occupational health problems
- Lack of ergonomically designed work equipment/ tools and administrative control

Work done

Developed a modified trolley as a coping strategy and provided PPE to reduce the occupational health problems. An on - site, feasibility testing of the intervention was done on 10 workers.

Ergonomics solutions suggested and implemented

A trolley to carry the bricks and to reduce the body discomfort among female workers and help them to maintain a good posture was developed. Personal protective equipment (PPE) was given for the workers in order to ensure safety during the work.

User Responses

The use of this new ergonomically designed trolley was effective in reducing the body discomfort experienced by the female workers, helped in maintaining the good posture, and reduced the workload.

PPE were widely accepted as they were protecting and lessen presence of occupational health problems.

These three case studies related to Product/ Space/ Equipment Design highlight that there needs to be suitable modifications in the products or equipment or spaces which are used by the workers working in places like commercial kitchens, brick manufacturing units etc. All the physical characteristics like the colour, finish, weight, size and shape etc., must be taken into consideration when one is trying to design suitable interventions for people working in such informal and undefinable jobs. Posture evaluations must be done, and tools and equipment which promote good postures and avoid awkward postures must be encouraged by the owners. PPE kits are also important tools to protect the safety of the workers and should not be ignored.

CONCLUSION

Work-related musculoskeletal disorders (WMSDs) are a major concern in unorganized and the informal sectors as in most cases they are not aware of ergonomics and also because most of the times these are traditionally followed techniques since ages. The unorganized or informal sectors are characterized by poorly designed workplace and work environment, manual work, heavy loading, awkward postures and the prevalence of WMSDs. Occupational safety, health and ergonomic deficiencies exist and these are major contributors to WMSDs and decrease in productivity. Application of ergonomic principles and low cost ergonomic interventions is the solution to overcome these deficiencies in the workplaces. However, owing to financial constraints and other factors, they cannot afford high cost ergonomic solutions and assessments by ergonomists. Availability of suitable alternatives for these technologies or tools may not always be available and the tools may have to be need based and customized. These studies have revealed that ergonomic factors like unnatural working postures, static load, contact stress and task invariability to be some of the significant factors to contribute to development of WRMSDs. It is therefore important to give due consideration to ergonomics and the use of ergonomic principles to overcome some of the deficiencies like, poor quality, lower production etc. The studies show

positive effect of application of ergonomic principles in work system design, work environment, job design and occupational health and safety, and reduce the postural risks with low or minimum investment.

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