

HEALTH HAZARDS AND SAFETY CULTURE DESCRIPTION AMONG CABLE MANUFACTURE EGYPTIAN WORKERS

By

Hakim SA and Moamen M

*Department of Community, Environmental and Occupational Medicine, Faculty of Medicine,
Ain Shams University, Cairo, Egypt*

Hakim SA: drsallyhakim7@gmail.com

Moamen M: mmomen1977@gmail.com

Abstract

Introduction: Cable manufacture workers are at risk of exposure to physical, chemical (as toluene di isocyanate, polyethylene, polypropylene, copper and polyvinyl chloride) and mechanical hazards. Safety culture is defined as the group of beliefs, perceptions and values regarding safety that are disseminated within a specific group. Safety culture is considered as an important concept in understanding the state of safety in organizations.

Aim of work: To identify the knowledge of workers of a cable manufacture factory with the types of occupational exposures they may encounter, to evaluate their perception of workplace safety culture and to find out the factors related to workplace accidents.

Materials and Methods: This cross-sectional study included 122 workers. An interview questionnaire including information on their socio-demographic and occupational history, their knowledge of workplace hazards, and safety culture perception at work was included. Blood lead level was measured for 24 workers as a part of their periodic medical examination.

Results: The most common exposures encountered were noise, accidents mainly related to bad housekeeping and lack of personal protective devices, fire and ergonomic hazards. Fifty nine percent of workers felt they were facing medium to high risk at work. About 83.3% of the workers who had blood lead levels done were below 40 micrograms/dl. A significant association was found between number of accidents encountered in the previous year and education, noise exposure, awkward posture and wearing personal protective devices. **Conclusion:** Cable manufacturing is a risky occupation thus safety culture rising at workplace is crucial to acquire higher levels of performance and productivity.

Keywords: Cable manufacture, Occupational exposures, Safety culture Blood lead and Cable workers.

Introduction

Safety Climate is defined as the group of beliefs, perceptions and values regarding safety that are disseminated within a specific group (Cooper and Philips, 2004). Safety climate refers to the level to which employees believe real priority is directed to organizational safety performance, and its measurement is thought to provide an alarm of potential safety system failure. Therefore, safety climate refers to the overall aspect of safety within an organization. A safety culture within an organization depends on safety values and attitudes which are shared by the majority of workers within the company. It can be described as 'the way we do things around'. A positive safety culture can result in better workplace health, safety and performance (Workplace Health and Safety Queensland, 2013). Workers at companies for manufacture of cables are at risk of exposure to several chemicals as toluene di isocyanate, polyethylene, polypropylene, copper and polyvinyl chloride (Attarchi et al., 2014). In some steps of cable manufacturing as cable splicing and termination, the danger is

more evident as these steps need heat application which may result in the release of dangerous chemical fumes (Miriam and Simon, 2016). In humans, inhalation of copper fume has been shown to induce irritation of the upper respiratory tract, metallic or sweet taste, and discoloration of the skin and hair. Copper fume exposure is associated with metal fume fever, an acute 24– to 48–hour illness characterized by influenza–like symptoms including fever, chills, sweating, weakness, headaches, muscle aches, and dryness of mouth and throat (ACGIH ,1999). Moreover, the most common material used as the conductor in cables has always been copper due to its electrical conductivity. Copper exposure may lead to skin and eye irritation, coughing, sneezing and wheezing. Moreover, copper is one of the metals causing (metal fume fever) which is an illness, flu like, with symptoms of metallic taste, fever, chest tightness, headache and chills. Chronic exposure may lead to decreased fertility, skin allergy, liver and kidney affection (New Jersey Department of Health, 2016). Contact with Aluminum can cause skin and eye irritation. Exposure to aluminum can cause metal fume fever,

lung scarring with cough and dyspnea. Aluminum powder is a flammable solid and represents a fire hazard (New Jersey Department of Health and Senior Services, 2007). Regarding insulation, the most common materials that could be used are plastic materials as polyvinyl chloride (PVC), polytetrafluoroethylene (PTFE), polyethylene and polyamides. Vinyl chloride monomer (VCM) is used in the manufacture of plastics and as a raw material in organic synthesis. Its polymerization results in polyvinyl chloride which is widely used in plastic and can replace rubber. PVC is widely used in electrical cable insulation (Lopez et al., 2013). The polymeric form is safe but chronic toxicity by the gaseous monomer VCM is related to symptoms as asthenia, dizziness, Raynaud's syndrome (Fontana et al., 2006). Lead also is commonly encountered among those workers. Lead has a negative impact on nervous, hematopoietic, digestive, urinary, reproductive, cardiovascular, endocrine, immune, and skeletal system function. However, the main effects are seen in the nervous and hematopoietic systems (Xie et al., 2013). Worldwide, over 264 million work related accidents

occur every year, with above 350,000 mortalities (Hamalainen, 2009). Work conditions as well as personal background are important causes for occupational injuries (Mohammadfam and Moghimbeigi, 2009). Main factors identified as causes for occupational accidents are noise, untidiness, poorly maintained machines, lack of training and having careless employees at work (Esroy, 2013). One of the common types of accidents among cable manufacture workers is electrical injuries. Workers in cable manufacture face many safety risks due to the job nature. The results of earlier studies on workplace safety have indicated that culture is the basis for unsafe attitudes and behavior (Turtiainen and Vaananen, 2012).

Materials and Methods

Study design: It is a cross-sectional study

Place and duration of the study: at a cable manufacture plant in Mostord, Egypt during the period from May to November 2017

Study sample: A sample of 122 workers was included. These represented the whole working staff

not on vacation during the period of data collection of the study and they all were involved in production tasks of cables (none had administrative duties). Those workers are concerned with assembly of wires, plating them with anticorrosive material, softening and annealing of wires to be flexible and not easily fractured also covering the wires with lead, aluminum, copper or plastic according to their subsequent use.

Study method:

- a) An interview questionnaire to describe their knowledge about workplace hazards and possible health effects, their socio-demographic characteristics and occupational history.
- b) Perception of safety culture was assessed using a group of questions used by Dedobbeleer and Beland's, 1998.

These questions included:

1. Managers in my department would pay attention to employees' safety and health.
2. Managers in my department would pay attention to employees' safety and health training.

3. Managers in my department would appropriately reduce the stress of workloads for employees.
4. Managers in my department would reward employees for good safety and health practices.
5. My department has good housekeeping practices.
6. My co-workers would participate in safety and health activities with positive attitudes.
7. My co-workers would voluntarily use protective equipments when needed.
8. Employees in my department would openly discuss safety and health issues with the managers.

c) Laboratory investigations: 24 workers had blood lead level measured as a part of their periodic medical examination and the results were included in the current study. Eighty three percent of the workers who had measured blood lead showed levels below 40 microgram/dl.

The workers were asked if they felt that their workplace was risky and to what extent such that little risk

was considered if the worker reported he feels he could suffer minor and/or infrequent work injuries, medium risk if he feels he is facing moderately severe work injuries and /or of moderate frequency while high risk was considered if he feels he is facing severe work injuries and / or frequent. This classification was inspired from the structured questionnaire named (Workplace Safety Questionnaire (WSQ) which was used to assess injury risk perception among the workers of a company by Michael et al., 2009.

Consent

Administrative consent was obtained from the factory and a factory staff member accompanied the study researchers during their visits to the factory. All participants were informed about the objectives of the study and

confidentiality of data was assured through anonymous questionnaires. Verbal consents were taken by all participants before being enrolled into the study.

Ethical approval

Approval of the administrative authority of cable manufacture plant was obtained. The study protocol was approved by the Ethical Committee of Faculty of Medicine, Ain Shams University, Cairo, Egypt.

Data management

Data was coded, entered on SPSS version 16; analysis was done using frequency distribution and chi square tests. The statistical significance level was set at ≤ 0.05 and highly statistical significance level was set at ≤ 0.01 .

Results

Table (1): Socio-demographic and occupational background of the study population.

Variables	
Age (Mean \pmSD)	34.57 \pm 9.30
Marital status	No (%)
Married	90 (73.8)
Unmarried	32 (26.2)
Education	
Do not read or write	26 (21.3)
Primary school	46 (37.7)
Higher school	35 (28.7)
University	15 (12.3)
Which of the following exposures you know you are at risk of at work:	
Noise	48 (39.3)
Heat	30 (24.6)
Bad illumination	40 (32.8)
Electric shock	33 (27)
Solvents	33 (27)
Lead	40 (32.8)
Copper	34 (27.9)
Dangerous fumes of polyvinyl chloride (PVC)	20 (16.4)
Accidents	48 (39.3)
Repetitive movements	42 (34.4)
Awkward postures	42 (34.4)
Fires	44 (36.1)
Pre-employment examination	53 (43.4)
Periodic medical examination	20 (16.4)
Working years (mean \pmSD)	6.38 \pm 2.09
Working hours per day (mean \pmSD)	7.89 \pm 0.61

Table 1 showed that all participants were males, with mean age of 34.5 years, mean duration of work 6.3 years and mean working hours per day of 7.8. Seventy three percent of the participants were married. About 38% had primary education. Most of them knew they were at risk of exposure to: noise and accidents (39.3%) each, fires (36.1%), repetitive movements and awkward postures (34.3%) each and exposure to lead (32.8%).

Table (2): Accidents description as stated by participants during the previous year.

Number of accidents	No %
None	43 (35.2)
1 - 4 (average)	61 (50)
More than 4 (high)	18 (14.8)
Generally, what are the causes of accidents at your workplace:	
Bad housekeeping	57 (46.7)
Non-use of personal protective devices	50 (41)
Lack of training	46 (37.7)
Carrying heavy loads	46 (37.7)
Uncovered wires	45 (36.9)
Slippery floor	39 (32)
Machine un maintenance	38 (31.1)
Personal negligence	22 (18)
Generally, the commonest types of work related injuries you see at your workplace:	
Falls	42 (34.4)
Machine injury	41 (33.6)
Musculoskeletal injury	19 (15.6)
Eye injuries	15 (12.3)
Electrical injury	5 (4.1)
Absent last year because of accidents at work	43 (35.2)
Knowledge of the presence of an accident record keeping system at the factory	30 (24.6)
Knowledge of the availability of first aid measures at work	34 (27.9)
Knowledge of the availability of personal protective equipments	34 (27.9)
Wearing protective devices	23 (18.9)
Knowledge of the presence of a working fire alarm system	32 (26.2)
Eating in separate eating places	46 (37.7)
Can you or your colleagues smoke at the work area	78 (63.9)
Changing the work clothes before going home	57 (46.7)

Table 2 showed that half of the participants suffered from an average number of accidents in the previous year (1-4 times). The most common causes of accidents were bad housekeeping (46.7%), non-use of personal protective devices (41%), and lack of training and carrying heavy loads (37.7%). The most common type of accidents encountered at work was slippage due to bad housekeeping. Thirty five percent reported they were absent last year because of accidents. Twenty four percent of participants said they knew there was an accident record system at the

factory, first aid measures and personal protective devices were available at work as stated by 27.9% of the workers in each case. More than 37% of workers reported eating in a separate place. Almost half (47%) reported changing clothes before going home. Those who declared they knew there was a working fire alarm system at the factory were 26.2% and 64% said they or their colleagues can smoke in the work area.

Table (3): Safety culture overview at the factory.

Safety questions: #	No (%)
Do managers pay attention to employees' safety?	33 (27)
Do managers pay attention to employees' safety training?	32 (26.2)
Will managers reduce the stress of workloads for employees?	29 (23.8)
Will managers reward employees for good safety practice?	21 (17.2)
My department has good housekeeping practice	30 (24.6)
My coworkers participate in health safety activities with positive attitude	40 (32.8)
My coworkers would voluntarily use protective equipment	27 (22.1)
Employees commonly discuss safety issues with managers	49 (40.2)
In your opinion, workplace safety is the responsibility of:	
Administration	70 (57.4)
Workers	40 (32.8)
Both	12 (9.8)
The degree to which you face risk from occupational exposures:	
No risk	21 (17.2)
Little risk	28 (23)
Medium risk	42 (34.4)
High risk	31 (25.4)
Do you think safety training at your factory is	
Not adequate	81 (66.4)
Adequate	41 (33.6)

Answer presented is Yes

Table 3 showed that 40% of workers agreed that employees commonly discuss safety issues with managers, 32.8% stated that coworkers participate in safety activities with positive attitude and about 27% declared that that managers pay attention to workers' safety and to safety training. Those who believed that workplace safety is an administrative responsibility represented 57.4% and 59.8% felt the risk they were facing at work was medium to high risk.

Table (4): Age, job duration and daily working hours in relation to elevated blood lead level (only 24 workers were examined).

	Blood lead level		p value
	< 40 $\mu\text{g/dl}$	\geq 40 $\mu\text{g/dl}$	
Age (Years)	31.8 \pm 8.6	42.8 \pm 8.7	0.031*
Job duration / years	5.9 \pm 1.9	7.3 \pm 3.4	0.291
Working hours /day	7.8 \pm 0.5	8.1 \pm 0.6	0.425

*: Statistically significant.

Table 4 showed that workers with older ages had significantly higher levels of blood lead. Also the level of blood lead was higher with longer duration of work and longer working hours but not to a significant level.

Table (5): Factors associated with high accident rate among studied workers.

			Number of accidents last year			X ²	p
			None	1 - 4 (average)	More than 4		
Education	Do not read or write	No	11	7	8	16.028	0.010*
		%	25.6%	11.5%	44.4%		
	Primary education	No	10	30	6		
		%	23.3%	49.2%	33.3%		
	Higher education	No	16	15	4		
		%	37.2%	24.6%	22.2%		
University	No	6	9	0			
	%	14.0%	14.8%	0.0%			
Noise	NO	No	35	32	7	13.041	0.001**
		%	81.4%	52.5%	38.9%		
	Yes	No	8	29	11		
		%	18.6%	47.5%	61.1%		
Awkward posture	NO	No	34	38	8	7.320	0.025*
		%	79.1%	62.3%	44.4%		
	Yes	No	9	23	10		
		%	20.9%	37.7%	55.6%		
Bad housekeeping	NO	No	27	30	8	2.539	0.281
		%	62.8%	49.2%	44.4%		
	Yes	No	16	31	10		
		%	37.2%	50.8%	55.6%		
Lack of training	NO	No	28	40	8	2.867	0.238
		%	65.1%	65.6%	44.4%		
	Yes	No	15	21	10		
		%	34.9%	34.4%	55.6%		
Wearing personal protective equipments	NO	No	36	53	10	9.205	0.016*
		%	83.7%	86.9%	55.6%		
	Yes	No	7	8	8		
		%	16.3%	13.1%	44.4%		

*: Statistically significant.

**: Highly statistically significant.

Table 5 showed that a significant association was found between number of accidents last year and education, noise exposure, awkward posture and not wearing personal protective equipments.

Discussion

The current study showed that knowledge of possible hazardous exposures was in general low among the study population where the best knowledge recorded was among 39.3% of participants and was in the form of noise and accidents (Table 1). This low level of knowledge and perception may be explained by the fact that most of the participants were with primary education only and all of them reported that no one gave them a pre-employment orientation on the types of hazards they could encounter. This is in accordance with the results of several previous researches. In a study done by Picard et al., 2008, they found that 12.2% of the accidents suffered by workers were attributed to a combination of noise exposure at work and noise induced hearing loss. In another study done by Berger et al., 2000, they deduced that workers exposed to noise at work are five times at risk for work related injuries, and those with infrequent noise exposure are 3.7 times at risk. Occupational noise may induce work related injuries as communication barriers (Berger et al., 2000) and also

to the affection of the concentration and memory of workers (Berglund and Lindvall, 1995). The risk of having a work accident was about twice as high among workers exposed to noise, after controlling for several co-variables (Dias et al., 2006).

Risk of exposure to fires at work is another occupational hazard encountered by 36% of workers (Table 1). This may be explained by the fact that most of the workers stated there was no working fire alarm system at the factory also 64% of them stated that they or their coworkers can smoke at the work area (Table 2). Several articles have discussed the common causes of workplace fires as faulty electrics, using flammable or combustible materials, human errors and negligence (Nordlof et al., 2015).

Indeed, the job demands in this type of production facility requires long standing hours, awkward postures, repetitive movements (Table 1), all these factors could predispose to musculoskeletal disorders. Several studies have shown that repetitive movements, vibration, transferring and carrying weights from one place

to another, wrong postures for long periods of time are all factors leading to musculoskeletal disorders because they expose soft tissues to tension (Jansen et al., 2004).

Regarding the causes of work related accidents as stated by the workers in the current study, bad housekeeping, non-use of personal protective devices, (where only 18.9% reported that they are using them), lack of training and carrying of heavy loads were the most common causes (Table 2). As stated by Gyekye, 2010 occupational accidents are related to two main causes: internal factors linked to dispositional characteristics of the worker and external causal points related to characteristics of the work environment.

In the current work, 64% of the workers reported that; they or their colleagues could smoke at the work area and only 40% reported they can eat in separate eating places (Table 2). OSHA, 2016 requires that no employee be allowed to have food in an area that could be contaminated with chemical or biological agents.

Our study revealed that the percentage of workers who voluntarily use protective equipments is only 23% (Table 2) with only about 26% reporting that managers pay attention to employees safety and safety training (Table 3). Biggs et al., 2013 found that management's commitment to safety is a key factor for positive safety culture and employee safety behavior and attitude. Cox et al., 1998 revealed that the quality of employee safety training was also an important factor associated with safety culture in the organization. Cavazze and Serpe, 2009 have shown that workers are more eager to use personal protective equipments when they perceive there is an organizational atmosphere supporting safety.

The current work found that a significant relationship exists between blood lead levels and age where those with older ages had significantly higher levels of blood lead (Table 4). This agrees with the findings of the work done by Cao et al., 2014 who detected that the blood lead levels increased with increasing age.

On analyzing accidents at this workplace it was found that sixty

one workers had an average of (1-4) accidents during the previous year and these accidents were mainly slips due to bad housekeeping as they stated in their own words (Table 5). According to statistics from the Health and Safety Executive (HSE , 2012), slips and trips are considered the single most common cause of work related injuries and account for 40% of all reported major injuries at work.

On studying the relationship between the number of accidents encountered by workers and several factors, a significant association was found between number of accidents last year and education, noise exposure, awkward posture and wearing personal protective devices (Table 5). The findings detected in the current study were similar to the study done by Rahmani et al., 2013 where the number of accidents increased with decreasing education level. Factors related to body posture and protective equipments are linked with proper training of workers which was found to be defective as 66% of workers reported that training offered through the factory was not adequate and 59.8% of workers stated that they felt the risk they faced

at work was medium to high (Table 3). This agrees with Mansor et al., 2011 who found that there are several causes for accidents as workplace design and training procedures. In another study by Swaen et al, 2003, results revealed a strong relation between age, gender, educational level, smoking, shift work, and work environment and the risk of being injured in an occupational accident. Hsiao and Simeonov, 2001 presented a model for explaining work related accidents which consists of factors related to the work environment including noise, machines- task related factors as load lifting, physical exertion and includes also personal factors as age, training and use of protective devices.

Recommendations

Applying ergonomics to the workplace can reduce the potential for accidents, injury, ill health and improve performance and productivity. Employers should evaluate workplace hazards and decide what is required to ensure safety and health of employees. Regular workplace assessments for safety measures is needed to identify types of hazardous workplace exposures

and all workers have the right to know these exposures so as to protect themselves.

Conflict of interests

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