OCCUPATIONAL HEALTH AND ERGONOMIC INTERVENTION IN INDIAN SMALL SCALE INDUSTRIES: A REVIEW

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ABSTRACT

The small scale industries (SSIs) play very important role in the Indian economy. SSIs contribute in terms of industrial production, export, employment and creation of an entrepreneurial base for the country. In most of the SSIs in India, either traditionally designed tools are used or manual work is performed. Long hours work with traditionally designed tools and un-ergonomic work places can cause musculoskeletal disorders (MSDs) and other occupational health problems among workers. Workers well-being is highly associated with the productivity and cost benefits of small scale industries. This review paper aims to identify various MSDs and occupational health problems among workers in SSIs. The effects of ergonomic interventions for improved occupational healthas well as productivity enhancement and cost benefits of SSIs are also reviewed in paper.

KEYWORDS

Ergonomic Intervention, Musculoskeletal Disorders, Productivity, Small Scale Industries.

1. INTRODUCTION

The SSIs are backbone for the growth of the country. This sector contributes about 40 percent of the gross industrial value added in the economy of India (MSME, 2014).The SSI sector produces more than 6,000 products including handloom products, carpets, soaps, pickles, auto and machine parts for Indian and foreign markets. SSIs are expected to achieve a high growth, and the contribution of SSIs in the country's Gross Domestic Product (GDP) is expected to touch double-digits 2020, from the current 8.72 percent (Gujral, 2014). According to the provision of Micro, Small & Medium Enterprises Development Act, 2006 the Micro, Small and Medium Enterprises (MSME) are classified in two classes: manufacturing sector and service sector. In manufacturing sector if investment is of twenty five lakh rupees to five crore rupees it is considered in SSIs, while in service sector investment of ten lakh rupees to two crore rupees is considered in SSIs (MSME, 2014).

Due to low investment and high labour absorbtion, SSIs have significant contribution to the economy of the country. SSIs generate foreign money for country through export. The share of SSIs in India's total exports is estimated to be around 43 percent(MSME, 2014).

The share of the top six commodities which account for about 70 percent of total SSIs exports is as shown in Figure 1.

However, in most of the SSIs are labour intensive in which the use of traditionally designed hand tools and un-ergonomic work places result MSDs among workers. MSDs are the most common injuries related to poor ergonomics. If these injuries are taken lightly, these will progress to permanent problems (Cooper and Kleiner, 2001). Ergonomic intervention in SSIs reduces MSDs among workers. Wellbeing of workers increases productivity, revenue, and reduces rejection cost which would greatly help the economy of the country.

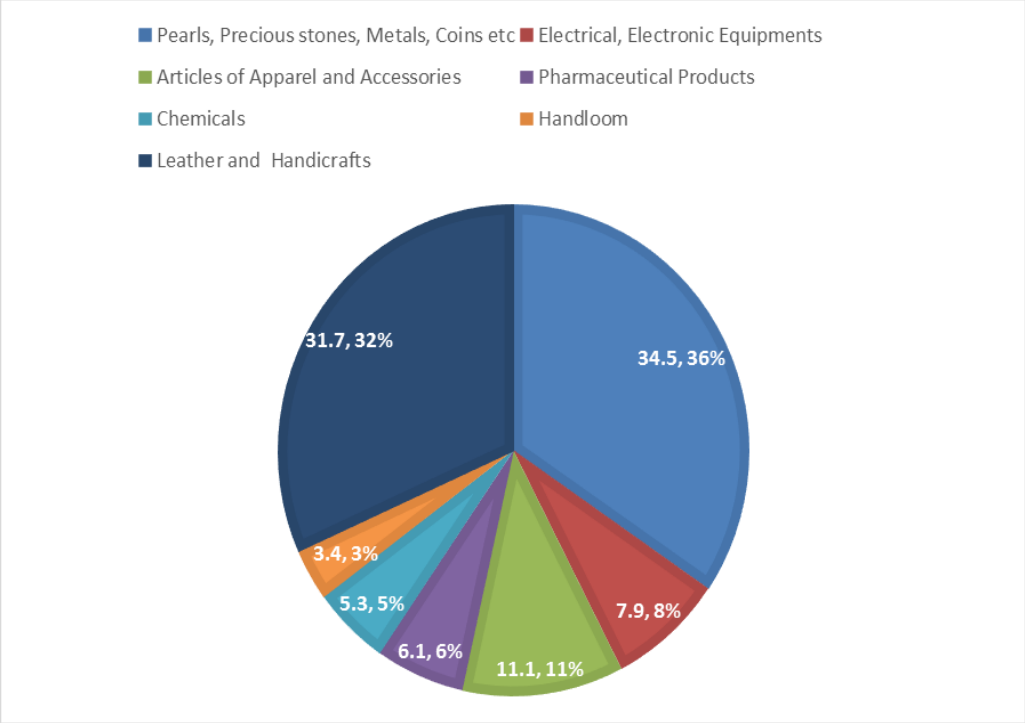

Figure 1: Percentage of top products in SSIs export (*Source: Gujral, 2014*)

2. LITERATURE REVIEW

Almost in all countries SSIs face serious occupational health and safety challenges (Hasle et al., 2006) and the scenario is also same for the India (Mukhopadhyay and Srivastava,2010). The level of awareness about ergonomics, good work environment and good postures in the SSIs and the unorganized sector there is very low. Musculoskeletal disorders (MSDs) are always there with the manual activities carried out in SSIs where a number of workers are working in awkward postures. It is therefore shows required to avoid the awkward body postures (Qutubuddin et al., 2013; Meena et al., 2014). MSDs are very common health problems in allover world and also a major cause of workplace disability (Nur et al., 2014; Punnett and Wegman, 2004). Most commonly affected body regions are the low back, neck, shoulder, forearm and hand (Punnett and Wegman, 2004). Most of the work related MSDs are cumulative disorders which result from exposures to high or low intensity repeated loads over a long period of time (Singh et al., 2012).

Ergonomic interventions are the best solutions for the prevention of work related MSDs (Gangopadhyay et al. 2014, Meena et al. 2014a). The Indian SSIs workers particularly sand core making workers, gold smiths and carpenters are highly benefited by ergonomic interventions as modified workstations and newly designed tools (Gangopadhyay et al. 2014).Also the carpet industry and bakeries are high risk occupations to develop various types of MSDs, respiratory disorders, injuries, eyesight problems, nerve disorders and skin problems (Choobineh et al., 2007;Al-Yassen, 2009**;**Waniet al., 2012).

The poor environmental conditions combined with unhygienic conditions have been found the reasons for developing various occupational disorders. Lack of awareness among the weavers deteriorates already existing problems in the carpet industry. Most of the diseases and occupational health problems in carpet industry can be minimized by following ergonomic principles. The safety equipments like facemasks, gloves first aid facility, and proper uniform, must be used for the protection of workers (Wani et al., 2012). Thus, improvement of working conditions and control of MSDs and other risk factors seemed essential.

For the industries which wish to have a competitive edge in present scenario, it is compulsory to emphasis on quality and excellence through ergonomics. Ergonomics management is valuable as a cost reduction, quality improvement, performance improvement and productivity-enhancing process (Rowan and Wright, 1995).The occupational health problems and ergonomic intervention in various SSIs are given in Table 1.

Work related MSDs, low back pain and other health problems result in increased absenteeism and lost working time, adverse effects on labour relations, higher insurance and compensation costs, increased probability of accidents and errors, job transfer and higher turnover of workers, more scrap and decreased production, low-quality work and high administrative and personnel costs (Cardinali, 1998; Miller, 1995; Niu, 2010; Widanarko et al., 2012). Which ultimately reduces productivity and increases cost to company. These problems can be reduced through ergonomic interventions which will create better quality of life for workers and reduces the financial losses and medical costs to companies and the economy (Roper and Yeh, 2007; Ahasan and Imbeau, 2003). A healthy worker is found nearly three times more productive than a worker in poor health (Niu, 2010).

Table 1: Key findings of some paper from literature

Author, Year	Industry	Key findings
Trevelyan and Haslam , 2001	Brick	• Data collection was done through medical records, semi-structured interviews, video recording to enable task, postural and force analyses, subjective discomfort survey, attitude survey, workplace analysis and comparisons with a sister concern. • The main task was found high repetitive, with a 13 s cycle time. • Poor standing posture and undesirable wrist positions with significant force loadings were found during posture and force analyses. • The piecework system was found as an important contributory factor.
Bandyopadhyay and Sen, 2014	Brick	• Active contraction of the extrinsic finger flexor muscles, increased tendon diameter, increases intra-carpal tunnel pressure, nerve or tendon trauma is common in brick manufacturing workers. • These MSDs can be reduced by eliminating clay pulling task element, reducing the load handled and improving wrist and hand posture.
Choobineh et al., 2007	Carpet	• It was found that the most of ergonomics problems originated from un-ergonomically designed weaving workstation. • The weaving height was adjusted 20 cm above the elbow height and a high seat with forward slope was used which improved working posture and result in reduced postural stress on weavers' bodies and, consequently, reduced prevalence of MSDs symptoms. • The seat with 10 degrees forward slope was placed 15 cm above the popliteal height of the weaver.
Nazari et al., 2012	Carpet	• A high prevalence of MSDs found among the hand-woven carpet workers. • The neck, lower back, ankles, feet, hands, wrists, upper back, shoulders and knees were found affected mostly.

		• Fifty percent of the weavers were unsatisfied with the working environment conditions like thermal condition, noise level and cleanliness of the air. • A significant relationship was reported between upper back symptoms and daily working time also between lower back symptoms and the numbers of rows of knots woven in a day. • Workers satisfaction with hand tools shape and thermal condition of the workshops were found associated with lower back symptoms, whereas satisfaction with weaving looms were found associated with upper back complaints.
Pandit et al., 2013	Handloom	• The four main problem areas causing MSDs were seating, treading, flying shuttle and cloth rolling operations. • The weaving workers were found to work in awkward posture continuously and repetitively. • The force required for for shuttle operation was found 6.67 ± 1.39 kg pulling with a repetition of 94.67± 13.59 rpm constantly for 10 to 15 minutes which leads to disorder in trapezius muscles.
Ikhar and Deshpande, 2011	Cotton spinning	• Among hand driven cotton spinning operators, symptoms from knees, back and shoulders over the course of time were significantly more prevalent compared to other body regions. • Any program for working condition improvement should focus on minimizing awkward posture of the body parts. • Workers with awkward posture, mostly suffer from MSDs particularly affecting the low back and neck region.
Sarder et al.,2006	Garment	• The garment manufacturing plants suffers with MSDs, mainly in the upper body, poor morale and high worker turnover. • The work culture requires changes unless it would always be difficult to implement changes that alleviate suffering and poor health among workers.

Megeid et al., 2011	Garment	• The garment industry suffers from poor performance of workers because of: (1) The un-ergonomic design of equipment and tools. (2) The inappropriate design of the workplace. (3) The absence of a suitable work environment. • The performance of the worker can be improved improving the conditions of the working environment.
Parimalam et al., 2006	Garment	• The workink environment in the garment factories is unhealthy and unsafe for the workers, resulting in several health problems. • Congested work area, improper ventilation, dust, un-ergonomic workstations, excessive noise and non-use of personal protective equipment are the major constraints faced by the workers in these units. • Ergonomic interventions to improve the work environment, safety aspects and work methods required on a wider scale.
Meena et al., 2014	Handicraft	• The factors which affect the quality of work life are: working environment, job security and cooperation with co-workers. • The quality of work life, reduced MSDs and increased productivity can be achieved by ergonomics interventions.
Meena et al., 2014a	Handicraft	• The workers engaged in handicraft industry are victims of different MSDs. • Appropriate risk reduction and health promotion programmes must be implemented to enhance safety and health among handicraft workers. • Ergonomic interventions could reduce MSDs which will result increased productivity.
Wang and Lin, 2011	Food and Bakery	• In bakery industries material handling, with use of certain parts of the body led to the MSDs. The productivity would also be affected.
Al-Yassen, 2009	Food and Bakery	• The work-related respiratory allergic problems were significantly higher among the exposed. • Safety measures are must be taken in such type of work conditions.

Moghaddasi et al., 2014	Food and Bakery	• The work related symptoms are significantly higher than those in the controls. • It may be due to nature of working processes which are dusty with high humidity and temperature. It implies that humidity may condense flour dust and increase the exposure in the workplaces. • The effect of flour dust on main lung function parameters, such as FVC and FEV1 was found adverse. • The wheezing and chronic cough is the main symptoms to find work related asthma among exposed workers to flour dust. • The risk of pulmonary disease among the workers exposed with flour dust is higher than the unexposed workers. • The occupational risk can be reduced by enhanced rate of ventilation, air flow, and increased number of inlets and outlets in the workplaces.
Jekayinfa, 2008	Food and Bakery	• The increase in the workers' body temperatures, blood pressures and heart rates after bread-baking operations were found moderate.
Guimarães et al., 2012	Footwear	• There was a reduction of accidents and absenteeism, and elimination of turnover and WMSD risk after a proper training to the workers. • Worker's and managerial commitment is crucial for the implementation of a macro-ergonomic intervention. • Economics evaluation showed that a participatory, macro-ergonomic intervention justifies the costs of the implementation, leading to positive outcomes.
Roquelaure et al., 2001	Footwear	• Ergonomic and psychosocial risk factors of CTS were assessed by workpost analysis and self-administered questionnaire. • No specific type of job performance was found associated with CTS. Obesity and psychological distress at baseline were strongly predictive of CTS. • A strict control of the work by superiors gives negative impact on CTS. • The level of CTS in footwear workers was higher than in the general population and industries.

Ali et al., 2012	Saw Mills	• In a saw mill process in northern Karnataka State, most workers are male. • Most of the work in saw mills carried out manually hence work related MSDs and injury in different parts of the body are common. • REBA and RULA analysis indicates that the workers work under high risk in saw mills. • The questionnaires and VAS (Visual Analogue Scale) techniques were also used to analyze working postures and MSD's. • The noise level was also found above the OSHA's safe limits for prolonged time.
Jones and Kumar, 2010	Saw Mills	• Five ergonomic posture assessment tools: rapid upper limb assessment [RULA], rapid entire body assessment [REBA], American conference of governmental industrial hygienist's threshold limit value for mono-task hand work [ACGIH TLV], strain index [SI], and concise exposure index [OCRA]) were used. • The quantitative ACGIH-TLV for mono-task hand work and Borg scale were found very bad.

In labour-intensive industries like SSIs, the salary bill is likely to be more than 70 percent of the total expenditure. Only area for loss control is reduction in bodily harm (Miller 1995) which can be achieved by ergonomic interventions. Many researchers reported productivity enhancement and cost benefits as the result of ergonomic interventions.

Govindraju et al. (2001) reported 23 percent increment in operator's productivity and 19 percent reduction in injuries as the result of improved workplace illumination in circuit board manufacturing company. In another case study in flashlight and lantern plant operation achieved a significant reduction in the reject rate and almost a 50 percent increase in output after ergonomic interventions.

Mukhopadhyay, and Ghosal (2008) worked on improving productivity and facilitating the occupational health and safety of the workers involved in incense stick (agarbatti) manufacturing at Ahmedabad in the Gujarat state of India. After using ergonomic intervention productivity was increased by 15 per cent and pain in different parts of the body was also reduced.

According to Megeid et al. (2011) garment industry in Egypt suffers from poor workers performance, as a result of inappropriate design of workplace. Yeow Paul and Sen (2006) studied in manual component insertion (MCI) lines in a printed circuit assembly factory there was an improvement of 50.1% in labor productivity with ergonomic principles. Also there was a 59.8

percent increment in the total revenue in the MCI lines. Guimarães et al. (2012) conducted ergonomic intervention in a Brazilian footwear company and found that the pilot line productivity increased by 3%, rework was reduced by 85%. The cost of the intervention was U$ 70,132 while annual savings were U$503,479.Tompa et al. (2012) performed economic analysis of a participatory ergonomics process at clothing manufacturer in Southwestern Ontario, Canada and found that the benefit-to-cost ratio was 5.5.

Lahiri et al. (2005) performed net- cost estimation for the wood processing and found that after applied appropriately ergonomic interventions productivity was increased by 10 percent and also the benefit to cost ratio was 84.9.

Itmight be in the economic interest of management to take a more active role to prevent MSDs and other occupational health problems among workers in SSIs by using ergonomic interventions. Design teams can play an important role for meeting ergonomic goals jointlywith productivity goals (Neumann et al., 2006).

3. CONCLUSION

The literature regarding MSDs and other occupational health problems in various labour intensive SSIs has been reviewed in order to identify occupational health problems and benefits through ergonomic interventions, to develop a future research strategy. It is observed that MSDs and other occupational health problems are common in SSIs due manual work and un-ergonomic design of tools and work places. It is also observed that the ergonomic intervention improves wellbeing of workers which ultimately increases productivity, revenue, and reduces rejection cost. This review gives a quick overview of ergonomic issues in Indian SSIs. In India a lot of work is required in the field of ergonomic intervention in SSIs which would greatly help the economy of the country. The study is limited to only Indian SSIs and the searced domains are also limited. In future a systematic review will be done covering wide domains.

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