Occupational Health Hazards and Protective Measures among Radiation Health Team

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Abstract

Background: Radiation was a threat to health in work place and in general environment. **Aim of the study** was to assess occupational health hazards and protective measures among radiation health team. **Subjects & methods**: **Research design:** Across-sectional descriptive design was used in this study. **Setting**: The study was carried out at the Radiotherapy Department in Zagazig University Hospital, and Radiology Department in El-Ahrar Zagazig Hospital. **Subjects**: A purposive sample composed of 70 subjects who worked at the radiation departments for at least two years. **Tools of data collection**: Two tools were used in this study**. Tool I:** A self-administered questionnaire to identify knowledge about radiation hazards, the effects of occupational health hazards, and protective measures among radiation health team. **Tool II:** An observational checklist to describe compliance with personal protective equipment and safe work practice**. Results**: The study findings revealed that 20% of nurses, 60.5% of technicians and 52.9% of physicians had satisfactory knowledge about radiation hazards. Additionally, the highest percentages of occupational hazards as reported by participants were physical hazards which constituted (100% among nurses, 93% among technicians and 88.2% among physicians). The highest percentages of the health problems related to exposure to radiation at work were found among technicians (95.3%) compared to 70% of nurses and 47.1% of physicians. As well, only 17.6%of physicians and 14% of technicians wear lead aprons all times. Also, 18.6% of technicians, and 5.9% of physicians wear monitoring badge. Moreover none of nurses comply with the use of personal protective equipment. **Conclusion:** the highest percentages regarding knowledge of radiation hazards were among technicians. The majority of occupational hazards were physical, followed by biological and psychological hazards among radiation health team. Minority of the participants were satisfactory with protective measures. **Recommendations**: To develop an educational program regarding radiation hazards and protective measures to all radiation health team.

Key words: Radiation, health team, Occupational health hazards, Protective measures

Introduction:

Occupational hazards can encompass many types of hazards including biological, psychological, and physical hazards[(1)]. Additionally, ionizing radiation in medical imaging is one of the powerful diagnostic tools in medicine. Ionizing radiations are used in a variety of fields such as: therapeutic and diagnostic modalities. Although all medical interventions have potential benefits, but their potential risks should not be ignored [(2)].

Ionizing radiation which is applied in radiology departments and in radiation therapy has hazardous effects on biological systems. It produces some type of injury that is incurable. The cancers risks arising with radiation have been known. Ionizing radiation may effect on gastrointestinal system, central nervous system, gonads or even whole body. These effects may appear as a somatic effect or in next generation as a genetic effect [(3)].

Occupational radiation protection measures are necessary for all individuals who work in the diagnostic imaging departments. This includes not only technologists and nurses, but also individuals who may be in a radiation environment only occasionally. All of these individuals may be considered radiation workers, depending on their level of exposure and on national regulations. All

workers require appropriate monitoring continuously by common personnel dosimeters like film badge and thermo luminescence dosimeter[4].

Reduction of exposure time, increasing distance from source, and shielding of patients and occupational workers have proven to be of great importance in protecting patients, personnel, and members of the public from the potential risks of radiation. These three radiation protection actions of "time-distance-shielding" are the triad of radiation protection [1].

Significance of the study:

Radiation exposure from medical procedures affects millions worldwide [5]. Ionizing radiations are the hazardous agents in work place. Health hazards from radiation may occur shortly after exposure or it may delay. The more immediate effects may include radiation sickness, hemorrhage, anemia and loss of body fluids. Health effects resulting from chronic exposure include genetic defect, benign tumor, skin changes and congenital defect [6]. Consequently, serious care is necessary for protecting both the health team care and the patients [7].

Aim of the study

The present study aimed to assess occupational health hazards and protective measures among radiation health team.

Research Questions:

1. What is the knowledge of radiation health team about occupational health hazards?

2. What are the effects of occupational health hazards among radiation health team?

3. Are the personal protective equipment available and used by radiation health team?

4. Are the radiation health team satisfactory with personal protective equipment and safe work practices?

Subjects and Methods:

Research design:

A cross-sectional descriptive design was used.

Study setting:

The study was conducted at the Radiotherapy Department in Zagazig University Hospital, and Radiology Department in El-Ahrare Zagazig Hospital. from beginning of March 2016 to the end of May 2016.

Study subjects:

A purposive sample composed of 70 subjects, of radiation health team after 7 excluded from them for the pilot study included nurses (10), technicians (43), and physicians (17) working at the previously mentioned settings at time of data collection were selected under the inclusion criteria:

At least two years of experience in radiation department, and accept to participate in the study.

Tools of data collection:

Two tools were used to collect the necessary data:

Tool (I): A self-administered questionnaire, developed by the researcher through reviewing related literature. It's composed of the following sections:

Part 1: Composed of personal data of the studied sample as gender, age, job, etc.

Part II: Health team knowledge about radiation hazards as effects of radiation on body systems, variation of age, sources of information about radiation hazards. The questions were in the form of closed and opened- ended questions (14Qs).

Part III:

The effects of occupational health hazards related to exposure to radiation at work as reported by participants as types of work hazards, and radiation effects on skin, eye, blood, reproductive, gastrointestinal, respiratory, cardiovascular, neurological and loco-motor systems.

The questions were in form of closed and opened-ended questions (10Qs).

Scoring system:

For the knowledge items, a correct response was scored 1 and the incorrect zero. The scores of the items were summed-up and the total divided by the number of the items, giving a mean score. The score was then converted into a percent score. Knowledge was considered satisfactory if the percent score was 60% or more and unsatisfactory if less than 60% based on statistical analysis**.**

Tool II: An observational checklist to describe compliance with personal protective equipment and safe work practices as wearing gloves, lead apron, mask, monitoring devices, head cap, and hand washing after each procedure (10Qs)**.**

Scoring system:

Used personal protective measures: For this, each item observed to be used was scored 1 and the unused zero. The scores of the items were summed-up and the total divided by the number of the items, giving a mean score. The score was then converted into a percent score. The subject was considered satisfactory if the percent score was 60% or more and unsatisfactory if less than 60%. The numbers of exposures and hazards were computed by simple summations of any checked related items.

Content validity and Reliability:

The validity of data collection tools was tested by three experts from the Medical Surgical Department, Community Health Nursing, Faculty of Nursing, Zagazig University and experts from the Radiology Department, Faculty of Medicine, Zagazig University, to assess clarity, relevance, application, comprehension, and understanding of the tools, all recommended modifications on the tools were done. Reliability of the proposed tools was done by Cronbach's Alpha test, it was 0.969 for tool (I) and 0.970 for tool (II)

Fieldwork:

Upon securing all official permissions, the process of data collection was started from beginning of March 2016 to the end of May 2016. The researcher met with each radiation health team included (nurses, technicians & physicians) individually, explained to them the study aim and procedures, and invited them to participate in the study. The time needed to fill in the forms of data collection tools ranged between 25 - 30 minutes for each participant. The time consumed for filling in the observation checklist, to evaluate compliance regarding protective measures ranged from 10-15 minutes. The researcher performed the fieldwork three days weekly (Saturdays, Mondays and Wednesdays).

Pilot study:

Before performing the main study, a pilot study was carried out on 10% (7) of the study sample. The purpose of the pilot study was to test the questions for any ambiguity, practicability, applicability, and feasibility of the tool and then the necessary modifications were done. It also helped the researcher to determine the time needed for filling in the forms. Those who shared in the pilot study were excluded from the main study sample.

Statistical analysis:

Data entry and statistical analysis were done using the statistical Package for social sciences (SPSS), version 20.0. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations, and medians for quantitative variables. Quantitative continuous data were compared using Kruskal-Wallis test. Qualitative categorical variables were compared using chi-square test. Whenever the

expected values in one or more of the cells in a 2x2 tables was less than 5, Fisher exact test was used instead. In larger than 2x2 cross-tables, no test could be applied whenever the expected value in 10% or more

Results:

Results revealed that the highest mean age 44.5±6.5 was among nurses compared to 33.3±10.9 among technicians and 31.8±4.9 among physicians. Additionally, 90% of nurses, 79.1% of technicians and 70.6% of physicians were married. Furthermore, 90% of nurses, 76.7% of technicians and 52.9% of physicians had insufficient income. Moreover, the highest mean score years of experience in radiation (11.5±9.7) was among technicians.

Table (1): Clarifies that statistically significant difference was found among the three studied groups regarding knowledge of the effect of radiation at work (X^2=7.55, p=0.02). Additionally, 20% of nurses, 60.5% of technicians and 52.9% of physicians had satisfactory knowledge about radiation hazards.

Table (2): Describes the exposure to hazards at work as reported by participants in the study sample. A statistically significant difference was found among the three studied groups regarding the mean score hazards (H=9.31, p=0.01). The technicians were the highly exposed to biological and psychological hazards (76.7% & 74.4% respectively).

Table (3): Reveals that the highest percentage of the health problems related to exposure to radiation at work was found among technicians (95.3%) compared to 70% of nurses and 47.1% of physicians. The health problems among the technicians in descending order were as follows: blood problems (83.7%), loco-moter problems (79.1%), neurological problems (67.4%), skin and eye problems with equal percentages (58.1%), and gastrointestinal problems (44.2%). Additionally, the highest mean score of the health problems was found among technicians (4.7±2.2) followed by 2.4±1.4 among nurses, and 1.1±1.5 among physicians (H= 30.12, P< 0.001).

Table (4): Clarifies that only 17.6% of physicians and 14% of technicians wear lead aprons all times. Additionally, 18.6% of technicians, and 5.9% of physicians wear appropriate monitoring badge. Moreover, none of nurses comply with the use of all items of personal protective equipment**.**

Table (5): Demonstrates a statistically significant positive correlation found between participants knowledge and hazards (r=.331). On other hand, a statistically significant negative correlation was found between occupational hazards and compliance score (r=-.263).

Discussion:

Ionizing radiation has biological effects that affect the organism, non-stochastic (deterministic) effects and stochastic (random) effects. In addition, somatic effects (such as radiation sickness or cancer) are differentiated from genetic effects in the offspring so the radiation protection is necessary Khong et al.[8].

Concerning the answering of research question regarding the knowledge of radiation hazards among radiation health team, the findings of the present study revealed that the majority of nurses, slightly less than of technicians, and less than half of physicians had unsatisfactory knowledge regarding radiation hazards. On the same line, a study conducted in Kuwait by Alotaibi et al.[9] found that majority of radiation health workers had unsatisfactory knowledge about radiation hazards.. This might be due to lack of training courses, which emphasized the urgent need for educational programs for radiation health team regarding radiation hazards On the contrary, a study done in Nigeria by Awosan et al.[10] found that 59.1% of health workers had good knowledge of radiation hazards. This reflected the differences in the study setting.

In relation to answering of research question regarding the effect of occupational hazards among radiation health team, the findings of the present study revealed that more than three quarters of technicians were exposed to biological occupational hazards. This result was in agreement with that of a study conducted in Brazil by Fernandes & Marziale.[11], who found that the most occupational hazards among health workers were biological (bacteria 86-87.7% and viruses 69-70.41%). Similarly, Nedjjo et al.[12] in Kampala (Uganda) mentioned that the majority of occupational hazards among healthcare workers were biological hazards as (cuts/wounds/lacerations, sharp related injuries, direct contact with contaminated specimens, blood-borne pathogens, and infections). In the same context, Senthil et al.[13], conducted a study in India reported that 81·5% among healthcare workers were exposed to biological hazards from direct skin contact with infectious materials. This might be due to that technicians were the closest persons to the patients. Additionally, the study participants did not comply with using personal protective equipment

Additionally, the findings of the present study indicated that almost three quarters of technicians were exposed to psychological hazards. In the same line, in Brazil, a study carried out by Fernandes and Marziale·[11], found that psychological risks among health workers was stress (64-78.05%). Moreover, Owie and Apanga.[14] emphasized that work-related stress was the common occupational hazard prevailing among health care workers in developing countries. From the researcher's point of view, the nature of work setting might lead to workload. Additionally, dealing with patients that are seriously or terminally ill might have exaggerated the psychological state of participants.

The current study results revealed that all of nurses, most of technicians and majority of physicians were exposed to occupational physical hazards. Consistent with the previous results a study carried out, by Alexander et al.[15]), in India, revealed that the majority of health workers were exposed to physical hazards. The study results were also supported by Branco et al. [16], in Brazil, found that the incidence of physical hazards among health workers was the most common occupational hazards. This might be due to working in radiation field and unavailability of protective equipment's for each one

Additionally, a study done in Egypt, by Elewa and El- Banan [17] found that the majority of occupational hazards among health workers were physical hazards. Similarly, a study conducted in Greek hospitals by Tziaferi et al.[18] noted that common physical hazards are heat, noise and vibration. All can be found in excess in some health care settings. Furthermore, other physical agents such as lasers, X-rays, used on patients can be harmful to workers if not properly controlled.

Regarding health problems related to exposure to radiation at work as reported by participants, the present study results revealed that, three fifths of technicians and half of nurses had blood problems, mainly anemia.. In the same context, Ebrahim et al.[19], in Egypt, found that more than two thirds of radiation health team complained from anemia. Similarly, Ibrahim [20], in Egypt, found that the majority of radiation workers were anemic. Moreover, Zachariah et al.[21] showed a statistically significant decrease in the mean values of RBC, WBC and Platelet counts in X-ray technicians. This might be due to the Gamma radiation injury or damages hematopoiesis system which leads to anemia and hemorrhage, adding to, lack of iron supplementation

Furthermore, the current study, results revealed that more than three quarters of technicians had loco-motor problems, mainly bone aches among near half of them. This finding was supported by Alagha and Aljeesh[22], in Gaza found that 75.6%

among radiology technologists complained of musculoskeletal disorder included back pain. On the same context, Lorusso et al.[23]study in Italy, showed that musculoskeletal disorders were a common problem among X-ray technologists. Similarly, a study conducted in King Saudi Arabia by Abbas et al.[24] mentioned that low back pain and neck pain were major occupational health problems and represent a huge burden on nursing staff and on the health care workers. In this regard, Andersen et al.[25], in Denmark found that health care providers showed a higher prevalence of low back pain among occupational groups. Moreover, a study conducted by Yasobant and Rajkumar[26], in India found that the majority of health workers complained from musculoskeletal pain, mainly low back pain. This might be attributed to improper lifting technique during patient's movement and theydo not follow the appropriate body mechanism.

The present study result found that slightly more than two thirds of technicians had neurological problems, included headache among near half of them. The current study finding was in agreement with that of a study done in Taiwan by Kuo et al.[27], pointed to shift work, and sleep disturbance as causes of headache. In the same context a study done in Zimbabwe by Chingarande et al.[28] found that 90% of technicians had headache. Moreover, a study carried out in Nigeria, by Onwuekwe et al.[29], revealed that headache prevalence among hospital workers represented 88%. The World Health Organization[31], reported that the majority of health workers worldwide have experienced a headache. This might be due to heavy workloads, and work stress.

In the current study, less than three fifths of technicians had skin problems; mainly dermatitis in less than half of them. The study results were supported by Senthil et al.[13], who conducted a study in India and found that 93% among health care workers had skin problems. Furthermore, Chingarande et al. [28], in Zimbabwe found that 45% of technicians had dermatitis. In line with the previous findings, Ebrahim et al.[20], in a study in Egypt, showed that less than two thirds of radiation health team complained from dermatitis. This might be due to the lack of using the PPE. Additionally, radiation easily passes through clothing and human tissue and can also cause serious permanent damage to the body as well as skin problems.

The findings of the present study revealed that less than three fifths of technicians had eye problems, particularly inflammations among nearly two fifths.. On the contrary, Chodick et al. [31] mentioned that the exposure to ionizing radiation caused cataract. On the same context,Milacic[32], found that more significant incidence of cataract found among radiology technicians (63.5%). Additionally, Roguin et al. [33] mentioned that 41 % of nurses and technicians had significant posterior subcapsular lens changes, which are not age related. This might be due to unuse of personal protective equipment as goggles typical of ionizing radiation exposure.

The current study revealed that, more than two fifths of technicians complained from gastrointestinal problems. Additionally, Goodman [34] emphasized that acute sickness as nausea, vomiting, and diarrhea developing within hours or minutes after being exposed to 2 Sivert dose of radiation. Without exotic treatment such as, bone marrow transplant, death with this dose is common. The death is generally more due to infection than gastrointestinal dysfunction Donnelly et al.[35]. Christensen et al.[36] emphasized that the signs and symptoms of this form of radiation hazards include nausea, vomiting, loss of appetite, and abdominal pain.

Regarding the answering research question of availability and use of personal protective equipment, the current study revealed that most of studied sample did not wear apron, and appropriate monitoring badge. In line with the previous findings, Pak[37], found that majority of radiation health team did not use radiation protective measures such as eye glasses and lead aprons, only 7% regularly utilized film badge to monitor the exposure, as well, the causes of noncompliance were insufficient or uncomfortable wearing of personal protective equipment. Similarly, a survey conducted in Sirlanka by Dilusha et al.[38] revealed that 99% of the study sample did not use dosimeters. In this context, Pieters et al.[39] emphasized that using personal protective equipment is an important component in the radiation, and it is also important to ensure that the use of personal protection itself does not create a hazard to the worker. Conversely, a study conducted in California, by Reagan and Siechta[40] found that 70.5% of radiation health team were satisfactory with personal safety measures. Such differences might be attributed to the difference of health care setting. This might be due to unavailability of some of personal protective equipment as monitoring film badge and apron for each employee.

Concerning the answering research question regarding compliance with personal protective equipment and safe work practices as observed among radiation health team, the current study revealed that the entire studied sample did not wear gloves, mask, head cap, and didn't practice hand washing after each procedure. Similarly, a survey conducted in Sirlanka by Dilusha et al.[38], revealed that 89% refused to wear lead gloves, and 58% of them did not practice hand free technique from direct X-ray beam to reduce X-ray exposure. This might be due to lack of information and awareness about infection control practices.

Additionally, all radiation health team were satisfactory with safe work procedures as, used advantages of time, followed safe work practice with suitable distance and used of shield. This reflected the design and work set up of radiation department. In the same line, a study conducted in California by Reagan and Siechta[40], showed that the majority of health team were satisfactory to safety practices.

The present study results demonstrated that statistically significant positive correlation was found between knowledge and hazards. In the same line, a study carried out in Nigeria by Awosan et al.[10] found that more than three quarters (77.3%) of health workers were aware with exposure to ionizing radiations could cause harm to the body.

Regarding relation between occupational hazards and protective measures among radiation health team, the current study showed a statistically significant negative correlation between hazards and compliance. In the same line, a study done in Korea by Heo et al.[41], who mentioned that significant negative association was detected between exposure frequency and compliance with safety. This might be due to radiation safety control as shielding, time and distance.

Conclusion:

In the light of the results of the current study, it can be concluded that, the highest percentage regarding knowledge of radiation hazards among participants was among technicians. The majority of occupational hazards were physical hazards, followed by biological hazards and psychological hazards among radiation health team. Health problems related to exposure to radiation at work were highly reported among technicians, these were mainly blood and locomotor problems. Minority of the participants were

satisfactory with personal protective equipment.

Recommendations:

Based on the findings of this study, the following recommendations can be induced:

1. Develop an educational program regarding radiation hazards and protective measures to all radiation health team.
2. Personal protective equipment should be available for radiation health team in radiation department.
3. Periodic checkup of radiation health team for early detection of any health problems.
4. Further researches are suggested on wide scale to generalize the study results.

Table 1: Knowledge of Radiation Hazards Among Participants in the Study *Sample (n=70)*

Items	Job						x^2	p-value
	Nurse (n=10)		Technician (n=43)		Physician (n=17)			
	No.	%	No.	%	No.	%		
Knowledge about:								
Information of ionizing radiation	2	20.0	24	55.8	5	29.4	6.23	0.04*
Effect of radiation at work	8	80.0	43	100.0	15	88.2	7.55	0.02*
Effect on body systems:								
-Reproductive	2	20.0	34	79.1	12	70.6	13.18	0.001*
-Bone marrow	4	40.0	30	69.8	13	76.5	4.14	0.13
- Gastrointestinal	2	20.0	25	58.1	5	29.4	7.16	0.03*
-Respiratory	2	20.0	24	55.8	5	29.4	6.23	0.04*
Variation by age	5	50.0	37	86.0	13	76.5	6.32	0.04*
Age group susceptibility	8	80.0	32	74.4	11	64.7	0.88	0.64
Total knowledge:								
Satisfactory (60%+)	2	20.0	26	60.5	9	52.9		
Unsatisfactory (<60%)	8	80.0	17	39.5	8	47.1	5.33	0.07

(*) Statistically significant at p<0.05

Table (2): Exposure to Hazards at Work as Reported by Participants in the Study Sample (n=70)

Work hazards	Job						x^2	p-value
	Nurse (n=10)		Technician (n=43)		Physician (n=17)			
	No.	%	No.	%	No.	%		
Biological	2	20.0	33	76.7	12	70.6	11.96	0.003*
Physical	10	100.0	40	93.0	15	88.2	1.32	0.52
Psychological	2	20.0	32	74.4	10	58.8	10.45	0.005*
Total hazards:								
Range	1-3		0-3		0-3			
Mean±SD	1.4±0.8		2.4±0.9		2.2±1.0		H=9.31	0.01*
Median	1.0		3.0		3.0			

*(*)Statistically significant at p<0.0***5** *(H) Kruskal Wallis te***st**

Table (3): Health Problems Related to Exposure to radiation at Work as Reported by Participants in the Study Sample (n=70)

Variables	Job						X^2	p-value
	Nurse (n=10)		technician (n=43)		physician (n=17)			
	No.	%	No.	%	No.	%		
Has health problems at work	7	70.0	41	95.3	8	47.1	18.49	<0.001*
Skin problems:	0	0.0	25	58.1	4	23.5	14.27	0.001*
Burns	0	0.0	0	0.0	0	0.0	0.00	1.00
Eczema	0	0.0	4	9.3	0	0.0	--	--
Dermatitis	0	0.0	20	46.5	4	23.5	0.94	0.01*
Hair loss	0	0.0	1	2.3	0	0.0	--	--
Eye problems:	1	10.0	25	58.1	2	11.8	15.29	<0.001*
Inflammations	1	10.0	16	37.2	1	5.9	--	--
Cataract	0	0.0	3	0.0	0	0.0	--	--
Conjunctivitis	0	0.0	2	4.7	1	5.9	--	--
Decreased acuity	0	0.0	5	11.6	0	0.0	--	--
Blood problems:	5	50.0	36	83.7	4	23.5	20.26	<0.001*
Anemia	5	50.0	26	60.5	4	23.5	6.65	0.04*
Low platelets	0	0.0	10	23.3	0	0.0	--	--
Bleeding	0	0.0	0	0.0	0	0.0	0.00	1.00
Low WBCs	0	0.0	1	2.3	0	0.0	--	--
Genital problems:	3	30.0	6	14.0	0	0.0	--	--
Abortion	1	10.0	4	9.3	0	0.0	--	--
Infertility	0	0.0	2	4.7	0	0.0	--	--
Delayed pregnancy	2	20.0	0	0.0	0	0.0	--	--
Preterm labor	0	0.0	0	0.0	0	0.0	0.00	1.00
Gastrointestinal problems	0	0.0	19	44.2	2	11.8	11.10	0.004*
Anorexia	0	0.0	15	34.9	0	0.0	--	--
Nausea	0	0.0	3	7.0	2	11.8	--	--
Voiting	0	0.0	1	2.3	0	0.0	--	--
Diarrhea	0	0.0	5	11.6	0	0.0	--	--
Respiratory problems:	0	0.0	15	34.9	1	5.9	--	--
Cough	0	0.0	8	18.6	1	5.9	--	--
Dyspnea	0	0.0	7	16.3	0	0.0	--	--
Cardiovascular problems	5	50.0	14	32.6	0	0.0	--	--
Arrhythmia	4	40.0	11	25.6	0	0.0	--	--
Hypertension	2	20.0	4	9.3	0	0.0	--	--
Angina	0	0.0	1	2.3	0	0.0	--	--
Neurological problems:	4	40.0	29	67.4	2	11.8	15.57	<0.001*
Dizziness	2	20.0	10	23.3	0	0.0	--	--
Headache	4	40.0	22	51.2	2	11.8	7.88	0.02*
Locomotor problems	6	60.0	34	79.1	3	17.6	19.41	<0.001*
Fatigue	2	20.0	18	41.9	2	11.8	5.83	0.054
Bone aches	6	60.0	21	48.8	2	11.8	8.56	0.01*
Total problems:								
Range	0-5		1-8		0-5			
Mean±SD	2.4±1.4		4.7±2.2		1.1±1.5		H=30.12	<0.001*
Median	3.0		5.0		0.0			

(--) Test result not valid **(*) Statistically significant at p<0.05**
(H) Kruskal Wallis test

Table (4): Compliance with the Use of Personal Protective Equipment (PPE) as Observed Among Participants in the Study Sample (n=70)

Compliance with PPE use	Job						x^2	p-value
	Nurse (n=10)		technician (n=43)		physician (n=17)			
	No.	%	No.	%	No.	%		
Wear gloves all times	0	0.0	0	0.0	1	5.9	--	--
Wear lead aprone all times	0	0.0	6	14.0	3	17.6	--	--
Wear suitable mask	0	0.0	0	0.0	0	0.0	0.00	1.00
Wear appropriate monitoring badge	0	0.0	8	18.6	1	5.9	--	--
Wear head cap	0	0.0	0	0.0	0	0.0	0.00	1.00
Wash hands after each procedure	0	0.0	0	0.0	0	0.0	0.00	1.00

(--) Test result not valid

Table 5: Correlation Matrix of Scores of Knowledge, Hazards, Health Problems, PPE used, and compliance

Variables	Spearman's rank correlation coefficient				
	Knowledge	Hazards	Problems	PPE	Compliance
Knowledge score					
Hazards	.331**				
Health problems	0.06	0.11			
PPE used	0.00	0.30	0.15		
Compliance score	-0.05	-.263*	0.12	-0.15	

(**) statistically significant at p<0.01 **(*) Statistically significant at p<0.05**

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