

Risk Assessment of Physical Health Hazards in Al-Azhar University Hospital in New Damietta, Egypt

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ABSTRACT

Introduction: Personnel working in hospitals are exposed to many occupational hazards that may threaten their health and safety. Physical hazards that are encountered in hospital working environment include temperature, illumination, noise, electrical injuries, and radiation.

Objectives: The objectives of this study were to identify physical health hazards in all departments of Al-Azhar University Hospital in new Damietta, to measure risk level of these hazards, and to recognize safety measures in these departments.

Study Site: The study was conducted in Al-Azhar University Hospital in Damietta Governorate.

Study Subjects: All personnel (328) working in the hospital were recruited.

Study Methods: Interview forms; a workplace inspection checklist, assess physical health hazards in the hospital and a modified checklist (workplace safety and health risk management, assess leadership commitment towards workplace safety and health). Risk assessment matrix was used to describe the risk level. Also, environmental measurements of noise, temperature, relative humidity, and lighting were taken in all departments including auxiliary service offices.

Results: Majority of the staffs reported stairways were free of obstacles, emergency lighting worked properly, and temperature was suitable. Minority of the staffs reported stairways were slippery, they were informed on hazards of noise and non-ionizing radiation, and they were given radiation safety training. Measurements of physical agents revealed noise levels were above standard of the WHO in all wards and above slandered of OSHA as in laundry, kitchen, etc. Range of noise level was from 58 dB in renal dialysis unit to 88 dB in kitchen. Lighting level was from 290 to 1150 Lux, temperature level was from 25 to 31°C, relative humidity level was from 45 to 59%, and heat index was low in all departments except kitchen and boiler room, it was moderate. Risk level of electrical and fire hazards was medium 22 (B), while other hazards were of low risk level; 01, 11, and 12 (A). Leadership commitment towards safety and health in the hospital was only 14.3%.

Recommendations: Workplace environment should be monitored and evaluated. Environmental and behavioral interventions are indicated for all personnel to prevent undue exposures. Noise monitoring and noise engineering and administrative control should be established. Increase leadership commitment towards workplace safety and health. Training programs on health and safety issues should be conducted to all healthcare workers. Lastly, further studies in different hospitals in Egypt are needed to investigate this health problem.

Keywords: occupational physical hazards, Damietta,

INTRODUCTION

The current global labor force stands at about 2.6 billion and is growing continuously. Approximately 75% of them are in developing countries. Each year, another 40 million people join the labor force, most of them in developing countries. Workplace environmental hazards are therefore a threat to a large proportion of the world population. It is estimated that around 1.2 million work-related deaths, 250 million accidents, and 160 million work-related diseases occur worldwide each year (1).

Risk assessment can be described as a scientific evaluation of the potential for adverse health and safety effects to workers exposed to hazardous substances. When assessing risk, it must be determined whether a hazard is present and the extent to which a worker is likely to be exposed. So, risk involves both presence of a hazardous agent and the potential for exposure to that agent. Quantitative and qualitative risk assessment methods are used to evaluate risk (2).

Occupational hazards refer to workplace factors with a potential for harm in terms of injury or ill health. Hazards are classified in five categories: physical (noise, radiation, extremes

of temperature, etc), ergonomic (mechanical), chemical (solid, liquid, and vapors), and biological (bacteria, viruses, etc), and psychosocial (psychological and social stressful factors). Exposure to any of these hazards can cause occupational diseases and work accidents (3).

Hospitals are not quiet workplaces (4). Hospital workers are exposed to various occupational hazards that may threaten their health and safety. Physical hazards in the general working environment that are also encountered in the hospital sector include temperature, illumination, noise, vibration, electrical injuries, and ionizing and non-ionizing radiation (5).

Many hospital departments offer exposure to high noise level that can cause hearing problems and influence workers' ability of concentration. For example, a noise level of 89 dB (A) was measured in the kitchen of a large hospital (4).

Also, lighting is a hazard that concerns all workers, especially during the night shift, in all hospital departments. Bad lighting can cause eye fatigue with local symptoms (pain and redness) and general symptoms (as headache, sleepiness, irritation, and increased likelihood of accidents and decreased work productivity) (5).

Ionizing radiation is used in the hospitals for (1) diagnostic radiology as diagnostic X-ray, fluoroscopy and angiography, dental radiography, and computerized axial tomography scanners; (2) therapeutic radiology; (3) dermatology; and (4) radiopharmaceutical laboratories. Staff in departments where portable X-ray machines are used (surgical rooms, emergency rooms, and intensive care units) are often inadvertently exposed and inadequately monitored for the effects of radiation exposure (6,7).

Sources that transmit heat in a hospital setting are numerous and this makes them important. Boilers, sterilization units, or even intense lighting in operation theatres are sources of heat, which (especially over 30°C) can cause rash, heat cramps, nausea, headaches, dizziness or just fatigue, and which can lead to impaired performance and work accidents (8). Workers in hospital's kitchens, laundry rooms, and sterilization units are the main groups that are exposed to this hazard (3).

The National Safety Council in the United States reported hospital employees are

41% more likely to need time off due to injury or illness than employees in other industries (9).

The infrastructure for dealing with physical and chemical safety in Egypt is limited. So, healthcare workers are subjected to many health hazards in their workplaces (10).

OBJECTIVES OF THE STUDY

Ultimate Objective

Improve health and safety of personnel working in hospitals in Egypt.

Immediate Objectives

The immediate objectives of the present study are:

1. To identify physical health hazards in all departments, including auxiliary service offices, in New Damietta Al-Azhar University Hospital.
2. To measure risk level of physical health hazards in all departments in New Damietta Al-Azhar University Hospital.
3. To recognize the safety measures in these departments in New Damietta Al-Azhar University Hospital.

SUBJECTS AND METHODS

Research Questions

1. What is the knowledge of the healthcare workers in New Damietta Al-Azhar University Hospital about risk assessment of physical occupational hazards?
2. What are the physical occupational hazards present in the hospital environment?
3. Are there any available standards for these occupational hazards in the hospital?
4. Are these standards, if present, applied or not?
5. To what extent the risk level of physical health hazards are reached in different departments of the hospital?
6. What are the existed safety measures in these departments?

Study Design

I. Technical Design

A- Study Setting:

The study was conducted in all departments, including auxiliary service offices, in Al-Azhar University Hospital in Damietta Governorate.

B- Study Participants:

All personnel (328) working in the hospital (127 nurses, 110 physicians, and 91 workers) were recruited in the study.

C- Study Methods:

1- Interview forms:

- 1.1. Workplace inspection checklist was modified from **Victorian Trade's Hall Council**

(11) to assess physical health hazards in the hospital.

1.2. Modified checklist (workplace safety and health risk management) (12). Checklist was used to assess leadership commitment towards workplace safety and health.

2- Risk assessment matrix (RAM):

RAM describes risk level. It was used in all studied departments of hospital and classified the risk level into high, medium, and low (figure 1) (13).

Consequence				Possibility of exposure				
				0	1	2	3	4
Degree of consequence	Staff	Equipment	Consequence	Never Occurred In hospital area	Has occurred from 1/100 to 1/10000	Has occurred from 1/100 to 1/1000	Has occurred several times in hospital area from 1/10 to 1/100	Has occurred several times in several hospitals 1/10
0	No health effect	No damage	None	0 0	0 1	0 2	0 3	0 4
1	Slight Health effect	Slight damage	Restricted	1 0	1 1	1 2	1 3	1 4
2	Severe Health effect	Severe damage	Of Important level	2 0	2 1	2 2	2 3	2 4
3	Permanent total disability	Extreme damage	Crucial	3 0	3 1	3 2	3 3	3 4
4	Multiple loses	Extended damage	Catastrophic	4 0	4 1	4 2	4 3	4 4

Figure (1): Risk assessment matrixes, after Safe Health Work (13)

0 0, 0 1, 0 2, 0 3, 0 4, 1 0, 1 1, 1 2, 2 0, 2 1, 3 0 (A) LOW RISK
 1 3, 1 4, 2 2, 2 3, 3 1, 3 2, 4 0, 4 1 (B) MEDIUM RISK
 2 4, 3 3, 3 4, 4 2, 4 3, 4 4 (C) HIGH RISK

3- Environmental measurements:

Environmental measurements of noise, temperature, humidity, and lighting were measured instantly (referring to standards) in hospital departments, including auxiliary service offices, laboratory, different wards, the operation theatres, etc.

- Temperature (°C) and relative humidity (%) in indoor hospital workplace environments were measured by a digital humidity and temperature meter (HT- 3003, LUTRON).

- Illumination, referring to the work position in front of a desk, was measured by an electronic Lux meter (DIGITAL (LX-101) LUX METER, INS). Acceptable standard limits of light in hospital wards were according to CIBSE (2005a) (14).

- Noise level was measured by a type II sound level meter having a dB (A) weighting capability (CASTLE GA 205). Standard of noise levels in hospital wards during day and night were <40 dB(A) and <35 dB(A), respectively according to

WHO (2004) (15) guideline. Also, recommended noise level in auxiliary service offices was <85 dB/8h at day and night, according to OSHA (2007) (16).

- The standards of heat were depending on heat index that was according to NOAA (2008) (17); low (<91 °F), moderate (91 - 103 °F), high (103 - 115 °F), and extremely high (>115 °F).

II. Operational Design

1- Preparatory Phase:

This phase took about three months during the period from beginning of June 2012 to the end of august 2012. It included:

Administrative consideration

Written approval to implement study in the hospital was obtained. Also, oral consents were taken from all personnel participating in the study to ensure maximum cooperation.

Pilot study

Before starting the practical phase a pilot study was conducted on 40 participants. The pilot study aimed to:

- Test the questionnaire as regard clarity and coding process.
- Assess the respondent's acceptance and understanding the questions and accordingly the questionnaires were modified.

2- Implementation Phase:

This phase took about 3 months, from beginning of September to the end of November 2012.

Study constrains

- Lack of cooperation of some personnel who need effort to convince them to join.
- Lack of communication as regard health and safety programs in hospital.
- Absence of work related health hazards records among hospital's personnel.

3- Reporting Phase:

Statistical analysis of data was performed by using Epi info program, version 20?. Descriptive statistics (frequency and percentage distribution) and analytical statistics (Chi square, χ^2) were used. The difference was considered statistically significant if P-value <0.05.

RESULTS

Table (1) shows occupational safety hazards of stairways, aisles, and floors in New Damietta, Al-Azhar University Hospital. Regarding stairways, 72.7% of doctors, 68.5% of the nurses, and 63.7% of workers reported stairways were free from obstacles. As regard state of the step surfaces, 31.8% of doctors, 27.6% of nurses, and 44.0% of workers reported they were slippery. Regarding cleanliness regularity of stairways, 68.2% of doctors, 59.1% of nurses, and 62.6% of workers reported stairways were cleaned regularly. As regard condition of the stairways, 45.5% of doctors, 54.3% of nurses, and 57.1% of workers reported stairways were in good condition. There were no statistically significant differences in all previously mentioned variables. Regarding fire boxes, 65.5% of doctors, 21.3% of nurses, and 38.4% of workers reported fire boxes were closed, the difference was statistically significant (P=0.001). Also, **table (1)** shows occupational safety hazards of aisles and floors. Regarding the aisles and floors, 70.9% of

doctors, 81.1% of the nurses, and 67% of workers reported they were free of obstruction (P=0.04). As regard use of footwear by the personnel, 75.5% of doctors, 71.7% of nurses, and 68.1% of workers reported they use (P=0.05). As regard the aisles and floors, 78.2% of doctors, 65.5% of nurses, and 61.5% of workers reported they were in good condition (P=0.001). Regarding state of aisles and floors, 31.8% of doctors, 59.8% of nurses, and 53.8% of workers reported they were slippery (P=0.001).

Table (2) shows lighting condition in New Damietta, Al-Azhar University Hospital. Regarding work areas, 70.9% of doctors, 64.6% of nurses, and 67% of workers reported work areas were free from shadows (P=0.58). As regard vision, 74.5% of doctors, 59.8% of nurses, and 38.5% of workers reported they see without straining (P=0.001). Regarding task lighting, 61.8% of doctors, 68.5% of nurses, and 47.3% of workers stated it adjustable (P=0.006). As regard glare in work areas, 58.2% of doctors, 42.5% of nurses, and 23.1% of workers stated work areas were free of glare (P=0.001). Regarding lighting units, 34.5% of doctors, 35.4% of nurses, and 50.5% of workers reported lighting units were cleaned regularly (P=0.07). As regard emergency lighting system, 74.5% of doctors, 67.7% of nurses, and 67% of workers reported the system works properly (P=0.4). Also, **table (2)** shows ergonomic stressor inside office areas of the studied hospital. Regarding chairs in the offices, 52.7 % of doctors, 50.4 % of nurses, and 48.4% of workers reported chairs were adjustable (P=0.8). As regard foot support for the workers, 30.9 % of doctors, 18.9% of nurses, and 47.3 % of worker reported there was foot support (P=0.001). Regarding shelves for manuals and folders, 49.1% of doctors, 49.6% of nurses, and 53.8% of workers reported shelves were easy to reach (P=0.7).

Table (3) shows staff exposure to heat in the studied hospital. Regarding state of temperature in workplace, 56.6% of doctors, 62.2% of the nurses, and 58.2% of workers cleared it was suitable (P=0.4). As regard air conditioning, 53.6% of doctors, 37.8 % of nurses, and 36.3% of workers reported there was air conditioning in their workplaces (P=0.04). As regard the uniform, 64.5% of doctors, 63.8% of nurses, and 40.7% of workers stated it was comfortable (P=0.005).

Table (1): Occupational safety hazards of stairways, aisles, and floors in New Damietta, Al-Azhar University Hospital.

Variables	Doctors (n=110)		Nurses (n=127)		Workers (n=91)		χ^2	P
	No.	%	No.	%	No.	%		
Stairways								
Free of obstacles								
Yes	80	72.7	87	68.5	58	63.7	1.87	0.39
No	30	27.3	40	31.5	33	36.3		
Slippery step surfaces								
Yes	35	31.8	35	27.6	40	44.0	6.61	0.36
No	75	68.2	92	72.4	51	56.0		
Cleaned regularly								
Yes	75	68.2	75	59.1	57	62.6	2.12	0.34
No	35	31.8	52	40.9	34	37.4		
In good condition (no crack/ damage)								
Yes	50	45.5	69	54.3	52	57.1	3.13	0.20
No	60	54.5	58	45.7	39	42.9		
Fire boxes are closed								
Yes	72	65.5	27	21.3	35	38.4	47.94	0.001
No	26	23.6	36	28.3	25	27.5		
Do not know	12	10.9	64	50.4	31	34.1		
Aisles and floors								
Free of obstruction								
Yes	78	70.9	103	81.1	61	67.0	6.13	0.04
No	32	29.1	24	18.9	30	33.0		
Appropriate footwear worn by staff								
Yes	83	75.5	91	71.7	62	68.1	1.33	0.05
No	27	24.5	36	28.3	29	31.9		
In good condition (no crack/ damage)								
Yes	86	78.2	83	65.5	56	61.5	6.48	0.001
No	24	21.8	44	34.6	35	38.5		
Slippery								
Yes	35	31.8	76	59.8	49	53.8	19.82	0.001
No	71	64.6	39	30.7	42	46.2		
Do not know	04	03.6	12	09.5	00	00.0		

Table (2): Lighting condition and ergonomic stressor in the office areas in the New Damietta, Al-Azhar University Hospital.

Variables	Doctors (n=110)		Nurses (n=127)		Workers (n=91)		χ^2	P
	No.	%	No.	%	No.	%		
Lighting conditions								
Work areas free from shadows								
Yes	78	70.9	82	64.6	61	67.0	1.09	0.58
No	32	29.1	45	35.4	30	33.0		
Employees see without straining							27.67	0.001
Yes	82	74.5	76	59.8	35	38.5		
No	28	25.5	45	35.4	56	61.5		
Do not know	00	00.0	6	4.7	00	00.0		
Task lighting is adjustable							10.15	0.006
Yes	68	61.8	87	68.5	43	47.3		
No	42	38.2	40	31.5	48	52.7		
Work areas free of glare							25.13	0.001
Yes	64	58.2	54	42.5	21	23.1		
No	25	22.7	46	36.2	31	34.1		
Do not know	21	19.1	27	21.3	39	42.8		
Lighting units cleaned regularly							7.29	0.07
Yes	38	34.5	45	35.4	46	50.5		
No	39	35.5	56	44.1	45	49.5		
Do not know	33	30.0	26	20.5	00	00.0		
Emergency lighting work properly							1.77	0.41
Yes	82	74.5	86	67.7	61	67.0		
No	28	25.5	41	32.3	30	33.0		
Ergonomic stressor in the office areas								
The office chairs are adjustable							0.39	0.84
Yes	58	52.7	64	50.4	44	48.4		
No	52	47.3	63	49.6	47	51.6		
There is foot support for the worker							20.00	0.001
Yes	34	30.9	24	18.9	43	47.3		
No	64	58.2	92	72.4	39	42.8		
Do not know	12	10.9	11	8.7	9	9.9		
Shelves are easy to reach							0.53	0.76
Yes	54	49.1	63	49.6	49	53.8		
No	56	50.9	64	50.4	42	46.2		

Table (3): Exposure to heat among the studied groups in New Damietta, Al-Azhar University Hospital.

Variables	Doctors (n=110)		Nurses (n=127)		Workers (n=91)		χ^2	P
	No.	%	No.	%	No.	%		
Is temperature in your workplace suitable?							1.78	0.41
Yes	59	56.6	79	62.2	53	58.2		
No	51	46.4	48	37.8	38	41.8		
Is there in your workplace air conditioning?							6.23	0.04
Yes	59	53.6	48	37.8	33	36.3		
No	51	46.4	79	62.2	58	63.7		
Is uniform comfortable for your workplace?							14.85	0.005
Yes	71	64.5	81	63.8	37	40.7		
No	39	35.5	46	36.2	54	59.3		

Table (4) shows safety condition of electrical hazards. Regarding healthcare personnel knowledge about electrical hazards, 19.1 % of doctors, 37% of nurses, and 40.7% of workers knew ($P=0.001$). As regard electrical sockets, 55.5 % of doctors, 26.8% of nurses, and 46.1% of workers stated electrical sockets were overloaded ($P=0.001$).

Regarding electrical cables, 52.7% of doctors, 52.8% of nurses, and 50.5% of workers cleared cables were in good condition ($P=0.9$). Regarding electrical installations, 65.5% of doctors, 59.8% of nurses, and 63.7% of workers reported electrical installations were done by licensed electricians ($P=0.01$). As regard electrical equipment checking, 47.3% of doctors, 55.9% of nurses, and 61.5% of workers reported equipments were checked regularly ($P=0.1$).

Also, **table (3)** shows fire hazards and evacuation plane of the studied hospital. Regarding staff training, 32.7% of doctors, 37% of nurses, and 47.3% of workers reported staffs were attended emergency procedure training ($P=0.09$).

As regard floor plan, 10.9% of doctors, 25.2% of nurses, and 13.2% of workers reported they knew (0.007). Regarding fire extinguishers, 55.5% of doctors, 55.9% of nurses and 78% of workers reported fire extinguishers were available ($P=0.009$). As regard emergency exits, 21.8% of doctors, 25.2% of nurses, and 15.3% of workers reported emergency exits were clear of obstacles ($P=0.2$). Regarding emergency evacuation, 10.9% of doctors, 25.2% of nurses, and 19.8% of workers knew ($P=0.01$).

Table (5) shows radiation hazards. Regarding radiation warning signs, 58.2% of doctors, 50.4% of nurses, and 42.9% of workers reported they were posted.

As regard radiation labs, 31.8% of doctors, 80.3% of nurses, and 40.7% of workers reported radiation labs were secured against unauthorized access. As regard personal protective equipment (PPE), 25.5% of doctors, 21.3% of nurses, and 15.4% of workers reported they were worn it when dealing with radiation. Regarding refresher radiation safety training, 7.3% of doctors, 14.2% of nurses, and 12.1% of workers stated they were given it. Regarding hazards of non-ionizing radiation, 7.3% of doctors, 14.2% of nurses, and 12.1% of workers reported they were informed about it. There are no statistically significant differences in all previously mentioned variables.

Also, **table (5)** shows noise hazards. All personnel reported noise level was unknown, noise hazards zones was not marked, suitable hearing protective devices were not available, and no periodic hearing examination was performed. As regard noise hazards, 7.3% of doctors, 9.4% of nurses, and 19.8% of workers were instructed about instructed about noise hazards ($P=0.01$).

Table (4): Safety condition of electrical and fire hazards and evacuation plan in New Damietta, Al-Azhar University Hospital.

Variables	Doctors (n=110)		Nurses (n=127)		Workers (n=91)		χ^2	P
	No.	%	No.	%	No.	%		
Electrical hazards								
Healthcare personnel is informed about electrical hazards								
Yes	21	19.1	47	37.0	37	40.7	13.02	0.001
No	89	81.9	80	62.0	54	59.3		
Electrical sockets are not overloaded								
Yes	61	55.5	34	26.8	42	46.1	20.93	0.001
No	27	24.5	79	62.2	41	45.1		
Do not know	22	20.0	14	11.0	8	8.8		
Electrical cables are in good condition								
Yes	58	52.7	67	52.8	46	50.5	0.13	0.93
No	52	47.3	47	37.0	34	37.4		
Do not know	0	00.0	13	10.2	11	12.1		
Electrical installations done by licensed electricians.								
Yes	72	65.5	76	59.8	58	63.7	8.23	0.01
No	28	25.5	51	40.2	33	36.3		
Electrical equipments are checked regularly								
Yes	52	47.3	71	55.9	56	61.5	4.24	0.12
No	32	29.1	42	33.1	29	31.9		
Do not know	26	23.6	14	11.0	6	6.6		
Fire hazards								
Staff attended emergency procedure training								
Yes	36	32.7	47	37.0	43	47.3	4.61	0.09
No	74	67.3	80	63.0	48	52.7		
Staff know where the floor plan								
Yes	12	10.9	32	25.2	12	13.2	9.84	0.007
No	98	89.1	95	74.8	79	86.8		
Fire extinguishers are available and serviced regularly								
Yes	61	55.5	71	55.9	71	78.0	13.90	0.009
No	23	20.9	42	33.1	20	22.0		
Do not know	26	23.6	14	11.0	0	00.0		
Emergency exits are kept clear of obstacles								
Yes							3.06	0.21
No	24	21.8	32	25.2	14	15.3		
Do not know	33	30.0	38	29.9	38	41.8		
	53	48.2	57	44.9	39	42.9		
Flammable materials are kept in proper storage								
Yes	69	62.7	81	63.8	57	62.6	0.04	0.98
No	41	37.3	46	36.2	34	37.4		
Staff is briefed about emergency evacuation								
Yes	12	10.9	32	25.2	18	19.8	7.91	0.01
No	98	89.1	95	74.8	73	80.2		

Table (5): Radiation and noise hazards in New Damietta, Al-Azhar University Hospital.

Variables	Doctors (n=110)		Nurses (n=127)		Workers (n=91)		χ^2	P
	No.	%	No.	%	No.	%		
Radiation hazards								
Are radiation warning signs posted?								
Yes	64	58.2	64	50.4	39	42.9		
No	16	14.5	41	32.3	40	43.9		
Do not know	30	27.3	22	17.3	12	13.2	4.70	0.09
Is radiation labs secured against unauthorized access?								
Yes	35	31.8	102	80.3	37	40.7		
No	63	57.3	3	2.4	38	41.8		
Do not know	12	10.9	22	17.3	16	17.5	2.52	0.28
Is PPE* used when dealing with radioactive substance?								
Yes	28	25.5	27	21.3	14	15.4		
No	82	74.5	100	78.7	68	74.7		
Do not know	0	00.0	0	00.0	9	09.9	3.05	0.21
Are staffs given refresher radiation safety training?								
Yes	8	7.3	18	14.2	11	12.1		
No	102	92.7	109	85.8	80	87.9	2.89	0.23
Are they informed on hazards of non-ionizing radiation?								
Yes	8	7.3	18	14.2	11	12.1		
No	102	92.7	109	85.8	80	87.9	2.89	0.23
Noise hazards								
Is level of noise exposure known?								
No	110	100.0	127	100.0	91	100.0	---	---
Is noise hazards zones marked?								
No	110	100.0	127	100.0	91	100.0	---	---
Is employees instructed about noise hazards?								
Yes	8	7.3	12	9.4	18	19.8		
No	102	92.7	115	90.6	73	80.2	8.53	0.01
Is hearing protective devices available?								
No	110	100.0	127	100.0	91	100.0	---	---
Is periodic hearing examination performed?								
No	110	100.0	127	100.0	91	100.0	---	---

PPE*= personal protective equipment.

Table (6) shows noise level in different departments of the hospital. Noise levels were above standard of the WHO in all wards of the hospital and above the slandered of OSHA in laundry, kitchen, sterilization unit, and boiler room. Range of noise level was between 58 dB in renal dialysis unit and 88 dB in kitchen.

Table (6): Noise measurements in all medical departments and auxiliary services in New Damietta, Al-Azhar University Hospital.

Variables	Noise level in dB at day Mean (Range)	Noise level in dB at night Mean (Range)
Medical departments †		
Emergency wards (n=5)	77.2 (71-81)	74 (71-78)
Renal dialysis unit	58	Not applicable*
Laboratory	78	63
Hematology bank	79	62
Radiology units (MRI, CT, sonar, X-ray)	76 (75-77)	69 (65-72)
Outpatient clinics (n=14)	75.1 (71-78)	Not applicable*
Internal medicine wards (n=5)	70 (69-71)	67.2 (66-68)
Pediatric wards (n=3)	74.3 (73-76)	66.3 (65-68)
Obstetrics and gynecology wards (n=4)	76 (72-78)	66.2 (65-68)
General surgery wards (n=5)	73.6 (71-75)	67.8 (65-69)
Cardiology wards (n=2)	70.5 (70-71)	64.5 (64-65)
**E.N.T and ophthalmic wards (n=3)	73 (71-74)	67.7 (66-68)
Orthopedic wards (n=5)	74.4 (71-76)	67.8 (65-69)
Neurosurgery wards (n=2)	71 (70-72)	67 (65-68)
Urology wards (n=2)	75.5 (75-76)	68.5 (68-69)
Pharmacy (n=2)	77.5 (76-79)	Not applicable*
Intensive care units (n=2)	65.5 (64-67)	64.5 (64-65)
Coronary care unit	61	60
Neonatal intensive care unit	69	65
Operating rooms (n=4)	76.8 (74-78)	Not applicable*
Emergency operating room	78	72
Endoscopic room	76	70
Auxiliary services #		
Laundry	87	86
Kitchen	88	84
Sterilization unit	87	85
Boiler unit	86	86
Administrative offices (n=4)	75 (70-78)	Not applicable*

* Not applicable as there is no work at this time. ** Ear, nose, and throat.

† Recommended noise level in medical departments is <40 dB/8h at day and <35 dB/8h at night according to **WHO (15)**.

Recommended noise level in auxiliary services is <85 dB/8h at day and night according to **OSHA (16)**.

Table (7) shows lighting in different departments of the hospital. The level of lighting was between 290 and 1150 Lux with the lowest (lower than normal) in the internal medicine wards, urology wards, laundry, and in administrative offices.

Table (7): Lighting measurements in all medical departments and auxiliary services in New Damietta, Al-Azhar University Hospital.

Variables	Standard levels* of lighting Mean# (Range#)	Actual lighting levels* Mean# (Range#)
Medical departments		
Emergency wards (n=5)	300	334 (310-350)
Renal dialysis unit	100-400	350
Laboratory	500-700	560
Hematology bank	500-700	580
Radiology units (MRI, CT, sonar, X-ray)	500-700	528.8 (430-580)
Outpatient clinics (n=14)	500-700	557.3 (510-640)
Internal medicine wards (n=5)	300	334 (310-350)
Pediatric wards (n=4)	300	337.5 (330-350)
Obstetrics and gynecology wards (n=4)	300	433.8 (410-450)
General surgery wards (n=5)	300	425 (360-455)
Cardiology wards (n=2)	300	445 (440-450)
**E.N.T and ophthalmic wards (n=3)	300	360 (350-380)
Orthopedic wards (n=5)	300	376.8 (374-380)
Neurosurgery wards (n=3)	300	393.3 (385-410)
Urology wards (n=5)	300	455 (450-460)
Pharmacy (n=2)	500-700	495 (480-510)
Intensive care units (n=2)	100-400	405 (400-410)
Coronary care unit	100-400	490
Neonatal intensive care unit	100-400	560
Operating rooms (n=4)	1000	1058 (970-1150)
Endoscopic room	300	540
Auxiliary services		
Laundry	300-500	290
Kitchen	300-500	310
Sterilization unit	300-500	320
Boiler unit	300-500	315
Administrative offices (n=4)	500	491.3 (480-510)

* According to British standards of **CIBSE (14)**.

Measured in Lux.

** Ear, nose, and throat.

Table (8) shows levels of temperature were between 25 and 31°C. Levels of humidity were between 45 and 59%. Heat index was low (<91 °F*) in all departments except kitchen and boiler room where it was moderate (91-103 °F*).

Table (9) shows electrical and fire hazards were the medium risk level 22 (B), while other hazards were at low risk levels, 01, 11, and 12 (A).

Table (10) shows leadership commitment towards workplace safety and health in the studied hospital. Leadership commitment only represents 14.3% towards safety and health in the hospital.

Table (8): Heat, relative humidity, and heat index measurements in all medical departments and auxiliary services in New Damietta, Al-Azhar University Hospital.

Variables	Temperature °C Mean (Range)	Relative humidity % Mean (Range)	Heat index °F* Mean (Range)	Risk level according to heat index
Medical departments				
Emergency wards (n=5)	29 (28-30)	54.2 (53-55)	86.4 (84-89)	Low
Renal dialysis unit	26	45	78	Low
Laboratory	26	46	79	Low
Hematology bank	26	45	79	Low
Radiology units (MRI, CT, sonar, X-ray)	26	46	79	Low
Outpatient clinics (n=14)	28.4 (25-30)	49.8 (50-56)	85 (77-89)	Low
Internal medicine wards (n=15)	29.2 (29-30)	55 (54-56)	87.4 (87-89)	Low
Pediatric wards (n=4)	29	54 (53-55)	86.5 (86-87)	Low
Obstetrics and gynecology ward (n=4)	29	55.5 (55-65)	87	Low
General surgery wards (n=5)	37.3 (29-30)	54.4 (53-56)	88.6 (87-89)	Low
Cardiology wards (n=2)	28.5 (28-29)	56	85.5 (84-87)	Low
**E.N.T and ophthalmic wards (n=3)	28.3 (28-29)	56	85 (84-87)	Low
Orthopedic wards (n=5)	29.4 (29-30)	54.8 (54-56)	87.4 (86-89)	Low
Neurosurgery wards (n=3)	29	52.7 (52-54)	86	Low
Urology wards (n=2)	28.5 (28-29)	53 (51-55)	85 (84-86)	Low
Pharmacy (n=2)	26.5 (26-27)	47 (46-48)	80 (79-81)	Low
Intensive care units (n=2)	26	45.5 (45-46)	79	Low
Coronary care unit	25	45	77	Low
Neonatal intensive care	26	45	79	Low
Operating room (n=4)	26	48.5 (48-50)	79	Low
Emergency operating room	27	50	81	Low
Endoscopic room	28	52	84	Low
Auxiliary services				
Laundry	30	55	89	Low
Kitchen	31	58	93	Moderate
Sterilization unit	30	54	89	Low
Boiler unit	31	59	93	Moderate
Administrative offices (n=4)	28.8 (28-29)	53.3 (52-55)	86.3 (86-87)	Low

* Ear, nose, and throat.

Table (9): Risk assessment of physical health hazards in New Damietta, Al-Azhar University Hospital according to risk assessment matrix.

Variables	Consequence	Possibility of exposure	Risk level
Stairways	0	1	0 1 (A)
Aisles and floors	0	1	0 1 (A)
Lighting condition	1	1	1 1 (A)
Office areas	1	1	1 1 (A)
Electrical hazards	2	2	2 2 (B)
Fire hazards	2	2	2 2 (B)
Exposure to heat	1	1	1 1 (A)
Radiation hazards	1	2	1 2 (A)
Noise hazards	1	1	1 1 (A)

N.B. level of risk =consequence × possibility of exposure, according to Safe Health Work (13)

(A) Low risk: 0 0, 0 1, 0 2, 0 3, 0 4, 1 0, 1 1, 1 2, 2 0, 2 1, 3 0

(B) Medium risk: 1 3, 1 4, 2 2, 2 3, 3 1, 3 2, 4 0, 4 1

(C) High risk: 2 4, 3 3, 3 4, 4 2, 4 3, 4 4

Table (10): Leadership commitment towards workplace safety and health in New Damietta, Al-Azhar University Hospital

Items of leadership commitment	Answer	
	Yes	---
Management is aware of the Workplace Safety and Health Act and its coverage in the organization	Yes	---
All potential hazards at the workplace have been identified	---	No
Risk assessments covering all work activities and processes in the workplace have been conducted	---	No
Risk assessments are communicated to all staff	---	No
Investigation and management reviews are conducted for all workplace incidences	---	No
Workplace safety and health training is provided regularly to all staff	---	No
Sub-contractors engaged e.g. cleaning sub-contractors conduct risk assessments prior to the commencement of work.	---	No
Leadership commitment towards workplace safety and health	1 (14.3%)	6 (85.7%)

DISCUSSION

Hospital workers are exposed to many occupational hazards that may threaten their health and safety. Physical hazards that are encountered in hospital sector include temperature, illumination, noise, vibration, electrical injuries, and ionizing and non-ionizing radiation (5). In Egypt, the infrastructure for dealing with physical and chemical safety is limited. So, healthcare worker are subjected to many health hazards in their workplace (10).

The present study revealed more than 2/3 of staffs reported stairways were free of obstacles, about 1/3 of them reported stairways were slippery, and about 2/3 reported stairways were cleaned regularly. These findings are not coinciding with OSHA (9) guidelines, which revealed stairways should be free of obstacles, not slippery, cleaned regularly, and standard should be followed by 100%. In addition, this study revealed about 3/4 of staffs reported aisles and floors were free from obstruction, staffs worn appropriate footwear; about 3/4 of them reported aisles and floors were in good condition; and about 1/2 of them reported aisles and floors were slippery. These findings are coincide with Collins et al. (18), they cleared 58% of hospital employees thought slip, trip, and fall in hospital were due to liquid contamination (water/fluid) that lead to slippery floor and this was the most common cause. On the other hand, the present study was not coinciding with OSHA (19) guidelines, which reported aisles and

floors must follow standard by 100% to avoid slips, trips, and falls.

The variation of results of risk assessment level among doctors, nurses, and workers could be explained by the variety of knowledge level among these groups, ways of dealing with the surrounding environment, and differences in workplaces where they were in contact.

The present study revealed about 3/4 of staffs reported work areas were free from shadows. While, 38.5% of workers reported they can see without straining. Also, 47.3% of workers said task lighting is adjustable. This finding is coinciding with Simpson (20), who reported 46.3% of hospital workers thought light is adjustable and 42.1% see without straining. This might due to some tasks that done by workers not always take place in front of an office or a position where extra sources of lighting are available to help them work with greater resolution and accuracy. Further, our study revealed 34.5% of doctors, 35.4% of nurses, and 50.5% of workers stated lighting units were cleaned regularly. These figures were smaller than Dalke et al. (21), they found 54.6% of hospital nurses stated lighting units were clean. This is explained by absence of cleaning schedule in hospital in the present study. In addition, the present study noticed level of lighting was between 290 and 1150 Lux with the lowest (lower than normal) in the internal medicine wards, urology wards, laundry, and in administrative offices. These figures were less than Stylliani et al. (22), they revealed level of lighting was between 500 and 1805 Lux with the lowest in

the X-ray diagnostic room and in offices without natural light. Further, this result not coinciding with **CIBSE (14)** guidelines, which reported lighting in buildings, should follow standards by 100%.

The present study revealed 52.7% of doctors, 50.4% of nurses, and 48.4% of workers reported office chairs were adjustable. Moreover, 30.9% of doctors, 18.9% of nurses, and 47.3% of workers reported there was foot support. Also, 49.1% of doctors, 49.6% of nurses, and 53.8% of workers reported shelving of folders were easy to reach. These came in agreement with **Janowitz et al. (23)** they reported 22% of nurses reported there was foot support in their workplace and 49.3% revealed there were shelving for folders and these shelves were easy to reach.

The present study found 56.6% of doctors, 62.2% of the nurses, and 58.2% of workers stated temperature in workplace was suitable. While, 53.6% of doctors, 37.8% of nurses, and 36.3% of workers reported there was air conditioning in their workplaces. These figures were smaller than **Stylliani et al. (22)**, they observed 69.3% of hospital employees thought temperature in workplace was suitable and there was air conditioning in their workplace. Also, our study revealed levels of temperature were from 24 to 31°C and levels of relative humidity (RH) were from 45 to 59%. This isn't completely coinciding with a Greek study **(22)**, which revealed levels of temperature in different departments were from 16 to 27°C and levels of relative humidity were from 22 to 45%. These findings not coinciding with **CIBSE (24)** standard, which recommended thermal condition 22°C <Temp<24°C and 30%<RH<60% and standard should be followed by 100%. This might due to the hospital in the Greek study was completely occupied by air conditioning and ways of recycling air, while in our study hospital isn't completely occupied by air conditioning.

The current study showed 19.1% of doctors, 37% of nurses, and 40.7% of workers were informed about electrical hazards. These findings are coinciding with **Tziaferi et al. (25)**, they reported 36.2% of hospital workers were informed about electrical hazards. Moreover, the present study observed 24.5% of doctors thought electrical sockets were overloaded, while 62.2% of nurses and 45.1%

of workers had the same opinion. We could explain the higher proportions among nurses and workers who thought electrical sockets were overloaded was due to doctors don't deal with the electrical sockets in their workplaces, while nurses and workers are daily dealing with. Also this study reported 52.7% of doctors, 52.8% of nurses, and 50.5% of workers thought cables were in good condition and 65.5% of doctors, 59.8% of nurses, and 63.7% of workers reported electrical installations were done by licensed electricians. This is considered in accordance with **WSH (12)** guidelines, which revealed all electrical cables should be in good condition, electrical installations should be done by licensed electricians, and should follow standard by 100%. We might suppose poor knowledge about occupational health and safety measures in the workplace and shortening of training programs to hospital employees could be responsible for this lack of safety knowledge.

The current study revealed 32.7% of doctors, 37% of nurses, and 47.3% of workers attended emergency procedure training. Further, 55.4% of doctors, 55.9% of nurses, and 78% of workers reported fire extinguishers were available. Moreover, 10.9% of doctors, 25.2% of nurses, and 19.8% of workers were briefed about emergency evacuation. These findings were similar to **Tziaferi et al. (25)**, they revealed 24.1% of hospital workers were briefed about emergency evacuation of building and 33.6% of them had attended emergency training. On the other hand, findings of our study were not coinciding with **OSHA (26)** standards, which revealed fire extinguishers should be available and follow standard by 100%. Also, this finding was not coinciding with **WSH (12)** guidelines, which reported fire response plan should be made available to all healthcare staff and training must be provided to recognize fire alarms and carry out emergency response. All healthcare staff must be aware of their role in the event of emergencies and must be trained on the safe use of fire extinguishers. Fire extinguishers should be provided at appropriate and prominent locations that are clearly indicated. All emergency exits should be kept clear of clutter. Standard of fire safety should be followed by 100%.

The current study revealed 58.2% of doctors, 50.4% of nurses, and 42.8% of workers reported radiation warning signs were posted. Also, 31.8% of doctors, 80.3% of nurses, and 40.7% of workers thought radiation labs were secured against unauthorized access. **ICRP (27)** and **Radiation Protection Guidance for Hospital Staff (28)** cleared use of warning or caution sign was necessary to warn unauthorized or unsuspecting personnel of hazards. Also, radiation labs should be secured unauthorized personnel as well. Further, the present study found 7.3% of doctors, 14.2% of nurses, and 12.1% of workers were informed on hazards of radiation. Moreover, 7.3% of doctors, 14.2% of nurses, and 12.1% of workers were given radiation refresher safety training. These findings are coinciding with **Tziaferi et al. (25)**, they reported 15.6% of hospital workers were informed on hazards of radiation and 12.9% given radiation refresher safety training.

The present study revealed all healthcare personnel reported noise level was unknown, noise hazards zones were not marked, hearing protection devices were not available, and no periodic examination was performed. While, 7.3% of doctors, 9.4% of nurses, and 19.8% of workers were instructed about noise hazards. This is in accordance with **Stylliani et al. (22)**, they found PPE in case of annoying noise wasn't at hand of hospital employees, there were no periodic measurements of noise intensity, and noise level was unknown in their workplace. The present study is not in accordance with **OSHA (16)** guidelines, which revealed all workers should be instructed about noise hazards in their workplace.

Also, the present study reported noise levels were higher than standard of **WHO (15)** acceptable limits, in all wards of the hospital and higher than slandered of **OSHA (16)** in laundry, kitchen, sterilization unit, and boiler room. Range of noise levels were between 58 dB in renal dialysis unit and 88 dB in kitchen. This is coinciding with **Blomkvist et al. (29)** and **Allaouchiche et al. (30)**, they cleared noise levels typically were 45 dB to 68 dB, with peaks frequently exceeding 85 dB to 90 dB. Also, our result is in accordance with **Moshi et al. (31)** in Tanzania, they found noise levels were higher than WHO

acceptable limit on hospital buildings in all departments of hospital. Further, the present study is not completely in accordance with **Staylliani et al. (22)**, they noticed noise in the majority of departments was low (<45 dB), while in laboratories of technical service, boiler room, laundry, central sterilization unit, and outdoor space was measured as a high risk level (>85 dB). High level of noise in the studied hospital could be explained first; noise sources are numerous, include alarms, bedrails moved up/down, telephones, staff voices, trolleys, and noises generated by roommates, and second; environmental surfaces (floors, walls, and ceilings) usually are hard and sound-reflecting, not sound absorbing.

Regarding risk assessment matrix, the present study revealed electrical and fire hazards were of medium risk level (22 B), while other hazards were of low risk level. These findings are not completely in accordance with **Tziaferi et al. (25)**, they revealed staff perceived risk as of medium level in hazards related to environment, equipment, and in electrical ones, while perceived risks as of high level in hazards related to fire and waste management. This could be explained; **Tziaferi et al. (25)** investigated the perception of hazards by staff in two hospitals in comparison to expert's evaluation of risk level in the corresponding inspected departments, while our study depends only on the expert's evaluation of risk level.

The present study found leadership commitment only represents 14.3% towards safety and health in hospital. This finding smaller than **Conway (32)** and **Pinakiewicz et al. (33)**, they revealed leadership was a contributing factor in 50% of safety and health reports and showed leadership makes a major difference in quality and safety of the staff and patient care. Also, this finding not coinciding with **WSH (12)** guidelines, which reported leadership commitment should follow standard of WSH by 100%. Again, our finding not in accordance with **Botwink (34)**, who report leadership commitment represent great role in improvement of healthcare staff and safety.

CONCLUSIONS

The majority of staffs reported stairways were free of obstacles and cleaned

regularly. The aisles and floors were free of obstruction, in good condition, and clean. Exits were clear and free of obstacles. Work areas were free from shadows, staff could see without straining, and emergency lighting worked properly. Electrical cables were in good condition. Temperature was suitable, noise hazards zones were not marked, and hearing protection devices were not available. Majority of doctors and nurses and minority of workers reported task lighting was adjustable, office chairs were adjustable, there was air conditioning, the uniform was comfortable, and radiation warning signs were posted. Most of nurses and minority of doctors and workers reported radiation labs were secured. Minority of staffs reported lighting units were cleaned regularly, they were informed about electrical hazards, they attended emergency procedure training of fire safety, emergency exits were kept clear of obstacles, they were briefed about emergency evacuation, and they were informed on hazards of non-ionizing radiation. Staffs were given refresher radiation safety training and they were attended emergency procedure training of fire safety. Measurements of physical agents revealed noise level was above standard of the WHO in all wards of hospitals and above standard of OSHA in laundry, kitchen, sterilization unit, and boiler room. Range of noise level was between 60 dB (CCU) and 88 dB (kitchen). Level of lighting was between 290 and 1150 Lux. Levels of temperature were between 25-31°C and levels of humidity were between 45-59%. Heat index was low in all departments except kitchen and boiler room where it was moderate. According to risk assessment matrix, electrical and fire hazards were the medium risk level 22 (B), while other hazards were of low risk level; 01, 11, and 12 (A). Leadership commitment represents only 14.3% towards safety and health in the hospital.

RECOMMENDATIONS

Based on results, discussion, and conclusions of this study we could recommend workplace environment should be monitored and evaluated. Radiation labs should be secured. Staffs should be informed about electrical hazards and its safety measures. Engineering and administrative control of heat and relative humidity should

be established to decrease heat. Increase lighting power in low light areas. Also, noise monitoring and noise engineering and administrative control should be established. Further, environmental and behavioral interventions are indicated for all hospital personnel to prevent undue exposures. Training programs on health and safety issues should be conducted to all healthcare workers. Leadership commitment towards workplace safety and health should be increased and reevaluated. Lastly, further studies in different hospitals in Egypt are needed to investigate this health problem.

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