

Assessment Knowledge and Practices of Nurses & Technicians regarding Radiation Hazard and its Safety Measure at Main Assuit University Hospital.

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Abstract

Background: Radiation is a health danger in the work setting and in the whole environment. The exposure to ionizing radiation increases causing potential health hazards for patients and staff. Compliance with using health-care and safety guidelines may help reduce the incidence of health-related hazards sequences. **Aim of the study:** Assess knowledge, practice and use the safety measures of nurses and technicians regarding radiation hazards. **Research design:** Description Cross sectional research design was used. **Setting:** It was conducted in Main Assuit University hospital. **Sample:** Random 105 nurses and technicians. **Tools:** Two tools was used, self-administrative questionnaire and observation check list. **Result:** 83.8% of nurses and technicians had poor knowledge and 68.6 % of them had poor practice regarding radiation hazards and its safety measures **Conclusion:** The majority of the nurses and technicians had poor knowledge regarding radiation hazards while more than two thirds of them having poor score of practice. **Recommendations:** Health educational program for nurses and technicians to improve their knowledge and practice about occupational hazard of radiation and preventive measure.

Keywords: Radiation, Safety measure, Knowledge & Practice.

Introduction

Radiation is energy travelling through space, it describes any process in which energy emitted by one body travels through a medium or through space, ultimately to be absorbed by another body. Radioactive is the property of some atoms that causes them to spontaneously give off energy as particles or rays. Radioactive atoms emit ionizing radiation when they decay (US EPA United States Environmental Protection Agency, 2018).

Ionizing radiations are emitted from radioactive atoms and the process is known as radioactivity. Ionizing radiations are composed of two types of energy: Electromagnetic radiation (gamma or X-rays) and particulate radiation (neutrons, beta or alpha particles). In medical practice 20% of the total population is exposed to radiation and this is going to continue to increase all over the world. Annually worldwide, more than 3600 million diagnostic radiology examinations are conducted, 37 million nuclear medicine procedures are performed, and 7.5 million radiotherapy treatments are taken (WHO, 2016).

Occupational exposure to ionizing radiation is the result of exposure at work sites for diagnostic and therapeutic practices. Ionizing radiation is an energy type in the form of electromagnetic waves or particles. Radiographic imaging is extremely valuable as a diagnostic tool in medical fields leading

to different health hazards to health care workers and to the surrounding environment if safety measures are not observed (El-Feky et al , 2017).

Nuclear medicine is a branch of medical imaging that uses small amounts of radioactive material to diagnose and determine the severity of or treat a variety of diseases, including many types of cancers, heart disease and certain other abnormalities within the body. The radioactive material, or radiotracer, may be injected into a vein, swallowed or inhaled as a gas. The radiotracer will accumulate in the organ or area of the body being examined, where it gives off energy in the form of gamma rays, allowing the radiologist or nuclear medicine physician to view structural and functional information about organs or tissues within the body (Kim et al , 2018).

Radiation can damage living tissue by changing cell structure and damaging DNA. The amount of damage depends upon the type of radiation, its energy and the total amount of radiation absorbed. Also, some cells are more sensitive to radiation. Because damage is at the cellular level, the effect from small or even moderate exposure may not be noticeable. Most cellular damage is repaired. Some cells, however, may not recover as well as others and could become cancerous. Radiation also can kill cells (U.S.EPA, 2016).

Health hazards form radiation may occur shortly after exposure or it may delay. Health effects

resulting from chronic exposure has harmful effect on the entire body systems including genetic defects, cancer, benign tumours, skin changes and congenital defects. The more immediate defects may include radiation sickness (haemorrhaging, anaemia, loss of body fluids and bacterial infection (Salih et al, 2017).

Occupational radiation safety measures are necessary for all individuals who work in the radiation departments. This includes not only technologists and nurses, but also individuals who may be in a radiation environment only occasionally. Previous studies shows that there was lack of radiation safety knowledge among radiation exposed nurses and technicians in hospitals . They must also receive education and training appropriate to their jobs and protect by tools and equipment in addition to protection is mandatory; especially with the growing wide spread use of radiation in different medical procedures. (Holmberg et al, 2016).

In Nuclear Medicine Departments (NMDs), nurses care for patients undergoing diagnostic or therapeutic treatments. This involves patient preparation, administering radioactive and non-radioactive medications, explaining the procedure, comforting and ensuring patient safety. These nurses are vulnerable to the damaging effects of ionizing radiation. However, they can reduce the risks of radiation by using different principles of radiation protection (Alotaibi, et al 2015).

Significance of the study:-

Regarding to (Ahmed et al 2016) who conducted study about radiation health hazard in Assuit city which cleared that 22.7% of studied health team suffering from hazards resulting from working radiation departments and 48.5% of them complained from blood diseases also 11.8% of them complained from genital glands diseases that reported high among technicians and nurses. This attribute due to lack of knowledge about radiation hazards and it's safety measures in Assuit University Hospitals in Egypt.

Aim of the study:

Assess knowledge and practice of nurses & technicians regarding radiation hazards and its safety measures.

Objective of the study:

- To assess knowledge of nurses & technicians regarding radiation hazards.
- To assess practice of nurses and technicians about using safety measures in their workplace.

Research question

- Are the nurses and technicians have a knowledge regarding radiation hazard and its safety measure?

-What are the current nurses and technicians' practices regarding radiation hazard and its safety measure?

- Is there relation between nurses and technicians' knowledge about radiation hazards and their practice?

Subjects and Methods

Research design: - Description Cross sectional research design was used in this study.

Study settings: - The study was conducted in diagnostic radiation ,oncology and nuclear medicine departments of Main Assuit University hospital .

Sample: - Random sample was used by simple number generator including the nurses and technicians. The total number of them was 210 divided to 50 nurses and 160 technicians at selected setting. The sample size include 50% from the number of nurses and technicians were be selected by using simple number generator . The final sample size was 105 divided to 25 nurses and 80 technicians

Place	Total number of Nurses	Sample size 50%	Total number of Technicians	Sample size 50%
Diagnostic radiation department	20	10	140	70
Oncology and nuclear medicine department	30	15	20	10
Total	50	25	160	80

Tools of the study:-

Two tools were used to collect data for the study:-

Tool I:- Self-administrative questionnaire sheet was developed by researchers to collect information from the participants. It includes two parts:

Part (1):- This part include personal characteristics of nurses and technicians such as name, sex, age, marital status, occupation , education level, department and years of experience

Part (2):- Knowledge of health team regarding to radiation hazards and it's safety measures such as: definition, types, causes, uses, and effect of radiation on cells. Questions about health safety measures of radiation unit, personal protective equipment and types of occupational hazards and the effect of radiation on health , how to protect them-selves from occupational hazards, sources of information , most common diseases associated with radiation . Question related to using safety measures such as availability of safety measures, periodical checkup, attending training regarding using personal safety measures, lack of follow up supervision and punishment against un used personal safety measures. Knowledge about radiation safety measures such as: health safety

measures of radiation unit, personal protective equipment. Another question about availability of safety measures, periodical maintenance, attending training regarding using personal safety measures, supervision and punishment against un used personal safety measures .

Scoring system

A scoring system was designed for the assessment of knowledge was 31 questions. One degree was given for each correct answer and zero was given for an incorrect answer. The score of each item summed-up and then converted into a percent score. Poor score of knowledge: if score less than 50%, Fair score of knowledge: if score is from 50-70% and Good score of knowledge: if score more than 70% (Ahmed et al, 2016).

Reliability:-

The value of Alpha cronbach methods for knowledge questionnaire was $r_1 = 0.861$ this indicates high index of questions' reliability and their efficiency on expressing studied participants knowledge's regarding radiation hazard and its safety measure.

Validity:-

Valid according to (Ahmed et al, 2016).

Tool II: - Observation check list was developed by researchers to collect data related to practice of nurses and technicians regarding to use of radiation safety measures during their work. It was Includes protective measures as, wearing gloves, suitable mask, applying gown & apron and hand washing.

Scoring system

Regarding to total scoring for all procedures among studied sample practice was 42 questions. One degree was given for each done and zero was given for not done. The score of each item summed-up and then converted into a percent score. Poor score of practice: if score less than 50%, fair score of practice: if score is from 50-70% and Good score of practice: if score more than 70% (Aidaros et al, 2017)

Reliability:-

The value of Alpha cronbach methods was $r = 0.769$ at significant level at $P < 0.01$, this indicates high index of questions' reliability and their efficiency on expressing studied participants practices about radiation safety measures.

Validity:-

Valid according to (Aidaros et al , 2017)

Methodology:

Administrative process phase: An official letter approval obtains from dean of the Faculty of Nursing in Assuit to director of Main Assuit University hospital, director of diagnostic radiation, oncology and nuclear medicine departments.

Pilot Study: A pilot study was carried out before starting data collection on (10%) of study participants at setting of radiation in two departments they included in the study sample. It aimed to test the clarity and applicability of including question and statement, content, feasibility and consistency of the tools to detect any ambiguity in the study tools. The pilot study has also served to estimate the time required to fill the form. There weren't modification was done .

Data collection Phase**Ethical considerations**

Research proposal was approved from Ethical Committee in the Faculty of Nursing. There is no risk for study subject during application of research. Oral consent was obtained from guidance that is willing to participate in the study, after explaining the nature and purpose of the study. Confidentiality and anonymity were assured. Study subject have the right to refuse or participate and withdraw from the study without any rational reason at any time. Study subject privacy was considered during collection of data.

Field work

Data was collected during the period from the first of December 2020 to the end of March. The researchers introduce themselves and explain the purpose of the study for the participants. The average of time taken for completing each sheet was around 15-20 minutes. Through three days / week 5 sheet and observation check list was finished daily. Observation check list done by the researchers themselves to assess nurses and technicians performance during the work toward radiation safety measures on the actual and clinical situation of their work setting.

Statistical analysis:

The data obtained were reviewed, prepared for computer entry, coded, analyzed and tabulated. Descriptive statistics (i.e., percentage and mean standard deviation, etc.) was done using computer program SPSS version 22. Chi-square used to compare differences in the distribution of frequencies among different groups. Relevant statistical tests of significance were used to identify the relations among the study variables. It was considered significant when p- values were less than 0.05 and to identify the significance of the relations, associations, and interactions among variables.

Table (1): Personal characteristics of the study nurses and technicians at Main Assiut university hospital 2021

Variables	No. 105)	%
Age: (years)		
< 30	40	38.1%
30 – 40	30	28.6%
> 40	35	33.3%
Mean ± SD (Range)	36.54 ± 11.75 (22.0-58.0)	
Sex:		
Male	63	60.0%
Female	42	40.0%
Marital status:		
Single	26	24.8%
Married	79	75.2%
Years of marriage	N=79	
< 10	33	41.8%
10 – 20	19	24.1%
> 20	27	34.2%
Mean ± SD (Range)	15.09 ± 10.46 (1.0-36.0)	
Level of education:		
University education	16	15.2%
Secondary education	18	17.1%
Technical institute of health	71	67.6%
Work place:		
Diagnostic radiation	80	76.2%
Nuclear medicine and oncology unit	25	23.8%
Occupation:		
Nurses	25	23.8%
Technicians	80	76.2%
Years of experience in radiation therapy:		
< 10	54	51.4%
10 – 20	25	23.8%
> 20	26	24.8%
Mean ± SD (Range)	13.15 ± 10.85 (1.0-34.0)	
Attending training courses about radiation therapy:		
Yes	8	7.6%
No	97	92.4%

Table (2): Knowledge of the study nurses and technicians about radiation unit Safety Measures at Main Assiut university hospital 2021

Variables	No.(105)	%
Safety Measures for radiation unit:#		
A warning signs	32	35.6
The department separate & ventilated	21	23.3
The space must be sufficient	19	21.1
The work surface is separated	28	31.1
A wash basin in room	9	10.0
Lead walls and glass	59	65.6
A protective barrier	42	46.7
Special containers for keeping radioactive materials	7	7.8
Sewage system	11	12.2
Monitoring devices	26	28.9
Disposing of radioactive waste	21	23.3
Not eating and drinking in room	18	20.0
Warning devices	28	31.1
Don't know	24	26.7

More than one answer was allowed.

Table (3): Knowledge of the study nurses and technicians about personal protective equipment at Main Assuit university hospital 2021

Variables	No. (105)	%
Personal protective equipment:		
Present	105	100.0%
Not Present	0	0.0%
Criteria of Personal protective equipment		
Enough	6	5.7%
suitable for use	103	98.1%
Periodic maintenance	79	75.2%
Person responsible for maintenance of radiation equipment:		
Physicist	45	57.0%
Maintenance Officer	7	8.9%
Safety Officer	14	17.7%
Nursing supervisor	13	16.5%
Attending educational programs		
Attending training courses	18	17.1%
Seminars or lectures on the radiation risk	2	1.9%
If there is supervision for use personal protective equipment and environmental tools:		
Yes	101	96.2%
No	4	3.8%
Person who responsible for supervision: ≠		
		N=101
Safety officer	72	71.3%
Head of Department	4	4.0%
One of my collage	15	14.9%
Physicist	34	33.7%
Infection control officer	22	21.8%
Punishment for non-use personal protective equipment.		
Exposed to punishment	45	42.9%
Non - exposed to punishment	60	57.1%
Types of punishment. ≠		
		N=45
Delay in the upgrade	4	8.9%
Deducting a sum of money	44	97.8%
Deprivation of vacation	2	4.4%

More than one answer was allowed.

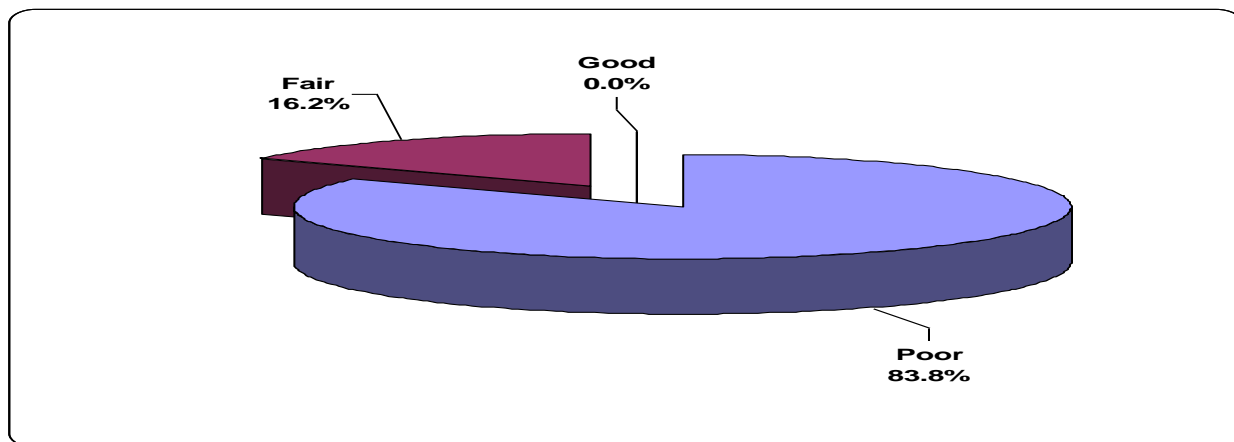


Fig (1): Total score of knowledge’s about radiation hazards among studied nurses and technicians at Main Assuit university hospital 2021

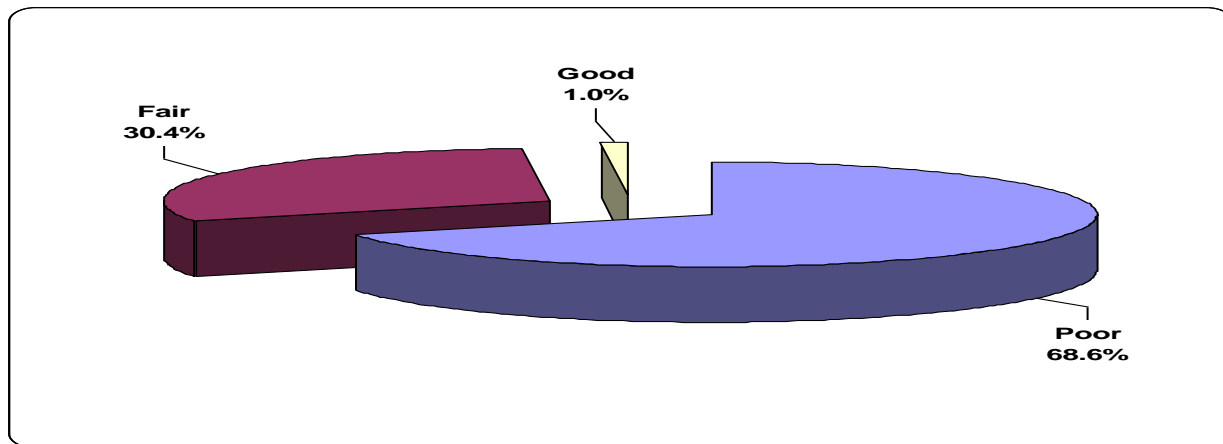


Fig (2): Total score of practice about radiation safety measures among studied nurses and technicians tests at Main Assiut university hospital 2021

Table (4): Relationship between level of education for study nurses and technicians with doing periodic medical examination and exposure to occupational diseases at Main Assiut university hospital 2021

Variables	Level of education						P-Value
	University Education N=16		Secondary Education N=18		Technical Institute of health N=71		
	No.	%	No.	%	No.	%	
Periodic medical examination:							
Yes	5	31.3	11	61.1	6	8.5	0.000*
No	11	68.8	7	38.9	65	91.5	
Frequency of examination: N=22							
Every six months	3	60.0	2	18.2	6	100.0	0.005*
Every year	2	40.0	9	81.8	0	0.0	
Diseases resulting from working in department of radiology:							
Yes	3	18.8	14	77.8	21	29.6	0.000*
No	13	81.3	4	22.2	50	70.4	
Types of Diseases:# N =38							
Skin diseases	2	66.7	8	57.1	8	38.1	0.425
Eye diseases	3	100.0	9	64.3	15	71.4	0.464
Blood diseases	3	100.0	13	92.9	14	66.7	0.114
Heart disease	1	33.3	12	85.7	13	61.9	0.131
Genital gland	0	0.0	4	28.6	0	0.0	0.022*

More than one answer was allowed.

Test of significant: Chi- square test

(*) statistical significant different at P value ≤ 0.05 .

Table (5): Relationship between years of working experience of study nurses and technicians with doing periodic medical examination and exposure to occupational diseases at Main Assiut university hospital 2021

Variables	Years of experience in radiation therapy						P-Value
	< 10 N=54		10 – 20 N=25		> 20 N=26		
	No.	%	No.	%	No.	%	
Periodic medical examination:							
Yes	11	20.4	5	20.0	6	23.1	0.953
No	43	79.6	20	80.0	20	76.9	
Frequency of examination: N=22							
Every six months	5	45.5	2	40.0	4	66.7	0.620
Every year	6	54.5	3	60.0	2	33.3	

Variables	Years of experience in radiation therapy						P-Value
	< 10 N=54		10 – 20 N=25		> 20 N=26		
	No.	%	No.	%	No.	%	
Diseases resulting from working in department of radiology:							
Yes	12	22.2	7	28.0	19	73.1	0.000*
No	42	77.8	18	72.0	7	26.9	
Types of Diseases:# N=38							
Skin diseases	3	25.0	5	71.4	10	52.6	0.120
Eye diseases	8	66.7	4	57.1	15	78.9	0.510
Blood diseases	11	91.7	7	100.0	12	63.2	0.053*
Heart disease	7	58.3	3	42.9	16	84.2	0.087
Genital gland	3	25.0	1	14.3	0	0.0	0.082

More than one answer was allowed.

Test of significant: Chi-square test

(*) statistical significant different at P value ≤0.05.

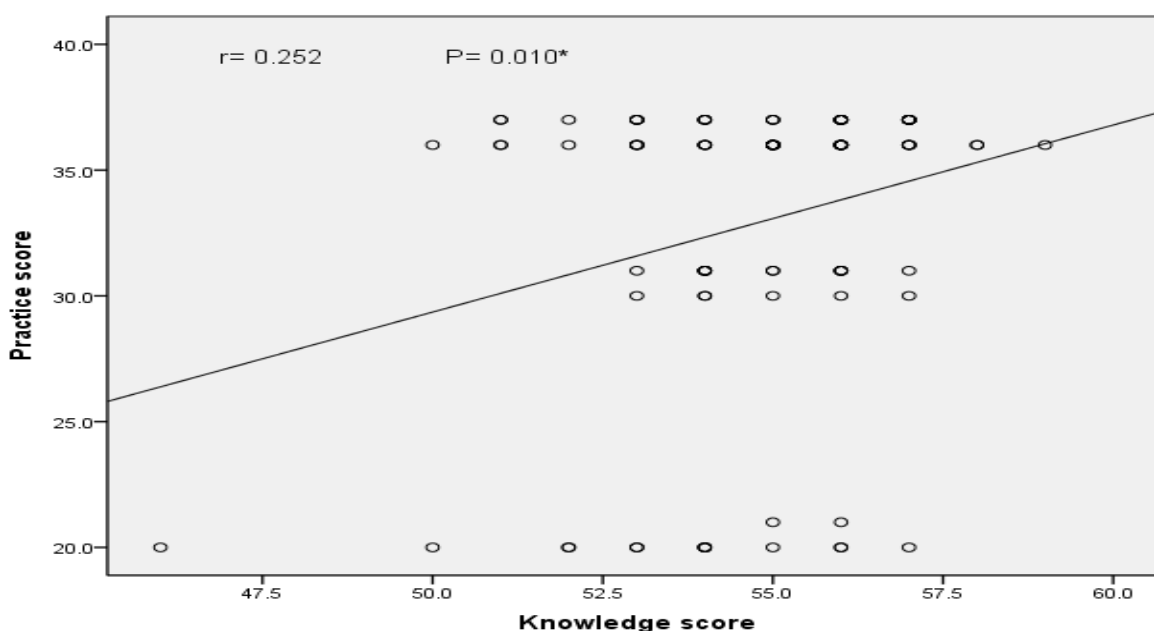


Fig (3):Pearson Correlation between knowledge’s and practices about radiation safety measures among studied nurses and technicians at Main Assiut university hospital 2021

Table (1): Showed that 38.1 % of the studied nurses and technicians aged < 30 years followed by 33.3% aged > 40years.As well as 60% of them were male. Regarding marital status it was observed that 75.2% of them were married and 67.6% of the them had technical institute. Also 51.4% had job experience less than 10years and 24.8% of them had job experience more than 20 years. It was noticed that only 7.6% of study nurses and technicians had attending training courses about radiation.

Table (2): Revealed that 65.6 % of the study nurses and technicians stated that was lead walls and glass for safety measures of radiation unit, followed by 46.7% 35.6% respectively mentioned that there were a protective barrier and warning signs . While

26. 7% don’t know safety measures for radiation unit.

Table (3): Found that all of study nurses and technicians said personal protection were present. Regarding to criteria of protective measures equipment it was observed that 5.7% of them said it was enough. Also the vast majority (98.1%) of them said that personal protective tools were suitable for use and 75.2% said there were periodic maintenance. Concerning to attending educational program it was fond that 17.1% had attending training courses for use personal and only 1.9% of them reported that department made seminars or lectures about the radiation risk. As regards to supervision on use of personal protective tools it was found that 96.2%

said was present and 71.3% of them said that the safety officer was responsible for supervision.

Fig. (1): It was found that 83.8 % of studied nurses and technicians had poor knowledge about radiation hazards.

Fig. (2): It was clarified that 68.6% of studied nurses and technicians had poor practices about radiation safety measures

Table (4): It was clear that there were statistical significant difference between periodic medical examination, frequency of examination and exposed diseases resulting from working in department of radiology with level of education p-value=(0.000, 0.005 and 0.000) respectively

Table (5): It was observed that there were statistical significant difference between diseases resulting from working in department of radiology with years of experience p-value=(0.000) and not significant difference between types of disease and years of experience in radiation therapy expect blood diseases p-value=(0.053).

Fig. (3): Illustrates that there was a positive correlation between total score of studied nurses and technicians knowledge and total score of studied sample practices regarding radiation safety measures with high statistically significant difference ($r=431$, $p = 0.000$).

Discussion

Radiation is a health danger in the work setting and in the whole environment. The extent of danger depends on the dose and type of radiation. Radiation has different health risks, which are affected by the dose level and exposure time; these include cancer, cataract, infertility and blood disorder genetically determined ill-health, developmental abnormalities, and degenerative diseases (Alzubaidi et al., 2017).

The findings of the present study showed that about one third of the studied nurses and technicians age were under 30 years old with mean age is (36.54 ± 11.75) years, which agree with Rahimi et al, (2021) who done his study to assess Malaysian nurses' knowledge of radiation protection and found that about one third of studied nurses' age was less than 30 years old.

The findings of the present study revealed that more than one third were females of the studied nurses and technicians . This finding is in contrast to Shaban & Mostafa (2019) who study about factors affecting compliance level regarding radiation standard precautions measures . and mentioned in his study that the majorities of the study samples were female. This can be rationalized by recently the number of male increase in nursing profession and technicians that may be distributed on work places with risky and heavy works rather than female .

Concerning educational level of studied nurses and technicians the finding of the current study indicated that the most level of education which was technical workers .This findings agree with the report of Central Agency for Public Mobilization & statistics (2019) about work hazards in Egypt revealed that majority of workers to be risk had secondary or technical level of education.

In contrast with Salah Eldeen & Farouk (2020) who conducted study about assessment of awareness and practice of ionizing radiation protection procedures among exposed health care workers and stating that the majority of his study participants were bachelor's degree who worked in radiation environments .

Regarding years of working experience in radiation therapy, the present study show that approximately half of the study participants had less than 10 years of experience, with most of them working as technicians in diagnostic radiation units, this finding concurrent with Ahmed et al, (2016) who study Evaluation of knowledge and practice of medical teams regarding radiation hazard and its safety measure at Assuit University Hospital and reported that the majority of the sample worked in diagnostic radiation place rather than oncology units with technicians more than nurses. This can be rationalized by that less experience years and less training personnel had higher risky than personnel with more experience years.

Concerning studied nurses and technicians attending radiation therapy training courses. The current study found that only a small number of study participants attended radiation therapy training courses. This agree with Abdellah et al, (2015) who evaluated health team knowledge, attitudes, and practices of radiation safety at Suez Canal University Hospital, It shows that just a small number of health team are given radiation safety training. This can be rationalized by that department didn't made lectures or training courses for the workers As regard to studied nurses and technicians knowledge about radiation unit safety measures the findings of the present study revealed that radiation unit had lead walls and glass , a protective barrier, warning signs, work surface is separated and warning devices and monitoring devices as a safety measures of radiation unit. This was accordance with Durduran et al, (2018) who studied factors affecting the occupational health-safety practice of the hospital workers of radiation therapy and found that barriers, shielding and unit protective measures decreasing the exposure to radiation hazards. This can be rationalized by the participants didn't attending training courses about radiation safety measures

In relation to using personal protective tools the present study was observed that all the participants said personal protection was present, suitable for use but not enough, However, only a small number of them reported that they receiving training courses for using this protective equipment and supervision for using personal protective equipment is the responsibility of the safety officer, these findings are compatible with those of **Fayed et al, (2016)**, who study about effect of instructional programme on health-workers compliance with universal precautions of infection control and reported that lake of supplies used with inadequate training for use and emphasizes the importance of the training program about using personal protective tools.

In current study found that there was statistical significant difference between periodic medical examination, frequency of examination and exposed diseases resulting from working in department of radiology with level of education .Which is agree with the findings of **Mohammed et al (2018)** who study about occupational health hazards and protective measures among radiation health team and found there was statistical significant difference between exposed diseases resulting from working in department of radiology with level of education and most exposure were technicians . This can be rationalized by in present study exposed many of nurses and technicians to occupational disease due to lack of periodic medical examination.

In the present study there were significant statistical differences between diseases resulting from working in department of radiology with years of experience p -value=(0.000) and there were significant statistical differences between the exposure participants and blood diseases p -value=(0.05). This result agree with **Reagan, (2017)** who found that years of employment in radiological were significantly to adherence with safety practices. And agree with **Mohammed et al, (2018)** who declared that three fifths of technicians and half of nurses had blood problems, mainly anemia. These findings may explained by that the long working in radiation therapy so they consider risk factors to occupational disease.

Concerning to the total score of knowledge's among studied nurses and technicians about radiation hazards which indicated that the majority had poor score of knowledge which agree with **Esfahani et al, (2020)** who study the effectiveness of a radiation safety training program in increasing the radiation safety and confirmed that pretest knowledge and awareness about radiation safety was low and indicated that the training program was more important. This can be rationalized by lack of training courses .

As regard to the total score of practice about radiation safety measures among studied nurses and

technicians was shown that slightly more than two thirds had poor level of practice. These findings are similar to **Hirvonen et al, (2019)**, who study the majority of participants had poor score of practice so the importance of education in establishing safe medical radiation procedures are critical. These findings may explained by un availability of preventive equipment in the departments.

Related the correlation between knowledge and practices about radiation safety measures among studied nurses and technicians, the present study revealed that there was a positive correlation between knowledge and practices at ($P = 0.000$), as the same context as studies done by **Fayed et al, (2016) & Ahmed et al, (2016)**. On the opposite way with **Yousef et al, (2021)**, who illustrated in his study that no statistical significant difference between knowledge and practices in his study.

Conclusion

According to the finding of the study found that majority of the nurses and technicians had poor knowledge regarding radiation hazards while more than two thirds of them having poor score of practice and there was a positive significant relationship between knowledge and practice among the studied nurses and technicians regarding radiation safety measures.

Regarding to level of education of study participants it was found that a few number of them doing periodical examination especially technicians . While the study participants who had more than 20 years of working experiences suffering from many occupational diseases also there was statistical significant difference were found between studied working experience and blood diseases .

Recommendations

Based on the results of present study, it was recommended that

- The hospitals must be provide radiation departments with adequate personal protective equipment to reduce exposure of the studied sample from radiation hazards.
- Periodical follow up and motivate them to wearing personal protective equipment
- Develop a plans for periodical safety measures training courses
- Educational programs for the studied sample member in radiation setting to help in improving their practice and update their knowledge.

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