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OCCUPATIONAL HEALTH AND SAFETY CONDITIONS IN SMALL MEDIUM SIZED ENTERPRISES OF IRON FURNITURE MANUFACTURING UNITS

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Abstract

This study was planned to identify factors which affect workers health and their safe working in unregistered and partially registered small iron units preparing 90- 95 % iron furniture under sheds. Focused group discussions (FGD) were conducted among workers of iron furniture manufacturing units (IFMU) employing a cross sectional, descriptive, analytic and time limited study. Personal interviews methodology was adopted to assess workers for their exposure to occupational risks, protective equipments and health issues. A set of fifty (50) workers of each of the iron unit were taken as study samples by completely randomized sampling method and every sample was studied with the help of self-designed questionnaire. All the values of physical parameters were noted using direct reading instruments. A large proportion of workers were studied with high exposures to dust, fumes, noise, and heat. A high level of self-reported occupational health problems, particularly from welders and metal workers were also observed. Similarly, workers reported their need of permanent workplaces, information on work related hazards, water and sanitation and legislation for small scale industries (**SSI**). Results revealed that workers have exposure of high levels to multiple health hazards due to limited or no availability of protective equipments. It may also be concluded that workers of these iron units having lack of trainings related to their health and safety. Outcome of this study is highly concerned for the regulations, legislation and policy matters of country especially in country like Pakistan where workers of small and medium enterprises are facing problems.

Keywords: enterprises, environmental risk, hazard, health and safety, iron furniture

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1. Introduction

Poor understanding of occupational hazards in sector of informal work and measures to control hazards is a cumbersome matter (Massoud et al., 2017). The informal sector is usually taken to include small medium enterprises generally with less than ten employees and is unregistered with common laws often without formal contracts of employment (Loewenson et al., 2001). There is also the expectation that the informal sector in developing countries would disappear once these countries achieved sufficient levels of economic growth and modern industrial development (Chen, 2005). Workers of many informal sectors belong to urban and poor low-income level with participation of women and children as well. Workers belonging to these units deprived of basic medical care facilities due to missing benefit of employment legislation (Anjana and Kandpal, 1997) and there exist risks of accident in small and medium sized enterprises (Fabino et al., 2004; Stevens, 1999).

The iron industry presents one of the most energy intensive sectors within the Pakistan's economy therefore of particular interest of both local and global environmental discussions. Manufacturing sector of iron furniture has got importance due to production, export and employment. There are many small scale iron and wood manufacturing units in

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Lahore Pakistan. According to the rough estimate 200 to 300 units are working in Ichera Market Lahore (City District Government Lahore, 2012). Iron furniture manufacturing units are established and working at small homes and some in small shops with most of them are not registered. The machines in these units are manually operated in which children and young boys are involved. There is no proper training and awareness of safety measures and they are not following any legislation. The occupational and environmental health and safety problems among the workers are increasing day by day due to employer negligence (Zivkovic et al., 2018). Employers are not feeling responsibility for the employee's health and safety risks instead they are much interested in the work done (Awan, 2002).

Small scale manufacturing industries in Pakistan have grown at a rate of more than eight percent during seventies and eighties (Kemal, 1993). The increasing trend in this sector is due to economic progress. Thus the informal sector accounts for 73% of employment in jobs outside agriculture in rural and urban areas (Shah et al., 2011). The contribution of informal sector to GNP, estimated at 36.8%, is quite significant for economic stability and progress (Iffat, 2008). Work is an activity that has a very important role in people's lives, since workers spend most of their time at workplace; they get exposed to multitude of hazards. There are some obvious unsafe working conditions but there are number of hazards which may not be obvious (LaDou, 2003). A large number of workers from rural areas tend to join the iron works due to the prevailing trend of urban and industrial culture in rural areas. It is also of great importance to the local economies, as a number of people could earn their living, or part of their living, by working at the iron units or in other forms of associated employment. A goal of occupational health is to inform workers regarding the hazards associated to their jobs (Behrens and Brackbill, 2007).

The infrastructure is highly unhygienic in iron furniture units. Rooms have no appropriate ventilation system usually having crowded and bad lighted rooms. Workers have to work in polluted and contaminated conditions which are major cause of health problems. They have to work in two shifts i.e., morning and evening. Sometimes, it takes 14-16 h a day (AIM, 1991).

It can also be labeled as harmful for physical and emotional responses that occur when the requirements of the job do not match with capability, resources, or needs of the workers. Job stress can lead to poor health and even injury (David, 1998). The control of environmental agents and stresses requires the comprehensive knowledge of their physical and chemical characteristics, the emission sites, effective and acceptable control procedures and levels to which exposures must be lowered (Bloswick and Sesek, 2000). Control methods for reducing and eliminating the environmental hazards and stresses are needed to be provided in industries (Singh and Pant, 2018; Stellmen, 1998). Often low cost solutions, especially in developing countries, are an important element of successful approach (Hasle, 2000). Pakistan belongs to developing countries of subcontinent where a large number of people earn their livelihood by working in small scale industries mostly iron and steel works lacking solid environment health and safety (EHS). Therefore workers of these industries are either unaware about basic requirement of safety or unable to avail facilities so work with high risk of accident. Keeping in view the prevailing conditions of health and safety of small scale iron industries in Pakistan present study was planned to assess occupational health and safety conditions in small medium sized enterprises of iron furniture manufacturing units. This study may be used for the benefit not only for the setting environmental policies and regulations but also for sustainable working of industries.

2. Material and methods

The study was carried out in different iron industries of Ichera market of Lahore, capital of the province of Punjab, Pakistan. A total of 40 industries with each set of 50 workers were studied for assessment. Instrumentation used for the measurement of noise level, light flux and humidity were provided by the Analytical Laboratory of Environment Protection Agency (EPA), Faisalabad, Punjab. The data were analyzed in the Department of Environmental Sciences and Engineering, Government College University, Faisalabad, Pakistan.

The study was based on data collected from three different domains of measurement relevant to the description of safety culture: workplace assessments, a survey of employee attitudes to safety, including questionnaire of interview data and company accident group records. Focused discussions (FGD) methodology was adapted for present research study among IFMU workers. Methodology was based upon a cross sectional, descriptive, analytic and time limited study. The data thus obtained was analyzed and interpreted in the following profiles: occupational accidents, safety measures and monitoring of work environment. The most important steps to assess the data were.

2.1. Walk through Survey

All the health hazards caused by mechanical operations and environmental problems were identified and assessed using walk through and preliminary survey.

2.2. Checklists

The checklists points out the ergonomics hazards and detailed analytical tool to quantify the risk level and enable to take mitigations, likely to reduce the risk to an acceptable level.

2.3. Measurements

For the analysis direct reading analytical instruments were used to record noise level, light intensity and humidity at workplace. For noise level EXTECH 407730 digital sound level meter was used to measure sound level in dB(A) and dB(C). Fast and slow response of noise with maximum holding capacity was recorded.

Intensity of light flux was analysed using EXTECH 407026 foot candle/lux light meter (0-50,000 LUX / 0-5000 FTC) and Hygrometer coupled with Infrared thermometer Model RH101 (EXTECH) was used to measure the humidity level (%). All the applicable instruments were provided by the analytical laboratory of environment protection agency (EPA), Lahore, Pakistan (Farid et al., 2013).

2.4. Process of manufacturing

2.4.1. Raw material collection

Raw material being used by the iron industries either purchased from the different scrap shops or iron and steel foundries or obtained from destructed building sites. Here is the pictorial view of machines and raw material being used in the formation of iron furniture (Fig. 1 and 2). Collected raw material was sorted out and melted in underground electric furnace and then poured into different kinds of moulds to get required structure (Goldsmith et al., 1976).

2.4.2. Casting

In casting molten metal is shaped in desired designed. These foundries melt the pig iron using different types of furnaces. Casting may be performed in permanent mold which are repeatedly used. Most often this process is used in molds of shaped with sand material which is high melting silica (quartz).

2.4.3. Cutting

Two types of cutting methods are used for cutting of iron according to required shape.

2.4.3.1. Manual cutting

In manual cutting hammer and saw is being used as cutting tools.

2.4.3.2. Electric cutting

Electrical cutting is being done using the electronic cutter and press. Electronic cutters are of different in sizes and associated with kind of accidents.

2.5. Welding

Welding is a fabrication process which joins materials usually metals or thermoplastics by causing coalescence. Arc welding is commonly used for joining the casted pieces; iron pipes and iron sheets etc.

2.6. Grinding

A grinding machine is used for grinding, which is a type of an abrasive wheel as a cutting tool. Each grain of abrasive on the wheel's surface cuts a small chip from the work piece via shear deformation.

2.7. Polyester Tape

Polyester tape is used for the purpose of sealing and smoothing the surface of joints of welded pieces.

2.8. Paint process

For the spray paints air compressor is used. For formulation of paints organic solvents are used to get desired quality and viscosity of paint. Mostly solvent based paints are preferred because they are cheaper with good quality.

3. Results and discussion

In this study a completely randomized set of 50 workers was taken into account in each analysis for all types of iron units for the assessment of occupational injuries, type of personal protection, age of starting job and safety measures at workplace. Results obtained from various assessments and measurements were tabulated and showing the frequency levels.

Table 1 shows the frequency of occupational accidents at workplace. A large number of injuries were caused by trapping (38%) in air compressors due to close contact of workers hands with moving wheel and their belts. The contact injuries happened with grinders where worker hold the pieces of metal while the edge of machine revolves at very highest speed. Electric shocks by machine can take place by electrical motor installed with machine assembly. Injuries caused by boring of material from drill machines can pierce the body of workers. Some accidents are associated to cutting sections. In industrial accidents sometime partial and sometime complete hand chopping takes place due to lack of safety parameters. All sorts of accidents of every nature take place while workers are fatigued and are less attentive to work with machines. A large number of workers living in developing countries are at risk of facing health and safety issues due to unhygienic workplaces (Kromhout and Vermeulen, 2000). These issues of health and safety risks are real in developing countries, like Pakistan, and there are enormous trends in occupational exposure (Ahasan and Partanen, 2001).

Table 2 presents the condition of personal protection during working in all the small and medium enterprises related to iron works. The workers attitude about the personal protection during working was found extremely poor. According to the analysis revealed through safety measures profile majority of workers found either careless or unaware to use personal protective equipment to safe their self while working (Fig. 3).



Fig. 1. Different types of raw materials being used in SME units: (A) Iron Rods; (B) Round bar; (C) Iron cones



Fig. 2. Methodical representation of SME units: (A) air compressor; (B) electric cutter; (C) welding machines; (D) underground electric furnace; (E) open furnace; (F) manual casting

Table 1. Occupational injuries associated with different types of machines

| Sr.# | Case type | Affected Frequency | Affected Frequency (%) |
|------|--|--------------------|------------------------|
| 1 | Trapped | 19 | 38 |
| 2 | Contact | 9 | 18 |
| 3 | Entanglement | 0 | 0 |
| 4 | Electrical Shock | 13 | 26 |
| 5 | Cut Injury | 3 | 6 |
| 6 | Ejection | 3 | 6 |
| 7 | Full hand amputation | 3 | 6 |
| 8 | Two or more fingers amputation | 13 | 25 |
| 9 | Tip of the finger amputation | 6 | 12 |
| 10 | Accidents due to flickering metal pieces | 16 | 32 |
| 11 | Skin allergies | 6 | 12 |
| 12 | Respiratory problems | 3 | 6 |
| 13 | Arc eye | 3 | 6 |
| 14 | Nausea | 0 | 0 |
| 15 | Metal fume fever | 3 | 6 |
| 16 | Skin burns | 3 | 6 |
| 17 | Paint fumes fever | 3 | 6 |
| 18 | Serious illness | 16 | 32 |
| 19 | Sprains and strains | 13 | 25 |

The results of analysis hence revealed that a major proportion of workers are facing hand injuries following after head and eyes. All sorts of issues are directly related due to the lack of personal protective equipment while working in industries. Therefore, identification and assessment of potential problems at workplace is more important than just visiting a factory which is very important for workplace intervention strategy (Westlander, 1993).

Table 3 shows the workers age of employment. Assessment shows that a large number of workers start their job at early age, they do not get education and training regarding the working in iron industries. There is no formal training given to the workers before starting the job. It has been found from analysis (Table 3) that almost 40% of the employee of these working units do not comply the requirement of age. The reason of this problem is the lack of education for changing the trend from unsafe to safe acts. Basic instinct does not change so they become habitual of the traditional methods of work as being followed by their ancestors (Palheta and Taylor, 1995). There are some very common reasons following which workers feel afraid to change unsafe practice. Firstly, they find it much easier to go about what they are using than to learn something new because they are afraid of mistakes and failures during the process of learning. The strenuous tasks, with which most of the manual workers are involved in various workplaces, have demand for immediate attention. Secondly, it brings anxiety and uneasiness among the workers and they think that by adopting such protective actions the production will decrease with result into joblessness.

The participation of employees regarding health and safety issues in small and medium enterprises is studied by Frick and Walters that required a management system which could include a health and safety committee, elections of safety representatives and periodic risk assessment (Frick and Walters, 1998; Walters, 2004). The evaluation of work hazards requires substantial evidence obtained by means of extensive research (Kogi and Kawakami, 1997). Table 4 indicates the profile of industries assessed by using various applicable parameters of safety. Assessment reveals that 76% workers in industries having no knowledge of safety measures and 60% of the workers don't use PPEs to ensure the personal safety.

Table 2. Frequency distribution of workers on the basis of personal protection level

| Sr.# | Type of personal protection | Complying | Frequency (%) |
|------|-----------------------------|-----------|---------------|
| 1 | Head | 15 | 30 |
| 2 | Eye | 10 | 20 |
| 3 | Ears | 09 | 18 |
| 4 | Nose and Mouth | 5 | 10 |
| 5 | Full Face | 0 | 0 |
| 6 | Chest | 3 | 6 |
| 7 | Hand | 33 | 66 |
| 8 | Legs | 3 | 6 |
| 9 | Foot | 2 | 4 |
| 10 | Full Body | 4 | 8 |



Fig. 3. Showing some safety measures being taken at workplace during use of welding machine (A), grinder cutter (B) and iron molding (C)

Table 3. Classification of workers on the basis of their starting job age groups

| Sr. # | Age group of employees (Years) | Frequency | Frequency (%) | Classification |
|-------|--------------------------------|-----------|---------------|-------------------------|
| 1 | 9-12 | 05 | 10 | |
| 2 | 13-16 | 06 | 12 | Not qualified Under age |
| 3 | 17-20 | 10 | 20 | |
| 4 | 21-24 | 09 | 18 | Qualified |
| 5 | 25 & above | 20 | 40 | Quanned |

| Sr. # | Factors Measured | Affected Frequency (%) |
|----------|----------------------------------|---------------------------|
| 1 | Knowledge of safety | 76 |
| 2 | Ignorance | 24 |
| 3 | Substitution | 10 |
| 4 | Segregation | 14 |
| 5 | Personal protection | 62 |
| 6 | Training of safety before job | 12 |
| 7 | Training of safety during job | 44 |
| 8 | Training after injury | 20 |
| 9 | Provision of PPE | 40 |
| 10 | Use of PPE | 40 |
| 11 | Accident rate at work | 32 |
| 12 | Avoidable accidents | 26 |
| 13 | Unavoidable accidents | 6 |
| 14 | Major injury rate | 24 |
| 15 | Minor injury rate | 8 |

 Table 4. Assessment of 40 industries on the basis of safety parameters at workplace

Substitution of material is not possible but substitution of process and technology is possible to replace old machines with new one. The major issue to substitute system is either of high cost or owners cannot afford to meet the cost of substitution. Most of the workers get knowledge about the nature of work by self-awareness (Aliakbari-Bedokhti et al., 2017). Only 12% got training before starting their job which indicates it a major source of accidents while working. The training before job is mandatory so that protection of the workers from occupational injuries could be ensured. The employers feel least responsibility to supply the PPE to workers.

The most effective preventive approaches seem to be simple and low cost solutions, disseminated through personal contact (Peter and Hans, 2006). In IFMU one of the major hazards is production of high noise levels from working machines exceeding the limits of quality standards. The noise level analyzed using analytical instrument and found too high which can damage to the hearing strength and can cause permanent deafness. Figs. 4(A, B) gives the levels of noise at workplace and the noise levels associated with different machines respectively. Industrial working standards approved from Environmental Protection Agency, Pakistan (Pak-EPA) is 85dB. In comparing the noise level of industries with National standards it was found that all the industrial working activities exceeding the set limit of noise.

The employers are not providing PPEs to workers for the control of noise within the permissible limits. Research of Boateng and Amedofu (2004) and Farid et al. (2013) enable to understand that machines noise can be controlled by proper oiling and greasing and their timely maintenance. For the effect of light flux Figs. 5 (A, B) showing that the illumination level was not satisfactory in most of the SMEs iron units. Light flux was measured during working conditions with light flux meter which shows poor intensity of light. There should proper light system to make clear visibility at working area so that workers could perform their work safely and efficiently (Lamm, 2000). Comparing the light standard only a single site was found which was meeting the requirement and rests of the units were below the standard. Similarly, humidity and temperature analysis was carried out at different sections like cutting, welding, grinding, and paint sections as shown in Figs. 6 (A, B). It was found that temperature of all these sections was exceeding the limits when compared with standard values. Many studies show that small industries have problems in fulfilling legal requirements for control measures of occupational health and safety issues like temperature, light and noise due to limited resources (Antonsson, et al., 2002; Mayhew, 2000; Walters, 2001).

Different hazards related to cutting, casting grinding, welding and manual handling of materials include finger amputation, cosmetic injury arc eye and many other different injuries ranged from loss of body part to permanent disability. Many physical injuries are associated to the use of these machines without personal protection.



Fig. 4. Noise levels (dB) at workplace (A) and associated with the machine (B) in SMEs of IFM units (All the values are the means of three replicates)



Fig. 5. Illumination levels (Lux) at workplace and work machines (A, B) in SMEs of IFM units (All The values are mean of three replicates)



Fig. 6. Humidity levels at workplace and machine (A, B) in SMEs of IFM units (Values are means of three replicates)



Fig. 7. Views showing work places missing PPE's in poor intensity of light



Fig. 8. Views of different incidents happened on workplace. (A), Finger amputation (B) cosmetic injury (C) Arc eye

Figs. 7 and 8 is clearly showing the poor conditions of workplace activities, the workers are not using PPEs during the use of electric grinding machine (7A), electric drill machine (7B) and pouring of melted material (7C). The work without PPEs may cause severe damages to worker's health and life, some accidents which occurs often during the use of these machines without PPEs are given in Fig. 8 which include finger amputation (8A) cosmetic injury (8B) and arc eye (8C).

4. Conclusion

People of Pakistan have possessed multiple skills in many fields of small scale industry. They have skills of handicrafts in metal, woolen, cotton or wood. Having all, there is lack of institution building where skilled worker could be produced for better quality and safety. No guild which pay their role to foster the skill and pass it on to the next generation. There were lack of regulation for the capacity development of people which may be capable of working in industries. It is not more than 10 years that Government of Pakistan has established an institution named small and medium enterprise authority (SMEDA) which is considered to be responsible to promote small and medium sized enterprises. The negligence of institutional management for Small and medium enterprises in Pakistan caused poor impacts on these industries and country's economy.

Present study was conducted both using walk through survey check lists and measurable parameters (noise, temp, light etc.) in small and medium enterprises (SMEs) units of iron furniture manufacture to evaluate the health and safety measures in these SMEs. On account of this study it can be concluded that SMEs especially iron furniture manufacturing units have very poor system of health and safety, use of PPEs and preliminary training of workers. It can be concluded from the study that most of the workers start their jobs in early age due to poverty which is the most important cause. Workers are either uneducated or low educated and belong to poor socioeconomic class. They work for long time a day and come to maximum exposure and risks at the working place. In respect of training neither employer nor media and Govt. departments played their role. It can also be concluded from the study that in spite of occupational injury the workers of these SMEs feel reluctant to adopt the safety measures because of lacking importance. After keen observations and analysis this study enables the researcher to submit their findings to SMEDA for essential improvement for the regulations and policy making purpose.

Following are the recommendations which can help to minimize risks of accidents at workplace.

The use of PPEs like Safety goggles, Safety glasses, Face shields, Respiratory mask Gloves, Safety shoes, Aprons should be mandatory while working through regulation in act and policy. Failing which

will be penalized for high amount of fine and prison for some fixed period.

Trainings of workers regarding PPEs should be mandatory before he/she join the job. SMEDA will ensure the trainings of workers through training institute. Secondly, SMEDA with combined action with Environment Protection Agency and Labor Department should ensure the application of environment quality standards and labor policy and labor rules in the SMEs especially IFM units.

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