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Awareness of Electricity Workers Regarding Occupational Health Hazards: Preventive Study

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Abstract Electricity workers are facing significant electrical hazards, preventive actions are important to decrease these hazards. This study **Aimed** to evaluate the effect of preventive program on electricity workers' awareness regarding occupational health hazards. **Design:** A quasi experimental design was used. **Setting:** This study was carried out at two districts of Qalubiya electricity sector. **Sample:** All electricity workers from the above mentioned settings were included. There were 78workers. **Tools:** I- structured interviewing questionnaire to determine electricity workers' socio-demographic characteristics, exposure to electricity hazards, knowledge regarding electricity hazards and its prevention and practices of workers regarding precaution to avoid electricity hazards. **Results:** The current study results revealed that, 35.9% of participants aged from 30 to 39 years old, 57.7% of them were experienced from 1 to 10 years, 43.6% of workers were exposed to injury during their current work, none of workers had good total knowledge scores regarding electricity hazards, and only 2.6% of workers had high satisfactory total practices score preprogram. While, after the program implementation, 89.7% of them had good total knowledge score, and high satisfactory total practices score increased to 88.5%. **Conclusion:** This study concluded that there were a significant improvement in electricity workers' knowledge and practices regarding prevention of electricity health hazards. **Recommendation:** ongoing periodic health education programs carried out by the occupational health nurse to raise the awareness of electricity workers about electrical health hazards and periodic training on hazards prevention and electrical safety as well as first aids should be sustained for electricity workers.

Keywords: *electricity hazards, electricity workers, prevention*

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1. Introduction

Occupational health is defined as the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into consideration the possible impact on the surrounding communities and the environment [1].

Electricity workers are an occupational group has a higher degree of work related risk exposure for injuries and death. Many injuries are associated with "work inappropriately performed on energized equipment" or "failure to recognize all electrical sources." The main cause of death was found to be contact with live equipment, wiring and light fixtures, and most often involving electrical control devices [2].

Electrical hazard is a hazard to a person of death, shock or other direct or indirect injury caused by electricity. Exposure to generated electricity causes work-related fatalities and injuries. When an electrical current passes through the human body can cause cardiac arrest, damage of internal organs and tissues, and burn the skin. The severity of electrical injury depends on type and strength of voltage, duration of exposure and the recipient's health status [3].

Electricity can kill or severely injure people and cause damage to property. Every year many accidents at work involving electric shock or burns are reported. Most of the fatal incidents are caused by contact with overhead power lines. Even non-fatal shocks can cause severe and permanent injury. For example, shocks from faulty equipment may lead to falls from ladders, scaffolds or other work platforms. Persons using or working with electricity may not be the only ones at risk – poor electrical installations and faulty electrical appliances can lead to fire, which may also cause death or injury to others. Most of these accidents can be avoided by careful planning and straightforward precautions [4].

Electrical accidents cause many injuries and cost the lives of thousands each year. Lives can be saved and many injuries minimized if proper rescue techniques are used. Electrical accidents may occur at any time or place. Timely response (First Aid) and treatment of victims is a major concern. There should always be an emergency response plan including first aid training for electricity workers [5].

During working with or around electricity, it's important to comply with all applicable occupational

standards, personal safety precautions and manufacturer guidelines and information. At construction sites, thorough, pre-job planning with qualified personals essential to identify all electrical sources, including unanticipated hazards [6].

1.1. Significance of the Study

Electrical hazards pose a serious threat to worker safety. Many workers are unaware of the potential electrical hazards present in their work environment which makes them more vulnerable to the danger of electrocution and electricity related accidents. Unsafe equipment, unsafe acts, and working with live electrical circuits can lead to electrical accidents, injuries and even death [7].

Electrical injuries represent a serious workplace health and safety issue. There were nearly 6,000 fatal electrical injuries to workers in the U.S. between 1992 and 2013. Also there were 24,100 non-fatal electrical injuries from 2003 through 2012 [2].

About 5 workers are electrocuted every week which Causes 12% of young worker workplace deaths [8]. In Egypt, electrical injuries represent 8.7% of all accidents occurred to male youth in Upper Egypt [9].

1.2. Aim of the Study

The study aimed to evaluate the effect of preventive program on electricity workers' awareness regarding occupational health hazards.

1.3. Research Hypotheses

The occupational health hazards preventive program will improve electricity workers' knowledge regarding to electricity hazards, and help them to conduct electricity hazards preventive measures.

2. Subjects and Methods

2.1. Research Design

A quasi-experimental design was used to conduct this study- One group pre/posttest to evaluate the effect of occupational health hazards among electricity workers.

2.2. Setting

This study was carried out at electricity sector of Qalubiya governorate, Egypt. This sector of electricity is divided into ten districts, and nominated as Benha, Toukh, Qaluob, Qaha, Kanater El-kharia, Sheben Elkanater, Kafr-Shokr, Shobra- Elkhama, Alkhanka and Alobour. 20% from pre-mentioned setting were selected using simple random sample; the selected districts were (Toukh and Kafr-Shokr districts).

2.3. Sample

All electricity workers from the above mentioned settings were included. There were 78workers (42workers from Toukh district while, 36 workers from Kafr-Shokr district).

2.4. Tools of Data Collection

One tool was used for collecting data based on literature review and experts' opinion.

A structured interviewing questionnaire comprised of four main parts to assess the followings:

Part I: Demographic Characteristics of the electricity workers*:* This part includes 5 closed ended questions such as age, educational level, marital status, residence, and working experiences.

Part II: Exposure to electricity hazards: This part includes 6 closed ended questions as exposure to hazards or injury during current work, having knowledge to avoid hazards, informing medical team when exposed to hazard or injury, absent from work during the last year, having training courses about electricity dangers on health and its prevention, and having training courses about first aid of injuries from electricity.

Part III: Electricity workers' knowledge about electrical hazards and first aid*:* It consists of two main parts.

(A) Composed of 6 closed ended questions: which includes 35 items about meaning of electrical hazard, causes of electricity risks, types of electrical hazards, common injuries from electricity, factors affecting electric shock intensity, and prevention of electrical hazards.

(B) Composed of 4 closed ended questions, which includes 17 items about concept of first aid, first aid objective, rescues an electric shock victim and rescue an electric burn victim.

2.4.1. Knowledge Scoring System

All knowledge variables were weighted according to the items included in each question. A question that implies a 4 items answer would have a score of 4and another that implies 5 items answer would have a score of 5 and so on and each item has answer with" unknown" that implies 0. And means and standard deviations were estimated. The higher scores reflect higher levels of knowledge. The total score was evaluated in three categories as follows: Good: equal 75% or more, average: equal 50% -< 75% and poor equal: < 50%.

Part IV: Worker's practices regarding electricity hazards as self-reported*:* It consisted of two sessions: The first session: designed to assess worker's practices regarding usage of personal protective equipment; which included 10 items. The second session was designed worker's practices regarding first aid about electric shock and electric burn; which included 18 items.

2.4.2. Practices Scoring System

Each item was assigned a score of zero if not done and 1 if done. The total practices were considered high satisfactory if the score of total practices equals ≥ 75 % (≥ 29), satisfactory if it equals ≥ 50% - 74% (≥ 19- 28), and considered unsatisfactory if it is < 50% (< 19).

Validity and reliability of Tools: Validity of tools was tested by five experts; two experts in community health nursing, one expert in medical surgical medicine and two

experts in community health medicine and the appropriate modifications were done. Reliability was done by cronbach, alpha test (0.87).

2.5. Ethical Considerations

Written consent was obtained from the study participants. They were reassured about the confidentiality of the information. They were informed about their rights to refuse participation or withdraw at any time.

2.6. Pilot Study

A pilot study was conducted on 10% of the study subject (8 electricity workers) to test the content, applicability, subjectivity, clarity, consistency, and time needed to fill the tools as well as to calculate the sample size . The workers who shared in the pilot study were excluded from the main study sample. There were no modifications were made.

2.7. Field Work

Permission to conduct the study was obtained from the management of the different electricity districts and informed consent was verbally obtained from the respondents before the questionnaires were administered. Data collection was conducted a period of three months and beginning from August to October 2017. Prior to data collection the researcher introduced herself and explained the purpose of the study. A pretest was conducted as a first level of intervention by distributing the interviewing structured questionnaire after adequate explanation for the subjects and filled by the worker at the work place each tool from both knowledge and practices took about 25-30 minutes for filling. The educational intervention were carried out on discussion about the prevention and control of electricity hazard at work place and importance of using personal protective devices also, training of first aids. The electricity workers were organized into groups (each group 6-7 workers), each group received 6 sessions (4 for theory and 2 for practices) and allowed time was about 30-40 minutes for each session. One month after the last session the researcher gave the post-test to detect the improvement of workers' knowledge and practices.

2.8. Program Construction

The program was conducted in four consecutive phases

2.8.1. Assessment Phase

A pre-program assessment tools, using the previous interviewing questionnaires for data collection from electricity workers. This phase aimed at identifying the electricity workers' needs regarding electricity hazards, its' prevention and first aid for injuries.

2.8.2. Planning and Implementation Phase

The program was designed for electricity workers according to their needs.

The general objective of the program: To improve electricity workers' knowledge regarding electrical hazards and their practices to prevent it among them and first aid for injuries. This program was consisted of 6 sessions 4 for theory and 2 for practices each session duration ranged from 30-40 minutes, at the end of each session, the workers were informed about the content of the next session and it's time. Different teaching methods were used, including lecture, small group discussion, brainstorming, demonstration and re-demonstration. The teaching aids used were brochures, and colored posters. A booklet distributed to all studied workers to achieve its objective.

2.8.3. Program Content

- Meaning of electrical hazards
- Causes
- Types
- Most common electrical hazards
- Factors affecting electric shock strength
- Prevention of electrical hazards
- Meaning of first aid
- Objectives of first aid
- Ways to rescue the victim of electric shock
- Ways to rescue the victim of electric burn
- Usage of Personal protective equipment
- First aid of electric shock
- First aid of electric burn

2.8.4. Evaluation Phase

The effect of the program was evaluated by using the same format of pre-test to constitute the post-test.

3. Results

Table 1 shows that; 35.9% of studied workers aged ranged from 30 to 39 years old with mean age 33.68±8.76, 56.4% had primary education, 59 % of them were living in rural area, 57.7% of them were experienced from 1 to 10 years with mean ±SD 19.89±8.28 years, and 66.7% of them married.

Table 1. Distribution of studied subjects regarding their socio-demographic characteristics (n=78)

socio-demographic characteristics	Frequency	%
Age in years		
20-29	17	21.8
30-39	28	35.9
40-49	18	23.1
50-59	15	19.2
Mean ±SD	33.68±8.76	
Educational qualification		
Primary education	44	56.4
Secondary education	27	34.6
University education	7	9.0
Residence		
Rural	32	41.0
Urban	46	59.0
Years of experience		
1-10	45	57.7
11-20	18	23.1
21-30	15	19.2
Mean ±SD	19.89±8.28	
Marital status		
Married	52	66.7
Not married	26	33.3

Table 2 shows that; 43.6% of studied workers were exposed to hazard or injury during their current work. Also, 62.8% of them didn't have knowledge for avoiding hazards. (76.8%, 79.5%) of them didn't have training courses about electricity dangers on health and its prevention and first aid of injuries from electricity, respectively.

Table 3 shows that improving mean and standerd deviation of studied workers' knowledge post program 3.5128±.61883 compared by 1.1795±.80168 preprogram regarding prevention of electricity hazards . There were statistically significant differences regarding all electricity hazards and injuries knowledge items between pre and post program implementation.

Table 4 illustrates that improving mean and standerd deviation of studied participants' knowledge post program 6.4487±.74985 compared by 1.4487±.78372 preprogram regarding ways to rescue the victim of electric shock . There were statistically significant differences regarding all first aid knowledge items between pre and post program implementation.

Figure 1 illustrates that, before the program implementation; the workers didn't have good total knowledge scores regarding electricity hazards and injuries , while after the program implementation; good total knowledge scores increased to 89.7%.

Table 5 shows that's the electricity workers total reported practice scores related to usage of personal protective equipment and first aid were high satisfactory score and improved significantly after the implementation of the program ($P < 0.001$).

Figure 2 displays that, before the program implementation; only 2.6% of workers had high satisfactory total reported practices score, while after the program implementation; high satisfactory total reported practices score increased to 88.5%.

Table 2. Distribution of studied subjects regarding their work hazards and injuries (n=78)

Work hazards and injuries	Yes		No	
	No.	%	No.	%
- Exposed to hazard or injury during your current work.	34	43.6	44	56.4
- Have the knowledge for avoiding these hazards.	29	37.2	49	62.8
- Inform medical team when you exposed to hazard or injury.	19	24.4	59	75.6
- Absent from work during the last year.	15	19.2	63	80.8
- Have any training courses about electricity dangers on health and its prevention.	18	23.1	60	76.9
- Have any training courses about first aid of injuries from electricity.	16	20.5	62	79.5

Table 3. Mean knowledge score of studied subjects regarding electricity hazards and injuries pre and post program implementation. (n=78)

Knowledge	Total score	Pre-intervention	Post-intervention	Paired t test	p-value
Meaning of electricity hazards	5	1.6923±.79459	3.7821±.76697	-20.507	<0.001**
Causes of electricity hazards	5	1.5641±.76599	3.8718±.72719	-19.442	<0.001**
Types of electricity hazards	6	1.9359±.72685	5.5513±.59538	-29.790	<0.001**
Common injuries from electricity	9	2.0385±.85951	7.6923±.90177	-54.076	<0.001**
Factors affecting electric shock strength	6	1.5385±76773	5.6154±.56363	-34.990	<0.001**
Prevention of electricity hazards	4	1.1795±.80168	3.5128±.61883	-20.834	<0.001**
Total	35	9.9487±3.88436	30.0256±2.01922	-47.312	<0.001**

Table 4. Mean knowledge score of studied subjects regarding first aid pre and post program implementation.

Knowledge	Total score	Pre-intervention	Post-intervention	Paired t test	p-value
Meaning of first aid	1	.3974±.49254	.8974±.30535	-8.357	<0.001**
Objectives of first aid	3	1.0128±1.33381	2.6538±.47882	-10.527	<0.001**
Ways to rescue the victim of electric shock	7	1.4487±.78372	6.4487±.74985	-35.373	<0.001**
Ways to rescue the victim of electric burn	6	1.5385±.89286	5.7949±.49304	-34.991	<0.001**
Total	17	4.3974±2.08482	15.7949±.99817	-42.076	<0.001**

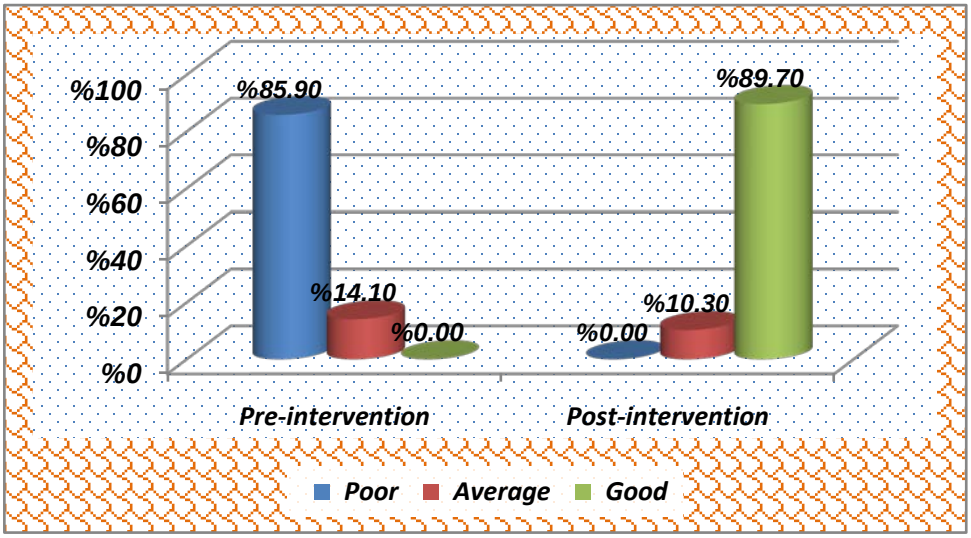

Figure 1. Distribution of studied workers according to their total knowledge scores levels regarding electricity hazards and injuries pre and post program implementation (n= 78)

Table 5. Distribution of studied workers according to their reported total practices scores regarding the usage of personal protective equipment pre and post program implementation (n= 78)

Practice	Score	Pre-intervention		Post-intervention		Chi square Test	P value
		No.	%	No.	%		
Personal protective equipment practice	Unsatisfactory	25	32.1	2	2.6	84.04	<0.001**
	Satisfactory	39	50.0	5	6.4		
	High satisfactory	14	17.9	71	91.0		
First aid practice	Unsatisfactory	67	87.0	0	0.0	133.50	<0.001**
	Satisfactory	8	10.4	6	7.7		
	High satisfactory	2	2.6	72	92.3		
Total practice	Unsatisfactory	59	75.6	0	0.0	124.68	<0.001**
	Satisfactory	17	21.8	9	11.5		
	High satisfactory	2	2.6	69	88.5		

**Highly significant at p< 0.01 level.

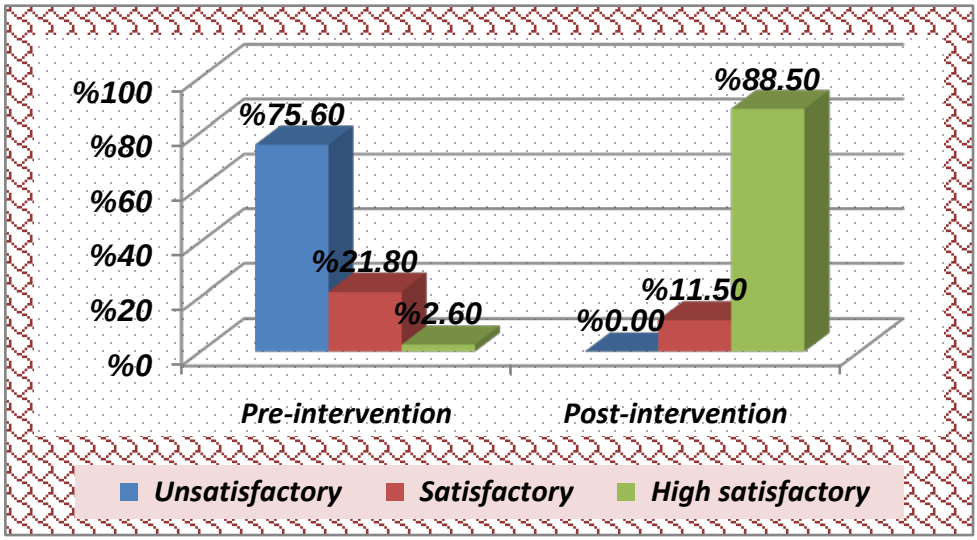

Figure 2. Distribution of the studied workers according to their total reported practices score levels regarding the electricity hazard and program implementation

4. Discussion

Awareness of occupational safety plays an important role in the prevention of occupational diseases. Electrical accidents arise as a result of unawareness of workers and lack of knowledge. Electricity has a prior importance in life the proper training should be provided for each worker [10]. The present study was aimed to evaluate the effect of prevention program on electricity workers' awareness regarding occupational health hazards.

According to the socio-demographic characteristics of the electricity workers Table 1, the present study findings revealed that the mean age of the subjects 28.69±6.35, and the mean years experiences of 19.89±8.28. This could be attributed to young and new workers have a high risk for work related injury compared with more experienced workers as well as young workers did not usually comply with safe work procedures . This finding is congruent with Kasana et al. [11] who observed that younger adults were most commonly affected by electrical injuries, with mean age of 29.77 years; this age group also includes inexperienced and inadequately trained electrical workers. Also, agreed by Roy et al. [12] who stated that workers were injured more with less than 2 years of experience. In disagreement with the study conducted in Egypt about an intervention study to evaluate compliance with personal protective equipment among workers at textile industry by Abd EL Hameed et al. [13], who found that the exposed workers' age ranges from 20 to 59 years with a mean of 44.2 ± 8.1 years. Also, this finding is inconsistent with Musa et al. [14], who reported that the mean age of workers 33.91 and the modal age were 35 years, who conducted study about occupational hazard awareness and safety practices among cement factory workers at obajana, Kogi state, Nigeria.

Regarding the work hazards and injuries Table 2, the present study findings revealed that more than two fifth of electricity workers were exposed to hazard or injury during their current work. This could be an indicator to lack of the studied worker's knowledge and practice regarding to workplace hazards and the preventive measures. Similar to Tulonen, et al., [7], who reported that (24%) of the participants had previously been injured in an electrical accident. This finding supported with Roy et al. [12], who mentioned that a qualified electrical worker that one who has skills and knowledge related to the electrical operations, equipment ,installations and has safety training to recognize as well as avoid the involved hazards. While, this finding was incongruent with Musa et al. [14], who reported that (19.6%) of the respondents had suffered injuries while at work and (80.4%) had not suffered any injury while at work.

On the other hand, about two thirds of electricity workers didn't have training courses regarding the dangers

of electricity on health and its prevention as well as first aid for injuries (Table 2). These could be explained that the person exposed to electrical hazards requires courses and training about the electrical safety. The level of training will depend on their job tasks and risks to the hazards. This finding was in accordance with Ibrahim [15], who found that few numbers of the flax factories workers received training courses about the occupational health and safety. However, the majority of them didn't receive. While in contrast with Tulonen, et al. [7], who found (86%) of respondents had received electrical safety training.

Concerning the mean knowledge score of electricity workers regarding electricity hazards and injuries the present study finding revealed that improving a mean of electricity workers post program 3.5128±.61883 compared by 1.1795±.80168 preprogram regarding prevention of electricity hazards (Table 3). This finding was matching with Ibrahim [15], who reported that the majority of the studied workers had correct knowledge about the occupational health hazards. In the same stream Kripa et al. [16], found that all workers had knowledge of preventive measures to protect themselves from the occupational health hazards.

In relation a mean knowledge score levels of electricity workers regarding first aid pre and post program implementation. The present study findings showed that improving mean of electricity workers post program 6.4487±.74985 compared by 1.4487±.78372 preprogram regarding ways to rescue the victim of electric shock. This could be explained that the electricity workers should be knowledgeable and training on the first aid to protect themselves from electrical shock and burn in the workplace. These findings are not coinciding with Tziaferi et al. [17] and El-Hady et al. [18] where less than quarter of HCWs attended emergency procedure training and fire extinguishers were available and regularly checked. A victim may require Cardio-Pulmonary Resuscitation (CPR) and give first aid for injuries and treat for shock.

Concerning total knowledge scores levels of electricity workers regarding electrical hazards and injuries pre and post program implementation (Figure 1). The present study findings revealed that before the program implementation the workers didn't have good total knowledge scores levels regarding the electricity hazards and injuries , while after the program implementation the majority of them had good total knowledge score levels with significant improvement.This result indicates that the educational program was successful in improving the workers' knowledge. This study was in agreement with Abd EL Hameed et al. [13] who found that a mean score levels of workers knowledge regarding the occupational health hazard and risks were highly significant differences ($P<0.0001$) before and after the educational intervention. On the contrary, El-Sallamy et al. [19] reported that the overall knowledge about all physical hazards was poor in 66.6% of participants and fair in 31.2% of them, and the difference was statistically not significant.

Regarding the total reported practices score levels of electricity workers regarding usage of personal protective equipment pre and post program implementation. The present study results revealed that high satisfactory score levels and improved significantly after the implementation of the program ($P < 0.001$) (Table 5 & Figure 2). This finding was in accordance with Abd EL Hameed et al. [13], who found that there were statistical significant differences of the workers' compliance with the usage of personal protective equipment (coverall, head cover, safety shoes/boots, face/nose masks and safety gloves) which reflects the raising of workers' awareness after the educational intervention. In the same stream Musa et al. [14], who reported that most of the respondents, (97.8%) used protective equipment's and only (2.2%) of them did not.

5. Conclusion

This study concluded that there were a significant improvement in electricity workers' knowledge and practices regarding prevention of electricity health hazards.

6. Recommendations

In light of the present study findings the main recommendations can be stated as follows:

1. Every worker in the electrical workplace area should be encouraged to use the personal protective devices and check all equipment before use during work time.
2. Ongoing periodic health education programs carried out by the occupational health nurse to raise the awareness of electricity workers about electrical health hazards.
3. Periodic training on hazards prevention and electrical safety as well as first aids should be sustained for electricity workers.
4. The developed illustrated booklet should be distributed and implemented in the different electrical workplaces focusing on necessary knowledge and practices regarding prevention of electrical health hazards and the proper using of personal protective equipment.
5. Conduct further researches to investigate the contributory factors leading to occupational health hazards in different electrical sectors in Egypt are needed and on large sample.

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