

V SUMMARY AND CONCLUSION

Occupational Safety and Health (OSH) is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goal of occupational safety and health programmes is to foster a safe and healthy work environment. As secondary effects, OSH may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment as well as reduce medical care, sick leave and disability benefit costs (Jadab, 2012). Garment industry is very labour intensive. The nature of work in the garment industries are sedentary type involving repetitive work pattern for long working hours. Posture of the worker during the work is the key determinant of postural stress. Spinal curvature, joint angles and head, neck, arm, legs and trunk positions determine the postures. The reduction of postural stress is fundamental to workspace design in ergonomics. Agrawal et al. (2011) Ergonomics is an important aspect in order to improve workers performance at work, develop an autonomous rhythm at work which will synchronize physical, physiological and psychological aspects that is responsible for human behaviour and efficiency at work and stands as a key factor deciding workers effectiveness.

Therefore a study on “**Ergonomic Interventions to promote Occupational Health and Safety among Workers employed in Garment Industries**”, had been undertaken with the following objectives to:

- Collect baseline information on the nature and type of activity performed by workers and the ergonomic condition of the workplace in selected garment industries
- Assess the relationship between worker, work environment and machineries and tools used by the workers
- Identify the hazards and risks faced by the workers in the workplace
- Creating awareness on occupational safety and health hazards and its prevention
- Fabricate and implement ergonomically designed stitching chair, and

- Evaluate the effectiveness of intervention strategies in promoting occupational health and safety.

The procedure followed for the study are discussed below:

The study was comprised of four phases. In the first phase, a survey was conducted among 514 employed in 13 large, medium and small scale garment industries, Tirupur, India, to find out the prevailing environmental conditions in the industries, the awareness of workers on the importance of occupational health and safety and need for ergonomic approach to improve their working environment.

In the second phase, an awareness programme regarding the need to apply ergonomic principles and health practices in the workplace were planned and conducted to create general awareness among public and special awareness for workers specifically in their workplace.

In the third phase, assessment of workplace hazards in terms of work environment, work posture of the workers, Hazard identification and risk analysis were carried out. Medical screening of the workers were examined using the following headings namely Body mass index, Blood pressure and Blood glucose, Spirometry test and Heart rate of the workers.

Fourth phase comprised of Ergonomic table for workers in checking section and Ergonomic chair for workers in stitching section.

The table developed by Ganguli et al. (2009) for checking workers were adopted for the study and modified based on the suggestions given by the workers. The modified ergonomic table were given to ten workers to use for a period of two months. Evaluation of the improved ergonomic table for checking workers were carried out using the following headings namely RULA, BPD, Heart rate studies and worker productivity.

Twelve anthropometric dimensions of 50 male and 50 female stitching workers for sitting posture were measured to design ergonomic chair to be used in stitching section. All the data were processed separately for male and female garment workers and descriptive values, 5th, 50th and 95th percentile values, mean, median, mode, standard deviation and range were calculated. Based on the results of anthropometric dimensions, an ergonomic chair for stitching workers was designed. The developed prototype chair was given to the workers for field trial.

Later based on the opinions of the researchers, workers and designers the prototype I and prototype II chair was modified. Thus the modified ergonomic chair was given to ten stitching workers to use for a period of two months. Evaluation of the ergonomic chair by stitching workers were carried out using the following headings namely RULA, BPD, Heart rate and worker productivity.

A. The findings of the survey are summarized below:

1. Personal details of the garment industry workers

- The mean age of the garment workers ranged from 15 to 56 years with a mean of 30 years (± 8.7).
- Above half of the workers (57 per cent) were male and (43 per cent) were female.
- Sixty per cent of workers were married while 56 cent had high school education.

2. Family profile

- More than half of the workers (65 per cent) were from nuclear family and 35 per cent were from joint family.
- Fifty eight per cent belonged to medium family with four to six members.
- Majority of the workers (91 per cent) were Hindu and 58 per cent of the workers were backward community.
- The head of the families were male and were educated upto high school level and employed in private sectors.
- Nearly half of the families (54 per cent) had double earners. The total monthly family income ranged from `1000 to `9000 with a mean of `4585 \pm 2.45.

3. Job history

- The minimum age of entry into garment industries was 10 years with a maximum of 45 years (19.77 \pm 5.82).
- Workers' mean work experience ranged from one to 40 years with a mean of 10 years (± 8.7).

- More than 90 per cent of the workers had chosen garment manufacturing job due to the influence of their friends and relatives and also because of indoor work and work spot nearby.
- The whole process in garment industry was categorized into three sections namely cutting, stitching and finishing. The cutting section included pattern making of fabric (both by manually or by using CAD) and its layout cutting while finishing section included checking of stitched fabric for damaged one, ironing and packing of garments. Forty eight per cent of the workers working in stitching section while 39 in finishing section Only 13 per cent of workers were engaged in cutting section.
- Seventy nine per cent of the workers worked between 11 and 12 hours during regular days while 93 per cent worked during peak days.
- Fifty six per cent of the workers worked without rest or break for 3 hours at a stretch while 44 per cent worked for 4 hours per day.

4. Details on income and allowance

- Due to contract system, most of the workers often shift from one garment industry to another. Hence their employment was naturally temporary (59 per cent). Exception was seen in some export garment industries where they were employed permanently (41 per cent).
- The mode of payment was either shift or piece-rate and paid weekly. The wage per week of the workers ranged from Rs. 550 to Rs. 3000 with a mean of Rs.1263.25 (± 444.447).
- Any additional bonuses or incentives, like attendance bonus, productivity bonus and incentive for reaching the target were not provided to the workers. Deepavali festival bonus was the only exception. The workers (57 per cent) in the present study received bonus during festival which ranged from Rs.1000 to Rs.10,000 with a mean of Rs.4541 (± 2186.285).
- Twenty nine per cent of the workers received incentives in the form of cash and promotion and 28 per cent enrolled in PF.

5. Occupational safety and health

- More than 90 per cent of the workers reported moderate discomfort in legs, feet, upper back, mid back and low back region.
- On an average one half of the workers felt pain in shoulders, neck and arms.
- Majority of the workers also reported mild discomfort in buttocks, thighs, wrists, palms and fingers.
- Discomforts in the lower extremities such as knees, legs and feet were reported in 16 per cent for everyday during the previous month.
- More than 60 cent of the workers reported the discomforts in the upper back, mid back, low back and lower extremities during the previous month but were not regularly faced by the workers.
- More than 80 per cent of the workers revealed pain in wrists, palms and fingers once in a week.
- Majority of the workers preferred to take complete rest after work hours till the next day morning. Two thirds of the workers used pain relieving balm to cope up with the discomfort in their back regions and lower extremities. Nearly 12 per cent of the workers reported consulting the doctors for relieving themselves from the pain. Absenteeism and temporary cessation of work were reported by less than one per cent of the workers, as this practice was not favoured by the employers. Eighteen per cent of the female workers employed in checking section dipped their feet in warm water to relieve pain.
- The most commonly reported accidents in cutting sections of garment industries were cutting the finger tips (80 per cent), electric shock (79 per cent) and cornifications in the fingers (62 per cent). The accidents observed in stitching sections of garment industries were hands getting caught in the wheel (99 per cent), needle piercing and electric shock (97 per cent) and trimmer piercing the palm (2 per cent). The accidents encountered in finishing sections of garment industries were electric shock (88 per cent), burns and scalds (87 per cent), trimmer piercing the palm (67 per cent), cornifications in the fingers (27 per cent) and hand and wrist injury by ticketing guns (8 per cent).

- The mechanical hazards were reported by one fourth of the workers which included from cuts, bruises, wounds, sprains, fractures, loss of fingers and hands and sometimes death. Thirty five per cent of the garment workers reported physical hazards such as noise, vibration, electricity, temperature and lighting in their working places. Twelve per cent of workers complained of chemical hazards which come from the high dust levels in certain sections of the industry (e.g. the cutting section) and from the choice of chemicals used in the spot cleaning process. Sixty seven per cent of the workers reported to have ergonomical problems which included Obsolete machinery, inadequate seating and standing arrangements for workers and the improper lifting or movement of heavy loads. Thirty three per cent of the workers of garment industries felt psychosocial hazards which were frustration due to type of work, risks involved in work, monotony, long working hours, lack of recognition, lack of job satisfaction, poor man/woman management, lack of welfare activities and tensions at home and place of work.
- Workers had medium level for all the particulars namely knowledge (72 per cent), attitude (93 per cent) and practice (70 per cent). The variables namely knowledge, attitude and practice of workers employed in garment industries were found to be significant at one per cent indicating a good relationship among them. **Hence Hypothesis 1 is rejected.**
- The workers reported generalized weakness by 97 per cent while headache by 45 per cent more than 30 days but not everyday. Exposure of the workers to excessive cotton dust might lead to breathing difficulty (24 per cent) and asthma (14 per cent) for the same periodicity. Irregular menstruation was reported by 19 per cent of the female workers.
- The other health problems reported by the workers were anaemia (19 per cent), blood pressure (14 per cent), thyroid (5.8 per cent), diabetes (5.3 per cent) and hernia (1 per cent).
- The workers reported lack of personal protective equipment (83 per cent), lack of furniture (45 per cent) mainly in cutting and finishing sections and improper furniture (20 per cent) in stitching section. All the workers strongly agreed to have work overload and frequent twisting. Less than half of the

workers reported inconvenience and lack of relaxation in the workplace. Workers reported work environment as unhealthy in general.

- Seventy six per cent of the workers rated the garment manufacturing activities as moderate while 23 per cent as heavy. Less than one per cent rated as light work.

B. The findings of the Impact of Awareness Programme on Occupational Safety and Health are summarized below:

Altogether two hundred garment workers and public participated in the public meetings. Since the awareness programme was a general awareness so no evaluation in the improvements of knowledge gained by the participants were assessed.

The improvement in knowledge on occupational safety and health and ergonomic principles in the specific awareness programmes conducted for selected workers in garment industries was assessed using a checklist. On an average 80 per cent of the participants gained knowledge from awareness programme when compared to 40 per cent before awareness programme. Hence, there was a significant improvement in the knowledge of the workers after the awareness programme.

C. Assessment of workplace hazards and medical screening of the workers

1. Workplace hazards

a. Work environment

The lighting levels ranged from 176 - 918 lx with a mean of 410 lx which was less than recommended level. The noise level ranged from 74 dBA to 102 dBA with a mean of 91.7 dBA which exceeded permissible level. The temperature in the industries ranged from 28⁰C to 37⁰C with a mean of 34.8⁰C which was again found to be above the recommended levels. Humidity in the industries ranged from 25 per cent to 59 per cent with a mean of 44.5 per cent which exceeded permissible level.

b. Work posture

i. Assessment using RULA

Thirty workers were selected randomly from six sections of the selected garment units making it a total of 180 for the assessment of Rapid Upper Limb

Assessment using RULA Employee Assessment Work Sheet developed by McAtamney and Corlett (1993) was used. None of the worker was at negligible and low risk level. In 63.9 per cent of the workers studied, RULA Grand Score was between 5 and 6 indicating that the level of exposure to musculoskeletal risks was high and ergonomics intervention to decrease exposure level seemed essential (action level 3). In 36.1 per cent of the workers studied, RULA Grand Score was 7 indicating that the level of exposure to musculoskeletal risks was very high and immediate ergonomics intervention to decrease exposure level seemed essential (action level 4).

ii. Assessment using postural discomfort

The assessment of postural discomfort was carried out using a body map developed by Corlett and Bishop's (1976) method of body mapping at regular intervals, namely, before the starting of work (BSF), before mid morning (MM), before lunch (L), before afternoon tea (MA) and before the end of work (BEW) throughout the day. Workers involved in pattern making and cutting of fabrics experienced extreme discomforts in both the legs and feet. They also reported severe discomforts in neck, shoulders, upper and lower arms. Moderate discomfort was felt in the back region due to frequent twisting of the trunk. However workers engaged in stitching of fabrics indicated extreme discomforts in the back region which may be due to forward inclined posture of the head and trunk. Moreover the condition of workers becomes worse due to lack of back rest. The stitching operators also experienced severe discomforts in their neck, shoulders, legs, feet, upper and lower arms. Checking workers felt extreme discomforts in both their thighs, legs and feet. They also reported severe discomfort in the neck region, shoulders, upper and lower arms, palms and fingers. The discomforts experienced by ironing and packing workers were similar to the workers involved in pattern making and cutting of fabrics.

c. Hazard identification and risk analysis

- In cutting sections, workers were exposed to cotton dust which has long been associated with adverse respiratory effects and diminished lung function. Workers should be encouraged to use protective devices such as face masks. Since heavy smoking is a risk factor for respiratory problems, measures should be taken to reduce smoking among garment workers. Rotating

workers from dusty to non-dusty sections on a regular basis might reduce the length of exposure to higher dust levels, thereby reducing the risk.

- The risk score of 10 was obtained for postural discomfort in the stitching section. Poor posture of the trunk, neck and upper extremities, and the monotonous repetitive movements result in a high prevalence of musculoskeletal complaints affecting the backs, necks and upper extremities among sewing machine operators. Injuries of fingers, excessive noise exposure and insufficient lighting were also observed in stitching section.
- The main risk in the finishing section was postural stress. It might be due to prolonged standing. Various spot cleaning agents are used in the checking section. While some industries changed to the safer option of using soap or water mixtures for the cleaning process, others used various solvents which could have serious health and safety problems if not used in the correct manner. Excessive noise, insufficient lighting, heat and burns of hands while ironing and removing stain using solvents.

2. Medical screening

- One hundred and fourteen male and 86 female garment workers totalling 200 workers with a mean age 42.7 (± 15.81) years and work experience 19.2 (± 12.07) years employed in the garment industries were enrolled in the study as experimental group. The mean of Body Mass Index (BMI) of the workers were found to be 23.6 (± 4.66).
- Thirty two male and 18 female persons totalling 50 with a mean age 36.4 (± 11.66) years and work experience 11.9 (± 9.32) years were enrolled in the study as control group. The mean of Body Mass Index (BMI) of the control group were found to be 23.9 (± 4.32).
- Almost all the workers (99 per cent) were exposed to cotton dust and solvents (17 per cent) during their working hours. Only 20 per cent of the workers wore protective devices during working hours. The prevalence of respiratory symptoms was 60 per cent of the total for phlegm, 57 per cent for shortness of breath, 41 per cent for chest tightness and more or less similar per cent for cold (17 per cent) and wheezing (16 per cent). History of respiratory disease and history of atopy were reported by equal number of workers (37 per cent).

- Subjects considered under control group had minimal prevalence of respiratory symptoms. Nearly half of the subjects (48 per cent) reported to have phlegm followed by one fourth of them shortness of breath (24 per cent) and four per cent for both cold and chest tightness. Nearly one fourth (24 per cent) had past history of respiratory disease and history of atopy.
- More than three fourth of the garment workers (81 per cent) had moderate COPD followed by severe COPD (17 per cent) and very severe COPD (1 per cent). The severity of COPD as per GOLD guidelines among control group was mild.
- When chi-square (χ^2) test was used to find the association between levels of COPD with its risk factors of experimental group, a significant association was found at one per cent level among garment workers who had respiratory symptoms namely shortness of breath and chest tightness and also number of years of work experience but all the other particulars were found to be non-significant. **Hence Hypothesis 2 is rejected** as there is relationship between the years of experience and development of COPD and respiratory symptoms.
- When chi-square (χ^2) test was used to find the association between levels of COPD with its risk factors of control group, all the particulars were found to be non significant. **Hypothesis 3 is accepted as all cases of COPD are work-related.**
- 't' test revealed a high significant difference at one per cent level between experimental group and control group when bronchodilator was administered to them. FEV1 increased by 65 per cent in experimental group while 91 per cent in control group after bronchodilator test.
- Thirty workers from each of the three sections namely cutting, stitching and finishing were selected for recording the heart rate. The heart rate was recorded for 8 hours for all selected workers in all the sections. The analysis of heart rate indicates that cutting and stitching section workers had average heart rate of 96 beats/min and 91 beats/min as against 98 beats/min of workers in finishing section.

D. Evaluation of Ergonomic Furniture

1. Ergonomic table for workers in checking section

a. Comparison of RULA using conventional and ergonomic tables

A high significant difference at one per cent level was found when 't' test was computed between conventional table and ergonomic table in terms of RULA.

b. Comparison of BPD using conventional and ergonomic table

High significant difference at one per cent level were observed in discomforts in the thighs, legs, feet, neck, shoulders and arms while using the conventional and ergonomic table in terms of BPD. There was no reduction of discomfort in the palms, fingers and back regions.

c. Comparison of heart rate using conventional and ergonomic table

There was a high significant difference at one per cent level when 't' test was used to compare heart rate of checking workers using conventional table and ergonomic table.

d. Change in production of workers using conventional and ergonomic tables

The percentage of increase in production ranged from 4 to 15. Their increase in the productivity pattern could be attributed to other factors such as nature of work, the physical fitness and the ability to adapt to the new table.

2. Ergonomic chair for stitching workers

a. Comparison of RULA using conventional and ergonomic chair

A high significant difference at one per cent level was found when 't' test was computed between conventional chair with ergonomic chair in terms of RULA.

b. Comparison of BPD using conventional and ergonomic chair

Workers experienced extreme discomfort (mean score of 4.50, 4.40 and 4.00) in the back, buttocks, neck and shoulders while using conventional chair. They also reported severe discomfort in the upper and lower arms, legs, palms and fingers. While using ergonomic chair, workers experienced moderate discomforts in the mid back, lower back, upper back followed by arms, legs, shoulders and neck and mild discomfort in palms, fingers and thighs. When 't' test was computed between

conventional and ergonomic chair, a high significant difference at one per cent level were observed in all the body parts.

The hypothesis 4 is rejected as there is relation between the conventional checking table and conventional stitching chair used in the garment industry and the incidence of Musculoskeletal Disorders.

c. Comparison of heart rate using conventional and ergonomic chair

There was no significant impact of the two different chairs. It might be due to the adoption of sitting posture while at work which might lead to less postural stress and thereby normal heart beat.

The Hypothesis 5 is rejected as there are changes in the physiological function of the heart with regards to the usage of the conventional checking table and conventional stitching chair.

d. Change in production of workers using conventional and ergonomic chair

The percentage increase in production ranged from 3 to 14. Hence the productivity pattern was improved by using the ergonomic chair.

Conclusion

The major findings of the study are that there should be general awareness among the garment workers regarding occupational safety and health because this would help them to minimize occupational hazards. Another finding that emerged from the study is the health problems faced by the workers during the working time such as musculoskeletal discomforts and respiratory problems which were solved by introducing ergonomic furniture and personal protective equipments.

Recommendation

- A general occupational safety and health needs to be enacted applicable to garment industries.
- Workers' bodies, NGO's and other agencies can influence law makers to expedite the issue.
- Extensive training of factory inspectors should be undertaken

- Trade unions can be very effective in the prevention of accidents and work related diseases through the use of OSH as a collective bargaining issue and by exerting pressure on political leadership.
- Special codes of practices on OSH issues such as noise, chemical handling and the like should be prepared and published for use by selected industries. Video films, manuals and booklets should also be prepared and distributed.
- OSH training programme should be categorized at a near place of work with mandatory participation of employers and their representatives.

Limitations

- The study has been restricted to Tirupur garment industry comprising of only cutting, stitching and finishing sections.
- Cotton dust concentration was not measured due to the lack of appropriate instrument.

Suggestions for future research

- A similar study can be conducted in other industries.
- Designing of ergonomic furniture for other sections of the industry worker
- Study with focus on women workers in the industry can be taken.