Ionizing Radiation Hazards among Radiology Health Team

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Abstract

Background: Ionizing radiation is an energy type in the form of electromagnetic waves or particles. Ionizing radiation as a diagnostic tool in medical fields leading to different health hazards to radiology health team. **Aim of the Study:** To assess the ionizing radiation hazards among Radiology Health Team. **Subject and Methods:** A descriptive research design was utilized. **Setting:** The study was conducted in radiology departments in 4 urban hospitals at Fayoum city: (surgical Fayoum university hospital, medical Fayoum university hospital, Fayoum Health Insurance hospital, Fayoum General Hospital). **Sample**: A purposive sample of all available radiology health team who are working with X-Ray devices in the selected settings. The total sample reached 150 of radiology health team. **Tools:** Three tools were used; 1st tool Ionizing Radiation Hazards Structured Questionnaire which included:1- socio-demographic characteristics,2- Radiology health team' medical history,3- Radiology health team' knowledge regarding ionizing radiation. 2nd tool Observational checklist of the ionizing radiation protection practices among radiology health team. 3rd tool Observational checklist of Environmental safety. **Results:** the studied sample ' age ranged between 20 and 55 years old, with mean 34.04 ± 8.83 years. 40.7% of the studied sample were aged between 30 and 39 years old, with slightly more male 62.0%. job title, 43.3% were radiology technician, radiologist 23.4%, nurse 33.3 and had 6 to 10 years of experience 30.7%. Hazards exposure 53.5% of the studied sample reported physics hazards followed by biological and physical hazards 39.3% then chemical hazards 22.0%. 52.0% of the studied sample had satisfactory knowledge regarding ionizing radiation and 48.0% of them had unsatisfactory knowledge regarding ionizing radiation. 68.0% in the study sample had inadequate practicing regarding ionizing radiation protection and 32.0% of them had adequate practicing regarding ionizing radiation protection. Results portrays that the environmental safety was adequate in only Fayoum insurance hospital 25.6% compared with other studied hospitals **Conclusion:** There was negative correlation between knowledge and health problems**.** knowledge had positive correlations with practices, also work hazards and health problems **Recommendation:** Educational programs about ionizing radiation hazards and protection practices should be provided obligatory to all radiology health team prior to work.

Keywords: Ionizing radiation, Ionizing radiation hazards, Radiology Health Team.

Introduction

Ionizing radiation (IR) is a type of energy released by atoms that travels in the form of electromagnetic waves gamma or X-rays or particles neutrons, beta or alpha. The spontaneous disintegration of atoms is called radioactivity, and the excess energy emitted is a form of ionizing radiation. Unstable elements which disintegrate and emit ionizing radiation are called radionuclides **(Matthias et al., 2020).**

Medical use of radiation accounts for 98 % of the population dose contribution from all artificial sources, and represents 20% of the total population exposure. Annually worldwide, more than 3600 million diagnostic radiology examinations are performed, 37 million nuclear medicine procedures are carried out, and 7.5 million radiotherapy treatments are given. Ionizing radiation plays an important role in the modern world. The use of X-rays brought about a revolution in diagnostics **(WHO, 2016).**

The first category of IR effects consists of exposure to high doses of radiation over short periods of time producing acute or short term effects while the second category represents exposure to low doses of radiation over an extended period of time producing chronic or long term effects .The long-term effects of radiation are those which may manifest themselves years after the original exposure **(Chaturvedi & Jain, 2019).**

IR 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 has 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 **(Eliwa, 2018).**

The risks of radiation are reduced by using different methods of protection like the principles of distance, and time as well as the use of various monitoring devices such as thermo-luminescent dosimeters (TLDs) and Geiger Muller GM) counters. Shielding personal protective equipment include lead aprons, eye goggles, lead gloves, gonad shields, and thyroid shields. Regular use of lead aprons provides an average of 75–80% protection to the bone marrow. Lead shielding is an important protective measure against radiation exposure **(Ria et al., 2017).**

Nursing represents a significant professional resource that can help facilitate positive changes in ionizing radiation prevention strategies. Occupational health nurses are members of the communities where they work, should be selected by the communities, should be answerable to the communities for their activities, should be supported by the health system but not necessarily a part of it, the most frequently identified roles of occupational health nurses are health education, health services provision, and individual navigation and support **(Cavli et al., 2021).**

Occupational health nurse have a commitment to empower radiology health workers with knowledge and safe care. Contemporary nursing requires that nurses possess knowledge and skills in a variety of areas to enable them to meet this commitment. Occupational health nurse have a vital role to play in encouraging radiology health workers to become more aware about radiation hazards. Their health promotion activities in the area of radiation hazards awareness can have a substantial impact on the uptake of screening initiatives **(Kahkhaei & Sarani, 2020).**

Significance of the study

According to WHO, 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.

Aim of the study

The aim of the study is to assess the ionizing radiation hazards among radiology team through:

1) Assessing radiology team' health status related to the ionizing radiation hazards.
2) Assessing the radiology team' knowledge about ionizing radiation hazards.
3) Assessing the radiology team' practices towards safety measures of protection from ionizing radiation hazards.
4) Assessing radiology team' work environmental safety related to ionizing radiation hazards.

Research Questions:

1. Is there a relation between radiology team' socio-demographic characteristics and their practices about ionizing radiation hazards?

2. Is there a relation between radiology team' knowledge and their health status related to ionizing radiation hazards?
3. Is there a relation between radiology team' practices and their health status associated with safety measures for ionizing radiation?
4. Is there a relation between radiology team' knowledge and their practice related to ionizing radiation hazards?

Research Design

A Descriptive design was utilized for this study.it was used to observe, describe and document the data as it naturally occurs.

Subjects and Methods

A. Study Settings

This study was conducted in radiology departments in 4 urban hospitals at Fayoum city: (surgical Fayoum university hospital, medical Fayoum university hospital, Fayoum Health Insurance Hospital, Fayoum General Hospital).

B.Subjects

Purposive sample of radiology health team was used from radiology departments in the 4 selected Fayoum City Hospitals. 40 in surgical Fayoum university hospital, 30 in medical Fayoum university hospital, 40 in Fayoum Insurance hospital, 40 in Fayoum General hospital. Total sample size is (150) persons. 50 were nurses who working with ionizing radiation devices in the selected settings**.**

Technical Design

It Included research design, study settings, subject and tools of data collection.

Tools of the study

Three Tools were used to achieve the purpose of this study:-

Tool I: Ionizing radiation hazards structured questionnaire:

It was developed by the investigator after reviewing the related national and international literature. It was written in a simple Arabic language to suit the understanding level of the study subjects.

It entails three parts as the following:

Part 1: Demographic characteristics as regards age, educational level, marital status, income, work experience and training courses.

Part 2: Radiology health team medical history as regards past and present history (Health status) which Includes: thyroid disorders, presence of anemia, infections, sleep disorders, psychological disorders, chemo-therapy radiations, menstrual problems, abortion, fetus malformations, and vision problems.

Part 3: Radiology health team' knowledge regarding ionizing radiation which includes definition, types of radiation, its effect, types of hazards, complications, safety measures and protection practices.

❖ **Scoring system:**

A scoring system was followed to assess health team' knowledge regarding ionizing radiation. The questionnaire was contained of 5 questions, the total scores of the questionnaire were 5 grades, the right answer was scored as a single point and the wrong answer was scored as a zero point. These scores were summed and were converted into a percent score.

It was classified into 2 categories:

- Satisfactory level of knowledge if score ≥ 70%.
- Un Satisfactory level of knowledge if score < 70%.

Tool II: Observational checklist of the ionizing radiation protection practices applied among radiology health team:

It contains the protection practices undertaken by the radiology team (wearing apron….) adopted from International commission of radiation protection **(ICRP, 2015).**

The Observational checklist of the ionizing radiation protection practices applied by radiology health team was contained 3 stages (before, during and after dealing with the radiation), 34 statements, the total score was 34 grades. 9 statements before dealing with radiation, 12 statements during radiography and 13 statements after

radiography. Each statement was scored as "Yes" was taken one score, "No" was taken zero score and "Not available" was taken zero score. The scores of the items were summed up and were converted into a percentage score.

It was classified into two categories:

- **Adequate** practice if score ≥ 70%.
- **Inadequate** practice if score < 70%.

Tool III: Observational checklist of Environmental safety.

It was adopted from **(Environmental protection Agency, 2015)** to assess the ionizing radiation settings to ensure protection of the radiology health team, such as radiographers, radiologists, nurses and medical physicists.

❖ **Scoring system:**

The Observational checklist of Environmental safety was contained of 39 statement, 14 for the design of the workplace, 6 for personal protective clothing and equipment, 3 for personal surveillance devices and 16 for records and registrations the total score was 39 grades. Each statement was scored as "Found" was taken score 2, "Insufficient" was taken one score and "Not found" was taken zero score. The scores of the items were summed up and were converted into a percentage score.

It was classified into two categories:

- **Adequate** environmental safety ≥ 60 %
- **Inadequate** environmental safety < 60%

Operation design

It included operational design for this study consisted of four phases, namely preparatory phase, ethical considerations, pilot study, and fieldwork.

Tools Content and face validity and reliability

Validity: A group of experts in the community health nursing departments ascertained the content's validity; their opinions were elicited regarding the format, layout, consistency, accuracy, and relevancy of the tools.

Reliability analysis by measuring of internal consistency of the tool through **Cronbach's Alpha test.**

Preparatory Phase

This phase included reviewing of literature related to nurses' ionizing radiation hazards and protection practices using articles, periodicals, magazines and internet. This served to develop the study tools for data collection. During this phase, the researcher also visited the selected places to get acquainted with the personnel and the study settings. Development of the tools was under supervisors' guidance and experts' opinions were considered.

Administrative design

An official permission to conduct the study obtained from the director of the study settings. The researcher met the hospital director and explained the purpose and the methods of the data collection**.**

Ethical consideration

Verbal approval was obtained from the radiology health team before inclusion in the study; a clear and simple explanation was given according to their level of understanding. They secured that all the gathered data was confidential and used for research purpose only. The researcher was assuring maintaining anonymity and confidentiality of subjects' data included in the study. The subjects were informed that they are allowed to choose to participate or not in the study and they have the right to withdrawal from the study at any time.

Pilot Study

Carried out on 15 radiology health team those represent 10% of radiology health team. In order to test the applicability of the constructed tools and the clarity of the included questions related to ionizing radiation hazards among radiology health team. The pilot has also served to estimate the time needed for each subject to fill in the questions. According to the results of the pilot, some corrections and omissions of items were performed so the pilot radiology health team was included in the main study sample.

Fieldwork

Data were collected in four months, from the beginning of June2020 to the end of December 2020.The researcher first met with the radiology health team at the previously mentioned settings, explained the purpose of the study after introducing herself. The researcher was visiting the study setting once in week on Tuesday from 10 a.m to 2 p.m. The questioner for knowledge was filled by nurses which take 15-20 minutes, while the checklist for assessing the radiology health team ionizing radiation protection practices among radiology health team were filled by the researcher in 4 months, one month in each hospital, once a week, in about 2-3 hours while radiology health team given radiation service from 10 am to 2 pm and about 10 of the study sample were included per day, while observational checklist of environmental safety were filled by the researcher in 40-45 minutes in each hospital.

Statistical analysis

Data collected from the studied sample was revised, coded and entered using Personal Computer (PC). Computerized data entry and statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 22. Data were presented using descriptive statistics in the form of frequencies, percentages and Mean SD. A chi-squared test is used to determine whether there is a statistically significant difference between the expected frequencies and the observed frequencies in one or more categories of a contingency table. A Spearman correlation coefficient is a numerical measure of some type of correlation, meaning a statistical relationship between two variables.

- Highly significant at p-value < 0.01.
- Statistically significant was considered at p-value <0.05.
- Non-significant at p-value > 0.05.

Results:

Table (1): reveals that, the studied sample' age ranged between 20 and 55 years, with mean 34.04 ± 8.83 years. 40.7% of the studied sample were aged between 30 and 39 years old, with slightly more male 62.0%. Concerning job title, 43.3% of participants were working as radiology technician, radiologist 23.4%, nurse 33.3 and had 6 to 10 years of experience 30.7%.

Figure (1): indicates that 43.3% of the studied sample were radiology technician, nurse 33.3%, and radiologist 23.4%.

Figure (2): demonstrates that 53.5% of the studied sample reported physics hazards followed by biological and physical hazards 39.3% then chemical hazards 22.0%.

Figure (3): portrays that 52.0% of the studied sample had satisfactory knowledge regarding ionizing radiation and 48.0% of them had unsatisfactory knowledge regarding ionizing radiation.

Figure (4): portrays that 68.0% of the studied sample in the study sample had inadequate practicing regarding ionizing radiation protection and 32.0% of them had adequate practicing regarding ionizing radiation protection.

Figure (5): portrays that the environmental safety was adequate in only Fayoum insurance hospital 25.6% compared with other studied hospitals.

Table (2): describes the exposure to physical hazards at work as reported by the studied sample. The highest percentage of physical hazards were attack the nervous system 67.3% especially, headache 92.1% and sleep disturbances 86.1%. Also, 61.3% of the studied sample experienced skin hazards as redness 77.7% and inflammation of skin 57.6%. Musculoskeletal system hazards were reported by 58.0% of the studied sample mostly neck pain among 56.3%.

Table (3a): reveals that 66.0% of the studied sample was having psychological problems, sleep disorders 58.0% and extreme fatigue and low energy 76.8%.

Table (3b): reveals that 16.7% of the studied sample were having

reproductive health problems especially, infertility and ovarian problems among 32.0%. With regard to the effects of current health on work, 67.3% of the studied sample reported effect of current health on work appears in fast fatigue 58.7%.

Table (4a): shows that there is statistically significant relation between the studied sample' practices, job title, years of experience and receiving training program (p=0.002 & p=0.000). It can be noticed that higher percentage of the studied sample who were working as radiology technician 62.5%, had more than 10 years of experience and receiving training program about radiation protection were having adequate practices.

Table (4b): the matrix illustrates the correlation between knowledge, practices, health problems and work hazards; It shows statistically significant negative correlations between knowledge and health problems, as well practices, work hazards and health problems. On the other hand, knowledge had statistically significant positive correlations with practices, also work hazards and health problems.

Table (1): Number and percentage of demographic characteristics of the studied sample of radiology health team (n=150).

Demographic characteristics	No	%
Age:		
20-	48	32.0
30-	61	40.7
40-	35	23.3
>50	6	4.0
Range	**20.0-55.0**	
Mean±SD	**34.04 ± 8.83**	
Gender:		
Male	93	62.0
Female	57	38.0
Marital status:		
Single	34	22.6
Married	105	70.0
Divorced	7	4.7
Widow	4	2.7
Job title:		
Radiologist	35	23.4
Radiology technician	65	43.3
Nurse	50	33.3
Years of experience:		
< 1 year	23	15.3
1- 5 years	40	26.7
6- 10 years	46	30.7
> 10 years	41	27.3

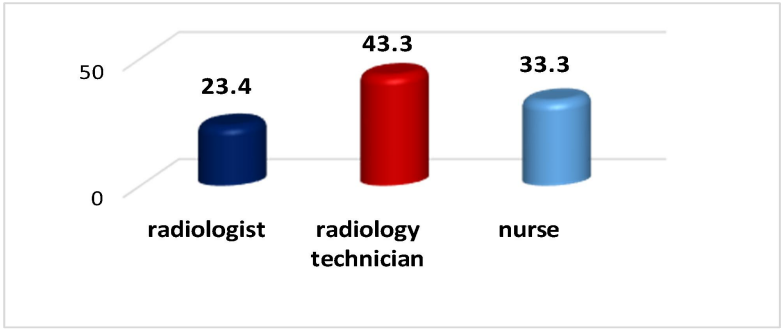

Figure (1): Percentage distribution of studied sample regarding their job title (n=150).

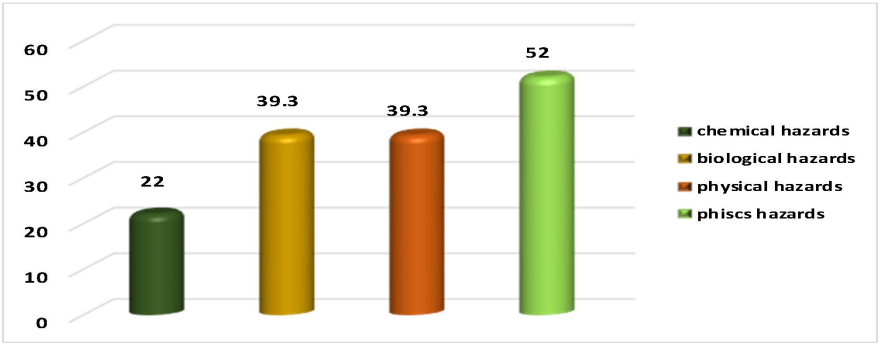

Figure (2): Percentage distribution of hazards exposure at work as reported by the studied sample (n=150).

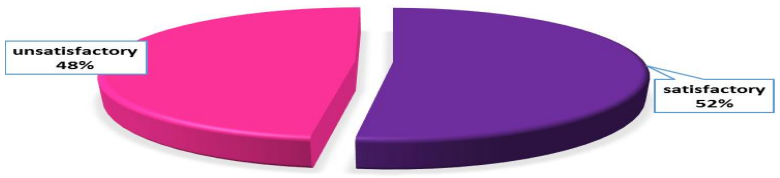

Figure (3): Percentage distribution of Total knowledge regarding ionizing radiation as reported by the studied sample (n=150)

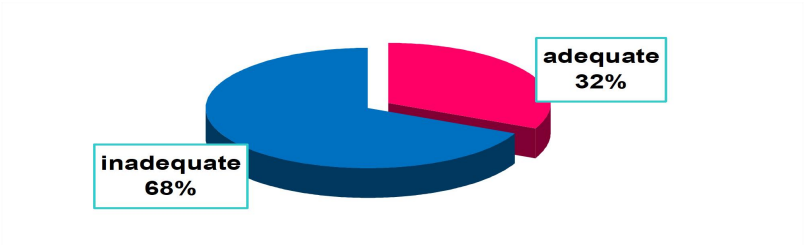

Figure (4): Percentage distribution of total protection practicing regarding ionizing radiation among the studied sample (n=150).

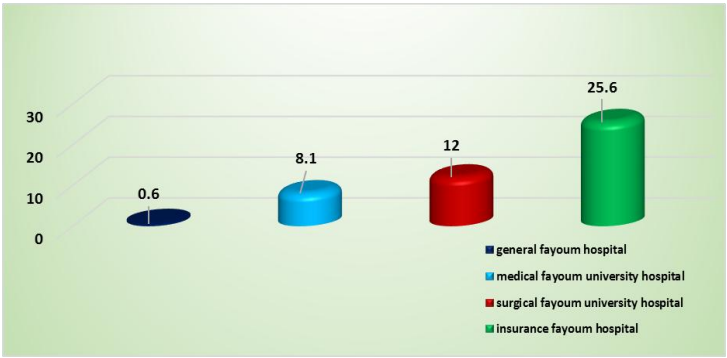

Figure (5): Percentage distribution regarding adequate for environmental safety regarding ionizing radiation in studied hospitals.

Table (2): Number and percentage of exposure to physical hazards at work as reported by the studied sample (n=150).

Physical hazards	No	%
Musculoskeletal system*:		
Lower back pain	44	50.6
Neck pain	49	56.3
Bone pain	37	42.5
Movement problems	11	12.6
None	63	42.0
Skin problems:*		
Inflammation of the skin	53	57.6
Pigmentation and hair loss	41	44.6
Eczema	27	29.3
Redness of the skin	66	77.7
Burns	7	7.6
None	58	38.7
Nervous system:*		
Headache	93	92.1
Sleep disturbances	87	86.1
Dizziness	37	36.6
None	49	32.7
Cardiovascular problems:*		
Arrhythmia	25	52.1
High blood pressure	43	89.6
Angina pectoris	3	6.2
None	102	68.0
The reproductive system:		
Abortion	8	32.0
Infertility	8	32.0
Miscarriage	3	12.0
Delayed pregnancy	6	24.0
None	125	83.3

(*) Not mutually exclusive

Table (3a): Number and percentage of health problems as reported by the studied sample (n=150).

Health status (problems)	No	%
Presence of infection:		
Yes	37	24.7
Signs & symptoms of infection:(n=37)		
• Fever	3	8.1
• Inflammations:		
- Oropharyngitis ulcerous	4	10.8
- Esophagitis	1	2.7
- Oral herpes	3	8.1
- Dermatitis	1	2.7
- Conjunctivitis	3	8.1
• Loss of appetite	8	21.6
• General weakness	5	13.5
• Slow healing of wounds	2	5.4
Presence of sleep disorders:		
Yes:	87	58.0
Presence of psychological problems:		
Yes:	99	66.0
Psychological problems*:		
Severe mood changes	21	21.2
Extreme fatigue and low energy	76	76.8
Sleep problems	87	87.9
Feeling sad or depressed	19	19.2

(*) Not mutually exclusive

Table (3b): Number and percentage of health status as reported by the studied sample (n=150).

Health status	No	%
Suffering from any type of cancer		
No	150	100.0
Presence of reproductive health problems :		
Yes:	25	16.7
infertility	8	32.0
Ovarian problems	8	32.0
Menstrual problems	6	24.0
Deformities of sperms	3	12.0
Changes in the health of the fetus during pregnancy		
Abortion of embryos	8	5.3
Fetus abnormalities	0	0.0
Premature birth	0	0.0
Current health affect your performance at work:		
Yes:	101	67.3
Type of effect:		
Fast fatigue	88	87.1
Continuous absence	13	12.3

Table (4a): Relation between participants' practices and their demographic characteristics (n=150) (Q1).

Demographic Characteristics	Practices				X^2 test	p-value
	Adequate 48 (32.0%)		Inadequate 102(68.0%)			
	No.	%	No.	%		
Age:						
20-	28	58.3	20	19.6	1.8	0.4
30-	18	37.5	43	42.1		
40-	2	4.2	33	32.4		
>50	0	0.0	6	5.9		
Gender:						
Male	6	12.5	87	85.3	1.7	0.52
Female	42	87.5	15	14.7		
Marital status:						
Single	13	27.1	21	20.6	0.14	0.9
Married	34	70.8	71	69.6		
Divorced	1	2.1	6	5.9		
Widow	0	0.0	4	3.9		
Job title:						
Radiologist	18	37.5	17	16.7	11.8	**0.002***
Radiology technician	30	62.5	35	34.3		
Nurse	0	0.0	50	49.0		
Years of experience:						
< a year	1	2.1	22	21.6	56.2	**0.000***
1- 5 years	9	18.7	31	30.4		
6- 10 years	15	31.2	31	30.4		
> 10 years	23	48.0	18	17.6		
Receive training program on radiation protection:						
Yes:						
No:	44	91.7	3	3.0		
	4	8.3	99	97.0	25.8	**0.000***

(*) Statistically significant at p<0.05

Table (4b): Correlation matrix of knowledge, practices, health status, and work hazards scores (Q 2,3,4)

Scores	Spearman's rank correlation coefficient			
	Knowledge	Practices	Health status (problems)	Work hazards
Knowledge				
Practices	**0.16****			
Health problems	**- 0.26****	**-0.34****		
Work hazard	0.11	**-.674****	**0.14***	

(**) Statistically significant at p<0.01

Discussion

The current study revealed the demographic profile of the studied sample revealed that out of 150 participants, more than one-third of the studied sample were aged between 30 and 39 years old, about two-thirds of them were males. More than one third of them were radiology technician, only 23.4% radiologist, and one third of them were nurses. Additionally, about one-third of them had from 6 to 10 years of experience.

Zekioğlu & Parlar (2020) in their study entitled "Investigation of awareness level concerning radiation safety among healthcare professionals who work in a radiation environment a radiation environment at a state hospital, a university hospital and a private hospital in Edirne province" the study demonstrated a contradictory finding. Regarding the occupation of the participants, 18.8% were doctors, 66.0% were technicians, only 10.4% were nurses, only 4.2% were radiation physicists. Additionally, of all the participants, 45.8% were healthcare professionals work in radiology, 19.4% work in cardiology, 20.1% work in radiation oncology and 14.6% work in nuclear medicine. Furthermore, as regard their experience, 29.2% of the participants had less than 3 years, one- quarter of them had 4–10 years, and 45.8% had more than 10 years of experience.

The current work demonstrates that the majority of the studied sample has not had health problems before joining the field of ionizing radiation. On the other hand, after joining the field of ionizing radiation one-third of them suffered from neck pain, nearly two-thirds suffered from headache, nearly one-third suffered from high blood pressure and only 2% suffered from miscarriage. Additionally, about two-thirds of the studied sample was having psychological problems, more than half of them had sleep disorders, and more than two-thirds had extreme fatigue and low energy. Prominently, about one thirds of them had infertility and ovarian problems.

a study entitled "Work-related ill-health in radiographers" aimed to analyze the medically reported incidence of WRIs among radiographers in the UK between 1989 and 2015, done by **Hulls et al., (2018)**. On a total of 131 reported cases, and demonstrated that 88% of cases had musculoskeletal problems, 77% of them had respiratory problems, and 95% suffered from skin problems.

Also, **Chhabra (2016)** in a study titled "Health hazards among health care personnel", Institute of Medical Sciences, Sevagram, Maharashtra, India, argued that radiation had possible effects not only on the fetus, but also on reproductive health in general, realized that radiological toxins may also induce hormonal alterations which might affect other aspects of reproductive health such as menstruation, ovulation, and fertility. Reproductive hazards may cause infertility, miscarriage, and birth defects.

The current study proved that there is statistically significant relation between the studied sample' practices, job title, years of experience and receiving training program with ($p=0.002$ & $p=0.000$). Radiology technician, and participants who had more than 10 years of experience and receiving training program on radiation protection were having adequate practices. Also, it demonstrated that there was a statistically significant negative correlations between knowledge and health problems, as well practices, work hazards and health problems. On the other hand, knowledge had statistically significant positive correlations with practices, also work hazards and health problems.

Abuzaid et al., (2019) in a study entitled "Assessment of compliance to radiation safety and protection at the radiology department" at University of Sharjah, Iran, argued that it is evident that older radiographers, adhere to the personal protection practices to a greater extent with $P<0.0001$. Indeed, higher adherence scores were found among radiographers aged 45 years or above (84.3%±16.2) compared to lower scores for younger radiographers,

those aged less than 25 years old (67.8%±19.9). Similarly, work experience was also found to be correlated with a radiographer's adherence score: where a significantly higher adherence score was observed for more experienced radiographers with *P*=0.001. On the other hand, no significant difference was found regarding the adherence score in relation to the radiographers' educational qualifications, despite of the diversity of educational qualifications observed among the participants.

Masoumi et al., (2018) in a study titled "A survey on the radiation protection status among radiology staff", iran, revealed that no significant difference in the level of radiation protection KAP between male and female radiology staff and among those with different educational levels and ages with (*P*>0.05). However, there was a significant association between radiation protection KAP and working experience, hospital size, and hospital type with (*P*<0.05). Additionally, there was no significant difference was observed in the radiation protection knowledge, attitude, and practice level among radiology staff of different regions (*P*>0.05).

Conclusion

The study concluded that there was a relation between the studied sample' practices, job title, years of experience and receiving training program. There was negative correlation between knowledge and health problems. Participate level of knowledge showed positive correlations with practices, also work hazards and health problems.

It also revealed that 52.0% of the studied sample had satisfactory knowledge level regarding ionizing radiation and 48.0% of them had unsatisfactory knowledge level regarding ionizing radiation.Also, 68.0% in the study sample had inadequate practicing regarding ionizing radiation protection and 32.0% of them had adequate practicing regarding ionizing radiation protection. Results portrays that the environmental safety was adequate in only Fayoum insurance hospital 25.6% compared with other studied hospitals.

Recommendations

Based on the findings of this study, the following recommendations are proposed to the radiology health team who exposed to ionizing radiation.

1- Up-to-date training courses, rigorous adherence to safety precautions, and the availability of all necessary radiation protection equipment among HCWs should be available.
2- Follow up diagnostic and therapeutic radiology personnel that they are required to attend and participate in radiation-related conferences and educational seminars.
3- All HCWs should undergo proper pre-employment and occasional refresher training in radiological safety protocols.
4- It is necessary to enforce rules and regulations, as well as conduct frequent environmental monitoring utilizing survey meters.
5- Emphasis on the use of the equipment for protection against ionizing radiation.
6- Health education is one of the most common roles of occupational health nurses in all types of settings .
7- Periodic checkup of radiology health team for early detection of any health problems.
8- Further wide scale studies are needed to be conducted on other settings in Egypt to have a baseline data about the personal and environmental safety practices undertaken to avoid or decrease the ionizing radiation hazards among radiology health team.

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