

Promoting OSHA at Technical Education Higher Institutions: Assessment of Safety and Health Awareness Amongst Industrial Technology Graduates in Libya

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Abstract – Occupational, safety and health administration (OSHA) is very important to maintain a safe working environment. Low levels of safety awareness and lack of basic professional training in OSH are main challenges. This study aimed to assess the level of awareness on OSHA standards and to evaluate the effectiveness of OSHA training among industrial technology graduates in Libya. A total of 74 trainees were trained on OSHA Outreach Safety Training Program (30 hours). Data was collected using a pre-constructed questionnaire before and after training. It included the demographic characteristics, their satisfaction by OSH information in their college curriculums and 175 questions to assess their safety awareness level for 35 OSHA items. Only 9.4% of them have received previous OSHA training and most of them reported that their college curriculums are extremely deficient in OSH information and applications (87.9%). The baseline level of safety awareness about OSHA requirements was very low in all sections, including general OSHA requirements, OSHA requirements for fire and emergency response, OSHA requirements regarding control of physical, chemical and mechanical hazards in work environment. The present study revealed that OSHA training was very effective in increasing the safety awareness level among industrial technology graduates. As conclusion, there is a very low awareness level for OSHA standards among graduates of college of industrial technology, training of these personnel is very important. Furthermore, introduction of OSH topics in the curriculums of the technical and engineering higher educational institutions is highly recommended.

Index Terms— Safety awareness, Occupational safety and health, Training, Industrial Technology.

I. INTRODUCTION

Workers represent about 50% of the world's population and their health is extremely determined by the availability and compliance with standard of

occupational health and safety services available at their work place [1]. Based on the International Occupational Hygiene Association (IOHA) Occupational safety and health is defined as the science of recognition, anticipation, evaluation, prevention and control of hazards of workplace that may harm or threaten the employees health or well being, all along with considering possible influences on the environment [2]. Occupational health means the maintenance of the highest degree of comfortable physiological, psychological, social, and spiritual state of health for all workers in different occupations [3], [4]. And occupational medicine is defined as occupational health in the clinical context [5].

Occupational health aims to provision of a comprehensive health care to all workers through conducting of a mix of promotive measures, preventive, curative and rehabilitative interventions in order to improve their quality of life [6]. Despite the fact that people spend most of their lifetime and working hours at the workplace; little attention, awareness and resources are accorded to safety and health at work [7]. Therefore, all organizations are responsible to ensure their employees working in a safe work place and environment and remind them about their safety all time. [8]

In order to enforce the work place safety regulation and as stated in section 30 by Occupational, Safety and Health Act (OSHA) 1994, each of company/employers with a minimum of 40 workers should establish an Occupational, Safety and Health Committee [9]. A way to improve safety and health issues at the workplace is the usage of practical tools. These tools will act as guides, instruments for developing OSH issues, in order to achieve positive changes or address a challenge. The more mechanised a workplace is, the more challenges

will be found in decision making and keeping up with the work speed [7].

There are many tools and still more to come that will empower people to be well informed and to know how to avoid serious effect, or any effect at all, during their work life. These tools, if properly utilised by people in the world of work, can improve the quality of life. It is pleasing to realise that the tools and guides being developed include everything from identification of risks, including data collection and job safety analysis, to work setting application [10].

Developing countries showed that the common constraints to the implementation of effective control strategies include insufficient occupational safety policy, awareness and education; lack of adequate financial and human resources; inadequate information and communication among institutions and professionals, deficiencies in preventive approaches, as well as failure to directly involve workers and their representatives in the problem-solving processes [11]. In the issues of OSHA awareness, Kawakami revealed that participatory and good practice approaches are the keys for improvements [12].

Nowadays, safety management is more concerned with accident prevention rather than reacting to accidents after they happen. Prevention requires adequate knowledge about what, how, where and when employees are exposed to hazardous situations, and in which ways they could be affected by these hazards [13]. Occupational diseases and accidents can be minimized through effective preventative measures by investing on safety training and educating the employees, personal protective equipment, process design, and machinery. Also, the workers attitudes are needed to be reoriented by developing a good safety culture, applying best work practices and good housekeeping [14].

Safety is very important in technical and engineering education to increase safety and health awareness and improve practices and maintain a safety culture at workplace [15]. Awareness of OSH remains low, so OSH awareness should be the main agenda to prevent occupational diseases and at the same time to reduce industrial accidents [7]. Technical and industrial technology higher education institutions should play a more active role in provision of safety and health education and training to enhance the safety awareness level aiming to control a wide variety of occupational and environmental hazards and to ensure safety of their students within faculty or even through their work practice later on [16].

So this study was conducted to assess the level of safety awareness among industrial technology graduates in Libya, and to evaluate the effect of OSHA training on increasing their knowledge. Also, it aimed to provide evidence to the policy makers in the Libyan authorities that a comprehensive review of the current curriculums of technical and industrial technology higher institutions must be conducted to meet the current changes in the working environment and to protect workers.

II. METHODOLOGY

This cross sectional study was conducted at one of the main training centers in Tripoli, Libya over a period of three months from February to April 2016. A total of 74 trainees, graduated from College of Industrial Technology, participated in our study after getting an informed consent from each participant. They were classified into three training classes (about 25 trainees in each class) to get the best training outcomes. Each class was trained on OSHA Outreach Safety Training Program "General Industry Procedures" (30 hours). Data was collected using a pre-constructed questionnaire that was formed of two parts. Part (I) included the demographic characteristics for the participating trainee, which are age, years of experience and history of previous OSHA training, plus one question asking them about their satisfaction by OSH information in their studied curriculums during college years. Part (II) Containing 175 questions to assess the safety awareness level of those participants. This part included 35 sections (5 questions for each section) classified as follow (8 sections "40 questions" about general OSHA requirements; 6 sections "30 questions" about OSHA requirements for fire and emergency response; 7 sections "35 questions" regarding OSHA requirements for control of physical hazards; 7 sections "35 questions" regarding OSHA requirements for control of chemical hazards; 7 sections "35 questions" regarding OSHA requirements for control of mechanical hazards). Awareness level in each of these items were assessed using the 5-point Likert scale (1 = Very Low, 2 = Low, 3 = Medium, 4 = High, 5 = Very high). The questionnaire is distributed to studied group two times (one before and one after) conducting the training. The pre-test was to assess the baseline level of safety awareness, while the post-test was to evaluate the effectiveness of the conducted OSHA training. The collected data were then analyzed using Statistical Package for Social Science (SPSS) software (18.0). To ensure the reliability of the questionnaire scales, we calculate Cronbach α coefficient to test the internal consistency among the different questions included in each section 1.1(Carmines & Zeller, 1979). The calculated Cronbach's α coefficients ranged from 0.73 to 0.89, which were at acceptable level, indicating that all questions are reliable, as the Cronbach α coefficients are considered reliable when its values is more than 0.7 1.1(Nunnally, 1978). The results was summarized, presented and displayed as frequencies and percentage for qualitative data, and as mean and SD for awareness scores. Comparing means was performed using Wilcoxon Signed Rank test. Results were accepted to be significant when ($p < 0.05$).

III. RESULTS

The majority of the studied group was aged 20- 30 years (60.8%) and of experience less than 5 years (78.4%). Only 9.4% of them have received previous OSHA training and only 12.1% showed satisfaction about

TABLE 1. RELEVANT CHARACTERISTICS OF STUDIED GROUP AND THEIR SATISFACTION ABOUT OCCUPATIONAL SAFETY AND HEALTH CURRICULUM DURING COLLEGE STUDY

Characteristics	No. of trainee	Percentage (%)
Age group (Y)		
20-30	45	60.8
> 30	29	39.2
Years of experience		
≤ 5	58	78.4
6-10	16	21.6
Previous OSHA training	7	9.4
Satisfaction about OSH knowledge in the studied curriculum during college years	9	12.1
Total	74	100

OSH knowledge in the studied curriculum during college years, as most of them reported that their college curriculums are extremely deficient in OSH information and applications. (Table, 1)

As revealed from Table (2), the studied group reported very low baseline safety awareness about general OSHA requirements, as the over all average awareness score was about (1.53± 0.69), specially regarding to Job Hazard Analysis; Risk Assessment; Health and Safety Committee; and Accident and Incident Investigation (1.02, 1.27, 1.29, 1.39) respectively. While, their awareness was highly statistically increased after OSHA training in all topics and the over all average awareness score reached (4.17±0.76).

Regarding to the safety awareness about OSHA requirements for fire and emergency response, the studied group showed very low baseline awareness, as the over all average awareness score was about (1.56± 0.74), specially regarding to First Aid; Means of Egress; Fire Extinguishers; and Emergency Preparedness and Response (1.17, 1.31, 1.42, 1.44) respectively. After OSHA training there was a high statistically significant increase in their awareness, where the over all average awareness score reached (4.09±0.86). (Table, 3)

TABLE 2. SAFETY AWARENESS LEVEL FOR GENERAL OCCUPATIONAL SAFETY AND HEALTH REQUIREMENTS

	General OSHA requirements	Before training	After training	P-Value
		Mean (SD)	Mean (SD)	
1	Occupational Health and Safety Program	1.76 (0.84)	4.22 (0.78)	<0.001*
2	Health and Safety Committee	1.29 (0.71)	4.23 (0.69)	<0.001*
3	Job Hazard Analysis	1.02 (0.48)	4.43 (0.63)	<0.001*
4	Risk Assessment and Management	1.27 (0.67)	4.35 (0.74)	<0.001*
5	Industrial Hygiene	1.92 (0.75)	4.03 (0.93)	<0.001*
6	Personal Protective Equipment (PPE)	2.14 (0.93)	4.15 (0.78)	<0.001*
7	Workplace Inspections	1.47 (0.63)	4.03 (0.77)	<0.001*
8	Accident and Incident Investigation	1.39 (0.58)	3.91 (0.82)	<0.001*
	Over All Awareness Score	1.53 (0.69)	4.17 (0.76)	<0.001*

TABLE 3. SAFETY AWARENESS LEVEL REGARDING OCCUPATIONAL SAFETY AND HEALTH REQUIREMENTS FOR FIRE AND EMERGENCY RESPONSE

	OSHA Requirements for Fire and Emergency Response	Before training	After training	P-Value
		Mean (SD)	Mean (SD)	
1	Emergency Preparedness and Response	1.44 (0.71)	4.01 (0.87)	<0.001*
2	Means of Egress and Escape Routes	1.31 (0.65)	4.03 (0.93)	<0.001*
3	Safety Signs & Signals	1.81 (0.78)	4.23 (0.72)	<0.001*
4	Fire Safety	2.23 (0.87)	3.83 (0.86)	<0.001*
5	Fire Extinguishers	1.42 (0.52)	4.17 (0.61)	<0.001*
6	First Aid	1.17 (0.61)	4.30 (0.59)	<0.001*
	Over All Awareness Score	1.56 (0.74)	4.09 (0.86)	<0.001*

Table (4), showed that the studied group reported very low baseline safety awareness regarding OSHA requirements for control of physical hazards in workplace. The over all average awareness score was estimated to be (1.45± 0.67). Radiation Safety; Compressed Gas Safety; Control of Hazardous Energy were the main deficient awareness topics (1.28, 1.52, 1.59) respectively. Their awareness was significantly increased after OSHA training in all topics and the over all average awareness score reached (4.02±0.82).

Regarding to the safety awareness about OSHA requirements for control of chemical hazards, the studied group reported very low baseline awareness, as the over all average awareness score was about (1.64± 0.71), specially regarding to dealing with Chemical Spill or Leak; Hazardous Classified Locations; and Confined Spaces Safety (1.18, 1.49, 1.42, 1.56) respectively. After OSHA training there was a high statistically significant increase in their awareness, where the over all average awareness score reached (3.89±0.95). (Table, 5)

TABLE 4. SAFETY AWARENESS LEVEL REGARDING OCCUPATIONAL SAFETY AND HEALTH REQUIREMENTS FOR CONTROL OF PHYSICAL HAZARDS

	OSHA Requirements for Control of Physical Hazards	Before training	After training	P-Value
		Mean (SD)	Mean (SD)	
1	Electrical Safety	2.11 (0.69)	4.06 (0.86)	<0.001*
2	Control of Hazardous Energy (Lockout/Tagout)	1.59 (0.71)	3.89 (0.82)	<0.001*
3	Radiation Safety	1.28 (0.59)	3.81 (1.04)	<0.001*
4	Hearing Conservation Program	1.97 (0.63)	4.22 (0.73)	<0.001*
5	Eye Protection in Welding, Cutting and Brazing	1.68 (0.77)	4.05 (0.87)	<0.001*
6	Bad Lighting Hazard	1.85 (0.66)	4.21 (0.72)	<0.001*
7	Compressed Gas Safety	1.52 (0.54)	3.92 (0.75)	<0.001*
	Over All Awareness Score	1.45 (0.67)	4.02 (0.82)	<0.001*

TABLE 5. SAFETY AWARENESS LEVEL REGARDING OCCUPATIONAL SAFETY AND HEALTH REQUIREMENTS FOR CONTROL OF CHEMICAL HAZARDS

	OSHA Requirements for Control of Chemical Hazards	Before training	After training	P-Value
		Mean (SD)	Mean (SD)	
1	Hazardous Classified Locations	1.49 (0.61)	3.58 (1.08)	<0.001*
2	Chemical Hazard Communication	1.72 (0.52)	4.11 (0.71)	<0.001*
3	Labeling of Chemicals	2.07 (0.84)	4.01 (0.81)	<0.001*
4	Material Safety Data Sheets	1.83 (0.79)	4.28 (0.59)	<0.001*
5	How to deal with Chemical Spill or Leak	1.18 0.49	3.83 (0.93)	<0.001*
6	Flammable & Combustible Liquids	1.68 (0.74)	3.67 (0.96)	<0.001*
7	Confined Spaces Safety	1.56 (0.61)	3.77 (0.99)	<0.001*
	Over All Awareness Score	1.64 (0.71)	3.89 (0.95)	<0.001*

The over all average score of safety awareness about OSHA requirements for control of mechanical hazards was significantly increased after OSHA training up to (4.12±0.82) from (1.73± 0.61) before training. The main topics that showed the lowest awareness score were Ergonomics; Forklift Safety; and Fall Protection (1.09, 1.13, 1.68) respectively. (Table, 6)

TABLE 6. SAFETY AWARENESS LEVEL REGARDING OCCUPATIONAL SAFETY AND HEALTH REQUIREMENTS FOR CONTROL OF MECHANICAL HAZARDS

	OSHA Requirements for Control of Mechanical Hazards	Before training	After training	P-Value
		Mean (SD)	Mean (SD)	
1	Machine Safeguards and Safety	2.18 (0.66)	4.52 (0.58)	<0.001*
2	Hand Tool Safety	2.27 (0.81)	4.46 (0.57)	<0.001*
3	Walking and Working Surfaces Safety	1.97 (0.56)	4.20 (0.74)	<0.001*
4	Stairways and Ladders Safety	1.81 (0.79)	4.35 (0.55)	<0.001*
5	Fall Protection	1.68 (0.53)	4.20 (0.76)	<0.001*
6	Forklift Safety	1.13 (0.43)	3.87 (1.15)	<0.001*
7	Ergonomics	1.09 (0.46)	3.28 (1.24)	<0.001*
	Over All Awareness Score	1.73 (0.61)	4.12 (0.82)	<0.001*

IV. DISCUSSION

In the last decades, rapid industrial growth was reported and associated with high number of occupational diseases and accidents due to incompetent safety implementation [17]. This strengthened the need for efficient occupational safety and health programs and increasing the workers awareness regarding to different occupational hazards to protect the health and safety of workers in all sectors for

reducing the prevalence of occupational diseases and accidents [18].

Teaching occupational safety and health is very important in engineering and technical education institutions to increase health and safety awareness and improve safe work practices and maintain a safety culture at the workplace [16]. So this study was conducted to assess the level of safety awareness among industrial technology graduates in Libya and to emphasize on the importance of OSHA training for these personnel and the urgent need for introduction of occupational safety and health topics in their curricula.

In our study, the majority of the studied group was aged 20- 30 years (60.8%) with less than 5 years experience (78.4%). Only 9.4% of them have received Previous OSHA training. These results was nearly similar to the study of Mostafa and Momen, 2014 in Egypt among technical education students, who founded that only 12.2 % of studied group have reported a previous training on occupational hazards [19]. While, that was on the contrary to another study conducted in Egypt by Elssayed et al., 2014 in Sidi Kerir Petrochemicals Company, who reported that 74% of workers are in the age group of 30 to 40 years old, 72% of them have average working years of 11 to 15 years [20]. On assessment of the future training needs in environmental and occupational health and safety in USA, it was concluded that there is a sharp shortage in occupational health training among graduates and that it should to be increased up to 3-5 times the current training capacity [21].

In this study, only 12.1% of the studied group showed satisfaction about OSH knowledge in the studied curriculum during college years, as most of them reported that their college curriculums are extremely deficient in OSH information and applications (Table, 1). This is supported by the findings of Al-Batanony and Shebl, in their study about the challenges facing teaching occupational and environmental health in Minoufiya University. They reported that the main challenges are the shortage in the qualified staff number, limited curriculum time for teaching environmental and occupational health, lack of student interest, wrong concept of other staff members about safety and health and inadequate financial support [5].

The same findings were observed through many questionnaires, there was a lake of many schools interest in teaching occupational and environmental health [22], [23]. In University of British Columbia, Canada [24], the same result was also observed. Learning Occupational safety and health ranked the last interesting issue between students in many schools in Canada. Limited curriculum time and lack of continuous training of staff members were the results obtained from recent and old studies [25].

The present study revealed that the baseline level of safety awareness about general OSHA requirements, among the studied group, was very low in all items, including health and safety committee, PPE, Job Hazard Analysis; Risk Assessment; Health and Safety

Committee; and Accident and Incident Investigation (Table, 2). Regarding to the safety awareness about OSHA requirements for fire and emergency response, the studied group also showed very low baseline awareness level, specially regarding to first aid; means of egress; fire extinguishers; and emergency preparedness and response (Table, 3). Also, Mostafa and Momen, revealed that only 22.4 % of students reported knowledge of occupational PPE, while they founded 93.3 % of students knew that changing clothes is mandatory before returning home, also they were aware of safety policies, safety procedure and safety committee, which was higher than founded in our study [19].

Our results were in disagreement with that of Elssayed et al., who detected a high level of awareness for health and safety among workers at Sidi Kerir Petrochemicals Company [20]. For better safety performance and to maintain ideal occupational safety, the job hazard profile for any company should be identified. This term is used to identify the particular blend of risks or exposures within a given work environment that may have the potential to cause harm or loss to workers [26].

Our study concluded that the baseline level of safety awareness among the studied group was very low for all OSHA requirements regarding control of physical, chemical and mechanical hazards in work environment (1.45, 1.64, 1.73) respectively (Table, 4, 5, 6). This is in agreement with Leman, who stated that awareness level of OSH remains very low, and OSH awareness should be our main agenda in order to prevent occupational diseases and to reduce industrial accidents at the same time [7].

3.3 Also, this study concurred with a similar study by Kukarni et al., who founded low level of awareness and practice for road safety precautions among medical students in a South Indian [27].

On contrary to our findings, Fazreen, in his study, reported high level of awareness of safety practices among undergraduates in engineering laboratories at University Tun Hussein Onn Malaysia [28]. Also, Mostafa and Momen founded 79.6 % of students knew the hazards of machinery noise, 83.7 % knew that bad lighting is an occupational hazard and 91.8 % knew that goggles are a must during welding. However only 4.1 % of students knew the proper management of chemical spill and 32.7 % of them knew the hazard of eating in the workplace [19].

Fadzli et al. 4(2002) has revealed that the OSH awareness among estate rubber tapers was satisfactory [29]. Abdul Rahim et al. study the causes of accidents in construction. They stated that the main causes of construction accidents are carelessness of workers to comply with work procedure, working at high elevation without safety devices, low knowledge, attitude and skills of workers and failure to use PPE [30].

The present study revealed that OSHA training was very effective in increasing the safety awareness level among industrial technology graduates, as the over all

average awareness scores were significantly higher after training compared to the awareness level before training.

Also, these results concurred with a similar study by Mostafa and Momen, after the training program there was a statistically significant improvement in the knowledge of occupational safety, proper management of chemical spills and knowledge about hazard of machinery noise (64.3%, 96% and 100% respectively) [19]. Also, Fadzli et al. suggested programs such as training, giving a talk on OSH and providing counseling of OSH to increase the level of OSH awareness [29].

Also, Yahya Thamrin et al., in their review of safety perception among South Australian University students, indicates strong relation between safety training, skills and confidence [31]. Durrishah Idrus et al. conduct a study on Level of university staff awareness on OSH at the Work place. This research recommended improvement in self evaluation, effective communications, OSH committee and effective safety program [32].

The incidence of industrial accidents can be minimized if students in higher educational institutions are learned issues of occupational health and safety [33]. Furthermore, they are in need to practice safety regulations, so that they can apply these current practices in their future working life.

The results of this study indicate negative safety and health awareness among industrial technology graduates. The implementation of health and safety awareness at higher technical institutions should be a combination of programs, seminar, awareness campaign and safety training. This will ensure that the awareness level regarding industrial safety becomes more efficient and comprehensive [34].

V. CONCLUSION

The present study revealed a very low awareness level for OSHA standards for all physical, chemical and mechanical hazards prevention and control safety requirements among graduates of college of industrial technology. Training of all students in technical and engineering higher educational institutions, on the issues of occupational health and safety, is highly recommended. Furthermore, there is an urgent need to introduce OSH topics in the curriculums of the technical and engineering higher education institutions on a national scale, so that their graduates can apply these safety practices in their future working life.

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BIOGRAPHIES

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