ERGONOMIC STUDY OF POWER-LOOM INDUSTRY WOMAN WORKERS FROM SOLAPUR CITY, MAHARASHTRA, INDIA

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Abstract: The aim of this ergonomic study was to understand the health and safety aspects of power-loom industry woman workers from Solapur City, Maharashtra, India. We assessed the samples of 219 workers for their general physique, muscle tone, lung condition, and eyesight using different techniques. In this study, we found that most of the workers were influenced by respiratory issues, increase in muscle tone, eye issues and musculoskeletal issues. Therefore, to improve the health of these workers, we presented the suggestions and recommendations in accordance with the ergonomics principle and available labour laws.

Key words —Ergonomics; Health and safety; Solapur city, Power-loom.

INTRODUCTION

Stooped and squatting postures are common in developing countries such as India, especially in small scale industries [1]. Most of the manually energized operations in these industries are carried out in uncomfortable postures. The power loom plays a vital role in Indian textile industry and providing the employment opportunities to 4.86 million people of the country in 2009 [2, 3]. The state of Maharashtra in India with an estimated investment in 2012 of United State Dollar (US$) 224 million on various textile projects is the biggest contributor to India's textiles market [4]. The prominent textile clusters in the state are Kolhapur, Nashik, Solapur and Thane.

Solapur city is an important district head quarter in western Maharashtra located at 17.6599° N, 75.9064° E, and is famous for its power-loom industry (Chadder and Towel), and Beedi making Industries. There are approximately 3500 units in this cluster, which are engaged in manufacturing of textile products such as towels, napkins and bed-sheets. The textile clusters are spread across different parts of the city and involves the use of 25,000 power looms today and employing about 100,000 workers. The operations involved in typical textile plant are fiber production, spinning, twisting, textile yarn production, weaving, knitting, dyeing and finishing. Thus the manufacturing processes convert raw materials into finished goods with entire process based on systematic function allocation to humans and machines. The human interference is essential during every operation mentioned. Further, in the processing of textiles, the industry uses a number of dyes, chemicals, auxiliary chemicals and sizing materials. Apart from occasionally occurring serious accidents, the textile industry is generally seen as a safe place to work in comparison with other industries. The major health risks in this industry do not arise from immediate, potentially fatal hazards; instead, the risks that textile workers face come from more subtle hazards whose effect accumulates over time. These injuries often start as minor aches and pains, but can develop into disabling injuries that affect our activities of daily living such as laundry and even the ability to pick up our children [5].

There is evidence from some studies in India about health risks to industry workers. Suryakar et al [6] carried out a study to assess exposure effects of cotton dust on oxidant and antioxidant in the spinning department of Misr Helwan Industry Misr Helan Spinning & Weaving Industry, Helwan, which may induce, related health hazards such as oxidative stress and immunoglobulin levels (IgG & IgM). Another article by Agnihotram [7] provided a review of existing evidence from community based epidemiological studies and addressed the growing need for evidence-based occupational health research in India. Knutsson [8] focuses on major disease related to shift work such as sleep disorders and risk of accidents. The effects of shift work on physiological function through disruption of circadian rhythms are well described. Knutsson [8] also provides a model to summarize possible mechanisms of disease in shift workers. Metgud et al [9] conducted an observational cross-sectional study on a sample of 100 women workers with respect to their cardio-respiratory and musculo-skeletal profile before, during and at the end of the work. Sant et al [10] have studied the adverse effect of smoke/flue on lung functions of glass factory workers of Firozabad district. Müezzino [11], Spiro and Stigliani [12] and Hendrickson et al. [15] have reported the adverse health impacts of textile effluents. Ayesha Anjum et al. [16] reported the health concerns among workers in weaving industry due to exposure to toxic chemicals, occupational health problems of workers involved in hand made carpets. It is mentioned by [16] the workers were subjected to health problems like skeletal deformities, ergonomic, eyesight and several others. Further, the impact on the health of the different exposures vary across different strata in the community, like age groups, social groups, gender, occupations, educations and other characteristics [17].

AIMS & OBJECTIVES

To develop a framework for understanding the risks of power-loom workers were exposed to Ergonomics aspects related to health and safety standards in the industry. To reduce health hazards through design of safe work systems in accordance with the ergonomics principle and available labour laws, engineering and administrative control measures.

MATERIAL AND METHODS

The health problems related to the workers in power-loom industry were assessed by carrying out field survey. During the survey, semi-structured interviews of unit owners and workers in various power-loom industries were conducted with the help of a checklist. The effect of process on raw materials used in this mill, were assessed by the operational performance indicator under, Environmental Performance indicator (EPI), review of existing CETP units (Centralized Effluent Treatment Plant recently established) and present health status of workers and their working conditions were analyzed. The study covered both small scale and medium scale units. At the first stage, out of 49 Powerloom units from the city a total of 15 power-loom industries was selected by random sampling technique. This is approximately 31% of the entire population. The field survey of power-loom industry, has been done during December 2015 to December 2016. In the second stage, workers were selected from these power-loom mill. For the selection purpose of respondents a complete list of permanent workers between the age of 21 to 60 which having the minimum 3 years work experience was proportionally selected from all the 15 power-loom industries. A sample of 219 workers (consented to be interviewed) from Powerloom industries participated and they were assessed on various measurements.

The monitoring equipment's and parameters for measuring occupational health status are detailed below:

Weight and Height: The body mass index (BMI) is a heuristic proxy for human body fat based on an individual's weight and height. The BMI is dependent on patterns of food consumption, associated living and working conditions, the nature and duration of physical work [17].

Hand Grip Meter: The test measures the maximum isometric strength of the hand and forearm muscles. This test is often used as a general test of strength. The strength also depends upon various activities like daily food intake, working hours, and pattern of work [18].

Peak Flow Meter: A peak flow meter is a handy, cheap, handheld device used to measure how air flows from the lungs in one "fast blast" [19]. The peak flow measurement of 350 l/min is considered to be normal for adults, while 200 l/min indicates a condition of chronic bronchitis and, therefore, major lung damage.

Eye testing: The Snellen chart is used by eye care professionals and others to measure visual acuity. There are several lines of block letters printed on the chart. The first line consists of very large letters or symbols, and subsequent rows have increasing letters or symbols decreasing in size. If the smallest row can be read accurately, it indicates that the person has good eyesight [20].

The data obtained by survey of workers in the light of above parameters were analyzed to quantify the assessment of probable health problems. The results obtained from this study are described in the following paragraphs.

RESULTS AND DISCUSSION

Health and Safety Indicators: In the industries that were surveyed, the team was able to interview and measure the selected health parameters of 219 woman workers. To aid comparison of the occupational health status, these workers were divided into two categories depending on the number of years of engagement in the current unit:168 of them had been with the units for up to 5 years, while 51had worked for more than 5 years. The Table 1 shows the no. of workers engaged in various processes in our sample.

TABLE 1. PROCESS AND NUMBER OF WORKERS

Textile Processes	Female						Total
	Age group 21 to 40		Age group 41to 50		Age group 51 to 61		
	A	B	A	B	A	B	
Thread	3	5	3	5	3	5	24
Spinning	4	7	4	7	4	7	33
Weaving	5	7	5	7	5	7	36
Knitting	5	8	5	8	5	8	39
Bleaching	4	6	4	6	4	6	30
Dyeing	3	4	3	4	3	4	21
Printing	3	4	3	4	3	4	21
Finishing	2	3	2	3	2	3	15
Total	29	44	29	44	29	44	219

Body Mass Index (BMI): The BMI of the workers as shown in Table 2 indicates that these are having <5 years, 24.40% (168) and 5> years, 13.72% (51) workers are underweight, it is observed that those are in 5> years are remaining in the same unit had better health. In other words, regular work benefits the workers, while also reflecting the sound health of the industry workers. For the improvement of the body mass index, our findings suggest that regular work with job security over time and incomes that enable the workers to sustain them and their families.

TABLE 2 BODY MASS INDEX OF WORKERS

Category of workers	Years worked in present unit	Nos. of workers	Body Mass Index (BMI)		
			Under Wt	Normal	Over Wt
Thread Formation	0-5	16	07	08	01
	>5	08	01	07	00
Spinning	0-5	21	08	12	01
	>5	12	02	10	00
Weaving	0-5	26	09	17	00
	>5	10	01	09	00
Knitting	0-5	29	06	21	02
	>5	10	00	10	00
Bleaching	0-5	22	03	19	00
	>5	08	01	07	00
Dyeing	0-5	18	02	16	00
	>5	03	02	00	00
Printing	0-5	21	03	18	00
	>5	00	00	00	00
Finishing	0-5	15	04	11	00
	>5	00	00	00	00

Pulmonary Function Test (PFT) and Pulmonary Health: The measurement of the PFT gives those are having <5 years, 15.47 % (168) and >5years, 15.68% (51) workers are normal and remaining had risen Combined obstructive / restrictive much concern Table 3. In other words, all the workers are being exposed to vapors, gases, fibers, and particles in a work atmosphere that is not conducive to pulmonary health. The precautions to be taken in such situations are to use pigments and cleaning agents that do not emit vapors known to be injurious; (b) install exhaust systems which ensure proper ventilation in the sheds and a regular supply of fresh air; (c) periodic medical checkups of all workers to identify the early signs of pulmonary distress; and (d) rotation of jobs so that exposed workers are able to reduce the duration and intensity of their exposure.

Hand Grip Meter (HGM) and Muscle Tone: The result indicated in Table 4 shows those are having <5 years, 39.88 % (168) and >5years, 52.94% (51) workers are below normal in the HGM test. The results of the test indicated that there was a decline in muscle tone. The safety measures comprise (a) regular rest periods to avoid muscle fatigue; (b) better designs of grips for the blocks and screens; (c) design of suitable places and registration guides; and (d) table heights that enable pressure to be applied directly onto the blocks.

TABLE 3 PULMONARY FUNCTION TEST

Category of workers	Years worked in present unit	Number of workers	Pulmonary Function Test		
			Normal	Asthmatic Tendency	Chronic Bronchitis
Thread Formation	0-5	16	3	6	7
	>5	08	1	5	2
Spinning	0-5	21	2	14	5
	>5	12	1	6	5
Weaving	0-5	26	5	14	7
	>5	10	1	6	3
Knitting	0-5	29	2	21	6
	>5	10	2	5	3
Bleaching	0-5	22	4	13	5
	>5	08	3	05	00
Dyeing	0-5	18	3	11	4
	>5	03	00	2	1
Printing	0-5	21	3	13	5
	>5	00	0	0	0
Finishing	0-5	15	4	9	2
	>5	00	0	0	0

TABLE 4 HAND GRIP METER TEST OF WORKERS

Category Of Workers	Years Worked In Present Unit	Number Of Workers	Hand Grip Meter					
			Above Normal		Normal		Below Normal	
			Right	Left	Rig	Left	Rig	Left
Thread Formation	0-5	16	1	1	0	2	8	4
	>5	08	0	0	0	0	6	2
Spinning	0-5	21	2	4	0	3	4	8
	>5	12	0	2	1	1	6	2
Weaving	0-5	26	0	0	2	1	12	10
	>5	10	1	1	1	1	6	0
Knitting	0-5	29	3	0	1	1	14	10
	>5	10	0	0	2	2	3	3
Bleaching	0-5	22	1	1	4	5	7	4
	>5	08	0	0	0	0	5	3
Dyeing	0-5	18	3	2	3	2	5	3
	>5	03	0	0	1	0	1	1
Printing	0-5	21	2	1	2	1	10	5
	>5	00	0	0	0	0	0	0
Finishing	0-5	15	3	1	1	1	7	2
	>5	00	0	0	0	0	0	0

Eye Strain and Eyesight: Apart from the effects of work on the body, the lungs, and muscle tone, the repetitive work and the continuous visual attention to detail also appears to have an upset on the eyes of the workers (refer Table 5). Those are having <5 years, 62.15 % (168) and >5years, 17.50% (51) Normal eyesight, <5 years, 12.85 % (168) and >5years, 25.0% (51) Hypermetropia (long-sightedness), and <5 years, 13.57 % (168) and >5years, 25.0% (51) myopia (short-sightedness) could be estimated through eye testing using the Snellen chart. In addition, a few of the workers also reported symptoms of watering, cataract, strains and swelling in the eyes in both categories. Our observations in the workplace suggest that there is a lack of uniform and adequate lighting in most of the sheds. Proper illumination and regular breaks from work will enable the eye muscles to avoid fatigue and redesign of the working tables to enable work to be done within the normal eye range would offer further relief to the workers as well as improve the quality of the work.

Muscular Pains and Body Pains: Additionally, many of the workers also reported muscular pains in the back, at the joints and the lower abdomen (Refer Table 6). Results revealed that there were <5 years, 0.052% (168) and >5 years 0.066 (51) complaints of pain in the chest and the right arm and shoulder. These complaints are clearly related to the nature of work. Regular rest periods are recommended through this report.

Some findings of the study: This baseline study, tried to examine the implicit linkages between working in the Powerloom industry and its impact on the health of the workers. This analysis is based on a cross sectional study and requires more detailed observation of a larger sample with experimentation at specific pilot locations. Some key findings from the pilot study are:

It was observed that the general body health improved for the workers in all sampled Powerloom industries as they worked for more years, indicating that regular work is beneficial for workers in the long run.

1. All the workers who participated in the survey were exposed to significantly higher levels of air pollution as only one-tenth seem to have normal lung functions. About 60% (168) workers have reported Asthmatic tendency, whereas, 25% (51) workers have shown symptoms of Chronic Bronchitis. It was noticed that the incidence of chronic distress increases with the number of years worked.
2. In the surveyed textile industries, among the weavers, it was observed that the muscle tone of those workers engaged in repetitive laborious work declines with increasing number of working years.
3. The eyesight of most workers is deteriorating over time in all locations, and a comparison between the workers shows that it is declining more rapidly for those engaged in certain tasks requiring immense and constant attention to detail.
4. Interviews with workers give in a range of complaints regarding body aches, sores, cuts, burns and calluses, lung and eye problems, deafness, fatigue and sleeplessness, and stomach problems, in relation to 73% (540) of workers have complained of muscle and body pain.

5. However, some of the problems are made worse by workers' habits of smoking, chewing tobacco, drinking alcohol, and taking intoxicating materials.

The study covered the sample survey of 540 Powerloom workers in selected industries in Solapur city and the results showed that most of the workers have been impacted by the unhealthy and non-safety working conditions which resulted in to 84.28 % workers affected by respiratory problems, 43.15 % have reported increase in muscle tone, 12% complained of eye problems and 73 % have been found affected by musculoskeletal problem. Hence, there is an immediate need to reinforce their workplace safety and health policies and implement measures in accordance with Indian Factories Act (OHSAS 18001/ILO-OSH 2001) which includes directions and procedures in respect of industrial installations, work environment such as dust, noise, temperature, and humidity. Based from these outcomes, it is strongly emphasizing the need of policies for successful implementation of health safety program. This will address key factors like well-being of workers, the development of policy and objectives related to hazard identification, emergency standards, and workers' participation in safety management, risk assessment and risk control. Such initiative will ensure the commitment of the top management towards healthy and safe working practices. The above guidelines are needed for the major work-related risk factors that should be eliminated or minimized such as manual handling of materials, repetitive work, static work, segmental vibration, and poor psychosocial work environments. Studies and evaluations on the technological and economic feasibilities of the application of these guidelines need to be conducted.

TABLE 5 EYE PROBLEMS REPORTED BY WORKERS

Category of workers	Years worked in present unit	Number of workers	Eye Problems							
			H	M	W	S	C	E	St	N
Thread Formation	0-5	16	3	6	1	0	0	0	0	6
	>5	08	2	5	0	0	0	0	0	1
Spinning	0-5	21	1	2	0	0	0	2	0	16
	>5	12	2	2	0	0	0	0	0	8
Weaving	0-5	26	3	2	1	1	2	0	0	17
	>5	10	2	2	0	0	3	0	0	3
Knitting	0-5	29	5	2	2	0	0	0	0	10
	>5	10	2	2	0	0	4	0	0	2
Bleaching	0-5	22	1	3	0	0	0	0	0	18
	>5	08	1	1	0	0	4	0	0	2
Dyeing	0-5	18	2	2	1	1	1	1	0	10
	>5	03	1	0	0	0	2	0	0	0
Printing	0-5	21	2	2	1	1	1	1	0	9
	>5	00	0	0	0	0	0	0	0	0
Finishing	0-5	15	1	2	0	0	0	0	0	12
	>5	00	0	0	0	0	0	0	0	0

TABLE 6 PAINS REPORTED BY WORKERS

Category of workers	Years worked in present unit	Number of workers	Pain									
			B	J	K	E	LA	C	RS	RA	L	H
Thread Formation	0-5	16	3	2	0	0	2	1	1	1	0	0
	>5	08	2	0	0	0	0	0	0	2	0	0
Spinning	0-5	21	4	3	1	1	1	1	0	0	0	1
	>5	12	2	2	0	0	0	1	0	1	0	0
Weaving	0-5	26	4	4	3	1	3	1	1	1	1	1
	>5	10	2	0	2	0	0	2	0	0	0	0
Knitting	0-5	29	6	2	1	2	1	2	1	1	1	1
	>5	10	2	2	2	0	0	0	0	0	0	1
Bleaching	0-5	22	3	1	1	1	0	0	0	0	1	1
	>5	08	1	1	1	0	0	0	1	1	0	0
Dyeing	0-5	18	3	1	0	0	0	1	1	1	1	2
	>5	03	1	0	0	0	0	0	0	0	0	1
Printing	0-5	21	3	3	1	1	1	0	2	0	0	2
	>5	00	0	0	0	0	0	0	0	0	0	0
Finishing	0-5	15	4	3	0	3	1	0	1	1	1	1
	>5	00	0	0	0	0	0	0	0	0	0	0

CONCLUSION

From this study it is observed that, the possible solution for mitigating the problem would be regular work with regular wages to the workers, use of non-toxic materials and processes, improved ventilation and lighting, regular medical checkups, adequate rest periods, and job rotation. Through this research work it is primarily hoped to enrich the lives of the Powerloom workers and people in the district. It is also envisaged that the success of these pilots will effectively demonstrate the viability of health and safety issues with exposures to ergonomics.

Finally, it is expected that the success of these projects will lead to scaling up of such initiatives to the state and national level under both commercial and CSR agendas. The results acquired can be disseminated through information and technology transfer to the nearby rural areas by setting up Innovation Centers and Centers of Excellence at the institution level. Funding and policy support is necessary for the success of such projects which can play a key role in improving the quality of life of the power-loom workers in the coming decades and contribute to sustainable and equitable development at a state and national level.

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