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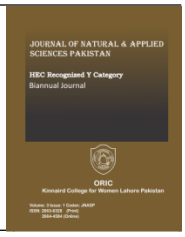

RISK ASSESSMENT OF PHYSICAL AND ERGONOMIC HAZARDS IN A REPUTABLE HOSPITAL OF LAHORE, PAKISTAN

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Abstract

A tertiary care hospital located in Lahore, Pakistan was visited for conducting risk assessment. Risk assessment was conducted by various steps that are involved in it.Its aim was to raise the health status of people living in Pakistan generally and in the city particularly. Most of the data was collected by walk through survey and the latest internet research articles. Main focus of the study was based on data collection and assessment related to health issues for this particular hospital by means of a comprehensive survey. In 1st step of risk assessment, physical and ergonomic hazards were found in different zones of hospital. In the second step it was found that by increasing dose or duration of exposure to hazards, portion of the population responding towards it increases. Then in 3rd step, exposed population, source and nature of exposure was determined. Finally risk was characterized through risk matrix. By the risk matrix it was interpreted that out of all hazards, electric shock, exposure to radiations, intense heat and noise exposure showed medium level risk whereas level of risk associated with stress on thoracic region of spine was unacceptable. Awareness regarding occupational health and safety hazards at the workplace can greatly reduce the risk associated with them.

Keywords
Risk Assessment, Hazard, Risk, Hospital

1. Introduction

Clinical threats in various health care systems have attracted the attention of authorities and regulating bodies (Kour *et al.*, 2020). Millions of people join the labor force every year mostly in developing countries. Workplace environmental hazards are therefore a menace to a large section of the world population. Risk assessment

involves a scientific evaluation of the possibility for unfavorable health and safety effects to workers exposed to precarious substances. When evaluating risk, it must be determined whether a hazard is present and the degree to which a worker is likely to be disclosed. So, risk involves both existence of a dangerous agent and the possibility for exposure to that agent (CDB, 2008). In terms of occupational health, purpose of risk assessment is to facilitate rational decision making in taking all the requisite measures that will control the vulnerability to health hazards in any operational environment. (Paustenbach, 1995; Sadhra & Rampal, 1999; Harrington & Gill, 1987).

Occupational hazards refer to workplace factors with a potential for harm in terms of injury or ill health. While risk is the likelihood of that potential harm being realized (0SHA, 2014). Hazards are classified in different categories such as physical (noise, radiation, extremes of temperature, etc.), ergonomic (injury to the musculoskeletal system), chemical (solid, liquid, and vapors), biological (bacteria, viruses, etc.), and psychosocial (psychological and social stressful factors).Job-related diseases and work accidents are caused by exposure to any of these hazards (Hasselhorn *et al*., 1999).

Slippery floors, electrical hazards, noise, poor lighting, and inadequate ventilation are the most commonly found physical hazards in hospitals (Patterson *et al*, 1985). Ergonomic hazards are the hazards that pose the risk of injury to the musculoskeletal system of the worker. Examples include: manual handling, repetitive movement, poor body positioning etc. In the general population, musculoskeletal disorders are the second most common cause of dysfunction. Occupational musculoskeletal disorders represent the second most common work-related health disorder (Harber *et al*., 1985).

A research study was conducted to identify physical health hazards in all departments of Al-Azhar University Hospital in new Damietta, to determine the level of risk associated with these hazards, and to recognize preventive measures in the inspected departments (Abdel-Wahed *et al*., 2013). Potential occupational hazards in the operating room were identified in order to assess the risk of adverse health effects related to the identified hazards among nurses working in operating rooms (Saleh *et al*., 2020).

There exists insufficient information regarding risk assessment of physical and ergonomic hazards in hospitals of Lahore. Purpose of this research was to conduct a risk assessment of physical and ergonomic hazards in a renowned hospital of Lahore in order to determine that how safe are the hospitals for its staff, patients and visitors.

2. Materials and Methods

Different types of hazards are found in hospitals. Hospital workers are exposed to a variety of hazards that differ according to education or tasks applied. Present study conducted a risk assessment of physical and ergonomic hazards in a hospital which is one of the best and most well equipped hospitals in Lahore. Patients not

only from Lahore but from other cities come here for their treatment. Necessary permission was requested and granted from the hospital in order to carry out the present research work. Workplace inspection checklist was used to assess physical and ergonomic health hazards in the hospital. Hazards were identified on the basis of personal observation. Following steps of risk assessment were undertaken in the hospital (USEPA, 2021).

2.1 Hazard Identification

Hazard identification was the first step in risk assessment which involved:

- Recognizing the hazard in an area.
- Its behavior and metabolism in the body and
- Its qualitative health impacts

2.2 Dose-response Assessment

Dose-response assessment was carried out in order to estimate that how different levels of exposure to a chemical can impact the likelihood and severity of health effects.

2.3 Exposure Assessment

Following questions were answered though this step.

- Who is exposed in the scenario?
- Route of Exposure – How they are exposed?
- What is the nature of this exposure? (Continuous/ Intermittent)
- Duration of Exposure/ Exposure Dose – How much is the exposure in population?

2.4 Risk Characterization

Risk characterization is assessed by the degree to which it achieves the principles of **T**ransparency, **C**larity, **C**onsistency, and **R**easonableness (TCCR). Risk characterization was done in order to provide an understanding of the type and magnitude of an unfavorable effect that a particular emission or chemical could cause under specific conditions.

3. Result and Discussion

Risk = Severity x Likelihood

Table 1 and 2 shows physical and ergonomic hazards respectively that were identified in the selected hospital. After this step, values for different hazards were assumed above and below threshold level. Graphs were generated to show health effects that could be observed in an individual.

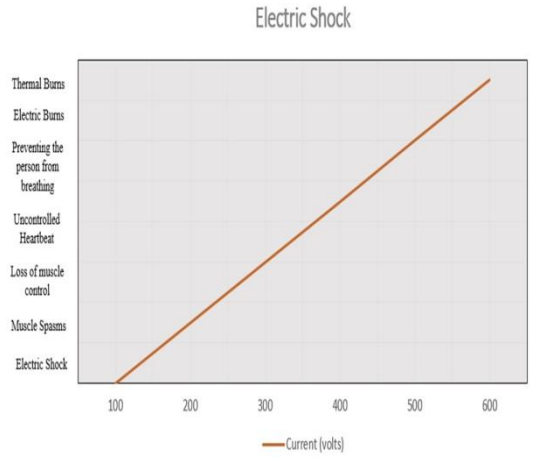
Table 1: Physical Hazards Identified In Below Mentioned Areas of Hospital

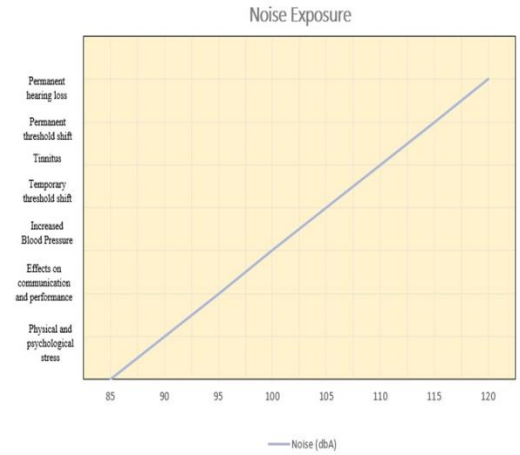
PHYSICAL HAZARDS				
Sr #	**Area**	**Probable Hazard**	**Metabolism and behavior in body**	**Qualitative health effects**
1)	General ward	Insect/pest control machine may fall on the patient beneath it.	Injury to living tissues occurs by an extrinsic agent.	Stroke, trauma
2)	Parking lot	Slip and fall	-	Twiddling, fracturing (bone)
3)	Ward's washroom, Corridor	Slip	-	Bruises, sprains, fractures
4)	Cafeteria, parking lot	Electric shock	Electricity always travel in the pathway of least resistance, the person offers the electricity, path of less resistance. (Under many conditions, body (skin) has a low level of resistance to electricity.)	Lose control of muscles, collapse, ventricular fibrillation, death
5)	Waiting area, wards, operating theatre, offices, laboratories, reception, cafeteria	Noise exposure	Sound / vibration from a device transfers energy to a person's organ and affect the entire body or a number of organs in the body.	Poor work quality issues, loss of sensation, focus and concentration
6)	Cafeteria	Microwave may fall on the person/ object near it.	-	Wrench, stroke, bone fragmentation
7)	Cafeteria	Intense heat.	Heat is transferred to human body through radiation.	Redness, swelling, pain, dehydration, fainting
8)	Corridor	Exposure to dust	Dust enters through nose, reaches the windpipe and deposits on the lining that surrounds the airways.	Hay fever, asthma attacks, sneezing, damage to respiratory tract, irritation of eyes, lung disease (Pneumoconiosis)
9)	Radiology unit	Ionizing radiations	Once a person is exposed to such radiations, it reduces the number of lymphocyte cells in the body, leaving the victim susceptible to infection.	Seizures, cataract, damage to reproductive tract, heart failure, immediate death
10)	Gas storage rooms, corridors, laboratories, maintenance and contractor operations, wards, respiratory therapy units	Fire, explosion	When cylinders are exposed to damage from heat, electric circuit or anything that can cause a crack or weakness in the cylinder wall or shell, a sudden release of gases from the cylinder can cause it to become a missile like projectile.	Breathlessness, acute respiratory distress syndrome, airway inflammation, trauma, burns, death
11)	Surgical unit	Laser radiations	Once in the body, they alter the body tissues.	Skin burns, permanent eye damage
12)	Microbiology lab	Hot pressurized steam	-	Burns to face, burns over large areas of body

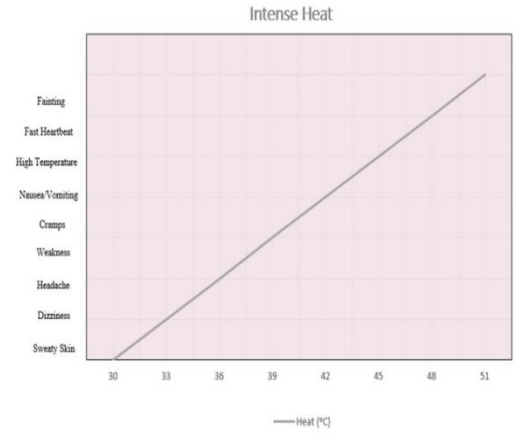
Table 2: Ergonomic Hazards Identified In Below Mentioned Areas of Hospital

ERGONOMIC HAZARDS				
Sr #	**Area**	**Hazard**	**Metabolism and behavior**	**Qualitative health effects**
13)	Laboratories, offices, reception	Stress on thoracic region of spine	Uneasy access to the object curves the top of back.	Kyphosis
14)	General wards	Stress on spine	Awkward postures while lifting damage the intervertebral discs which are found between the vertebrae of the spine.	Slipped discs, degenerative disc disease, pain radiating down the legs.
15)	Washrooms, kitchen, wards, laboratories, offices, corridors	Repetitive movements	Such motions affect the worker's muscles, nerves and joints.	Tendinitis, musculoskeletal disorders.
16)	Operating room, emergency unit	Uncoordinated movement (ataxia)	Communication between the brain and rest of the body is disrupted in some way.	Lesion, cuts

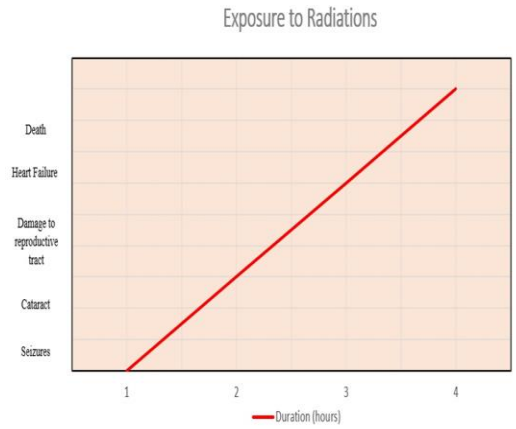
3.1 Physical Hazards and their Effects at Different Doses

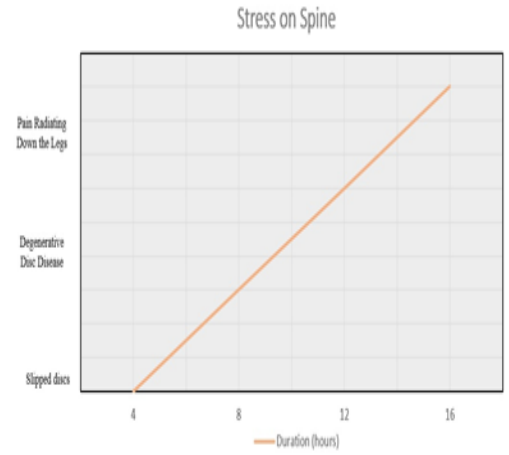


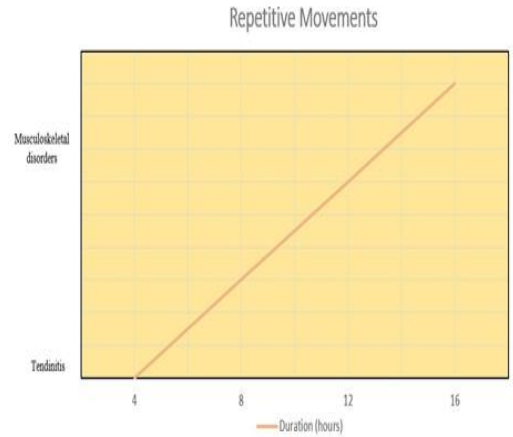




3.2 Ergonomic Hazards and their Effects at Different Doses







Population who was exposed to all identified hazards usually involved patients under treatment, visitors, lab workers, doctors, nurses, sweepers, administrative and custodial staff. So the exposure assessment was done for those victims who were directly exposed with the hazards explained above. Table 3 and 4 shows exposure assessment of physical and ergonomic hazards respectively.

Table 3: Route, Nature and Extent of Exposure towards Physical Hazards

Hazard	**Route of exposure**					**Nature of exposure**		**Extent of exposure**	
	Source	**VF**	**Route of intake**			**Continuous**	**Intermittent**	**Dose**	**Duration (hrs)**
			I.G	I.H	A. B				
Insect/pest control machine may fall on the patient beneath it.	Insect/pest control machine placed at a height	Accidents	__	__	__	____	✓	__	__
Slip and fall	physical obstruction in walkway	Accidents	__	__	__	____	✓	__	__
Slip	slippery floor	Accidents	__	__	__	____	✓	__	__
Electric shock	exposed wires near electrical outlet	Water, unguarded exposures	__	__	Yes	____	✓	10 mA	__
Noise exposure	ringtones of mobile phones	Air, unguarded exposures	__	__	Yes	____	✓	90 db(A)	4
Microwave may fall on the person/object near it.	precarious microwave	Accidents	__	__	__	____	✓	__	__
Intense heat.	oven	Air, unguarded exposures	__	Yes	Yes	✓	____	10 Joules	6
Dust Exposure	Dust deposition on ventilation.	Air,land	Yes	Yes	__	✓	____	5mg/kg/day	8
Ionizing radiations	X ray machine	Air, unguarded exposures	__	Yes	Yes	____	✓	5 rad	6

Fire, explosion	Cylinders of compressed gas	Air, Accidents	—	Yes	Yes	____	—	—
Laser radiations	Medical lasers	Air, unguarded exposures	—	Yes	Yes	____	10 rad	12
Hot pressurized steam	Autoclave		—	Yes	Yes	____	—	8

Table 4: Route, Nature and Extent of Exposure towards Ergonomic Hazards

Hazard	**Route of exposure**					**Nature of exposure**		**Extent of exposure**	
	Source	**VF**	**Route of intake**			**Cont.**	**Intermittent**	**Dose**	**Duration (hrs)**
			I.G	I.H	A.B				
Stress on thoracic region of spine	Equipment's/objects at a distance from the operator.-	—	—	—	—	____	✓	—	3
Stress on spine	Patient's manual handling by staff members	—	—	—	—	____	✓	—	8
Repetitive movements	Twisting and bending postures while performing cleaning task	—	—	—	—	____	✓	—	6
Uncoordinated movement (ataxia)	Moving haphazardly through single entry door.	—	—	—	—	____	✓	—	2

In last step, risk matrices were made in order to identify and prioritize the most severe risks in hospital. Measurement of the severity (Table 6) and likelihood ratings were determined (Table 5). The acceptability level of the risks were also interpreted (Table 7).

Table 5: Key for Likelihood

Probability	**Likelihood**	**Description**
1	Improbable	May occur only in exceptional circumstances
2	Rare	Could occur at some time; once or twice a year
3	Occasional	Might occur or should occur at some time; once a month
4	Probable	Will probably occur in most circumstances; once a week
5	Frequent	Is expected to occur in most circumstances, at least once a day

Table 6: Key for Severity

Probability	Severity	Description
1	Negligible	Requires no further assessment Needs no medical attention
2	Low	Requires a cursory assessment but not in-depth evaluation Needs superficial treatment No loss of work day
3	Moderate	Requires in depth evaluation Needs medical attention Reversible medical condition Loss of minimum one work day
4	Significant	Requires in depth evaluation Needs immediate medical attention and hospitalization Partially irreversible medical condition May require rehabilitation
5	Epidemic	Requires in-depth evaluation and immediate mitigatory action Injury will be long lasting or permanently irreversible

Table 7: Key for Risk

Level of Risk	Descriptor	Description
1	Desirable	Insignificant impact. No action is needed to be taken
2	Acceptable	Minor impact for small population. Area needs to be monitored
3	Undesirable	Minor impact for large population. monitoring needs to be increased
4	Unacceptable	Major impact for small population. Action(s) needed to be taken
5	Critical	Major impact on large population. Urgent action(s) needed to be taken

3.3. Risk Matrix for Physical Hazard

Risk matrix for physical hazards is shown in Figure 1.

3.3.1. Electric Shock

Risk was taken as 9 because it's probability of occurrence i.e. likelihood was occasional. The wires were at a distance from the possible exposed population. However, the chances of short circuit were such that its impact could be high which was considered as 3.

3.3.2. Intense Heat

Risk was taken as 8 because it's probability of occurrence i.e. likelihood could occur at some time depending upon the wear and tear of the wires. Its severity was 4 because the impact of this hazard was quite severe e.g. second and third degree skin burns which require prolonged medical attention.

3.3.3. Noise Exposure

Risk was taken as 10 because it's probability of occurrence i.e., likelihood was expected to occur frequently. However, its severity was taken as 2

*4

because although it needs to be monitored, its impact was minor in the large exposed population of the hospital.

Exposure to Radiations

Risk was taken as 10 because it's probability of occurrence i.e., likelihood was expected to occur maybe once a year. However, its severity was taken as 5 because its impacts were too severe in the exposed population of the surgical unit and radiology lab in the hospital.

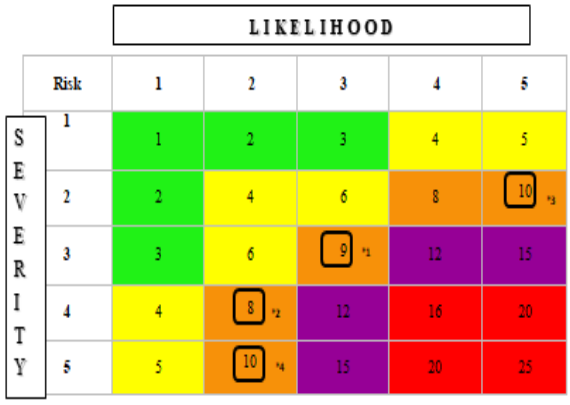


Figure 1: Risk Matrix For Physical Hazards

3.4. Risk Matrix for Ergonomic Hazard

Risk matrix for ergonomic hazards is shown in Figure 2.

3.4.1. Stress on thoracic region of spine

Risk was taken as 12 because it's probability of occurrence i.e. likelihood was occasional. Its impact needs to be monitored.

3.4.2. Repetitive movements

Risk was taken as 10 because it's probability of occurrence i.e. likelihood was rare. Its severity was 5 because the impact of this hazard was quite severe e.g. tendinitis which requires prolonged medical attention.

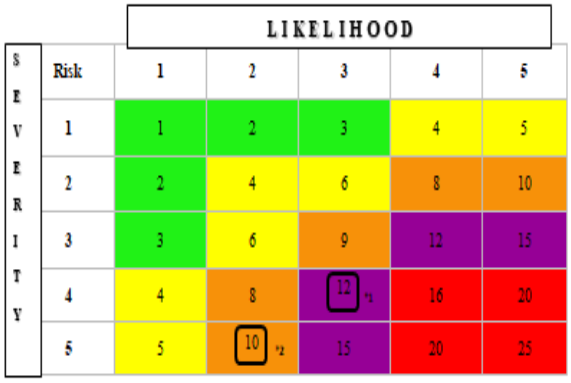


Figure 2: Risk Matrix for Ergonomic Hazards

Due to risk characterization it was found that workers at the hospital were exposed to many types of physical (electric Shock, intense heat, noise exposure and exposure to radiations), mechanical and ergonomic hazards (stress on thoracic region of spine and repetitive movements). Electric shock, intense heat, noise exposure, exposure to radiations repetitive movements were at medium level of risk that was undesirable. But the level of risk associated with stress on thoracic region of spine was found to be unacceptable. It requires high level of management and immediately mitigation should be done. This is in consistent with the study conducted by Saleh *et al*. (2020) in which risk linked to muscular pain (ergonomic hazard) requires attention.

4. Conclusion

Occupational health hazards are a significant problem in hospitals. Education can play an important role in this regard. The more hospital staff is aware about potential occupational health and safety hazards, the more successful they will be in diminishing the risks, avoiding accidents

and ensuring employee health and safety. Awareness regarding occupational health hazards and risk analysis can promote injury prevention. In order to increase understanding of the true extent of occupational hazards and consequences, occupational health environment in hospitals is also an area that requires further research in Pakistan.

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