

In Service Training Program About Radiation Safety Measures Among Nurses and Technicians at Main Assuit University Hospital

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Abstract:

Education and training of staff are important elements to create safety measures as potential contributing factors to risks and hazards of health care associated injury or harm and as intervention used in eliminating or preventing harm.

Aim: to improve knowledge and practices of nurses and technicians about radiation safety measures. **Research design:** Quiz-experimental research design was used. **Setting:** It was conducted in Main Assuit University hospital.

Sample: 105 nurses and technicians selected randomly. **Tools:** Two tools was used, self-administrative questionnaire and observation check list. The study was carried through 3 stages: preparatory, implementation and evaluation stage. **Results:** It showed that 83.8 % of studied participants had poor score of knowledge about radiation safety measures in pretest with improvement in post-test. Also there was statistical significant difference (P-value=0.000) between mean score of pre, post and follow up tests of Radiation Safety Measures program. **Conclusion:** Majority of the studied sample having poor score of knowledge and practice before in service program and improvement in their knowledge and practice occur in posttest and follow up after implementation the program. **Recommendations:** Periodic in-service training program for nurses and technicians about radiation safety measures should be done.

Keywords: *In service Training, Safety measure, Knowledge, Radiation & Practice.*

Introduction:

Radiation is an energy come from unstable atoms or machines can produce it and that travels through the air. While there are many types of radiation, they all fall into one of two classes: ionizing or non-ionizing. Non-ionizing radiation is all around us in forms as diverse as radio waves and visible light and we use many of those forms in our daily life. Ionizing radiation is used in healthcare facilities and manufacturing settings in healthcare, radiation is also used in a wide variety of diagnostic devices, such as CT scanners, and concentrated for the treatment of tumors and cancers (**Safety management group, 2018**).

Radiation work means work in which the radiation exposure of a worker may exceed any of the dose limits for members of the public. External radiation means radiation directed to the human body from outside of the body. Internal radiation means radiation that is emitted by radioactive substances that have entered the body and directed at the body itself. (**Reagan, 2017**).

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. Although all medical interventions have potential benefits but its potential risks should not be ignored (**El-Feky et al, 2017**).

Radiation exposure can cause severe health hazards the extent and severity of these health hazards differ according to radiation dose, dose rate whether acute or chronic exposure rate and surface the exposed body part, whether localized or generalized radiation exposure. 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 (**U.S.NRC, 2018**).

Awareness of works occupationally exposed to ionizing radiation regarding radiation induced health hazards and radiation safety guideline is important, previous studies shows that there was lack of radiation safety knowledge among radiation exposed workers in hospitals. In addition to protection is mandatory; especially with the growing wide spread use of radiation in different medical procedures. Radiation exposure in hospitals account for largest number of workers occupationally exposed to radiation (**Holmberg et al, 2016**)

Safety inspections help to ensure that critical preventive measures in place to reduce the risk of overexposure including environmental design ,visible warning signs, contamination surveys conducted, and device tests for all radiation-producing equipment .All workers must be trained to limit time of exposure, use radiation shields, and increase the distance of contact with radioactive devices and materials and wearing monitoring devices (e.g film badge) to measure cumulative radiation exposure in addition to personal protective devices such as helmet for head protection goggles for eye protection ,ear plugs for ear protection ,mask for lung ,ect (OSHA, 2018).

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:

To improve the knowledge and practices of nurses and technicians about radiation safety measures at Main Assuit university hospital.

Objective of the study:

1. Assess knowledge of nurses and technicians about radiation safety measures

2. Design, implement and evaluate the in –service training program about radiation safety measures.

Research hypothesis:

Hypothesis: The training program will improve the nurses and technicians knowledge and practices about radiation safety measures after implementation it.

Null hypothesis: The training program will haven't any effect on the nurses and technicians knowledge and practices about radiation safety measures after implementation it.

Subjects and Method

Research design:

A quiz -experimental research design was used in this study.

Study settings: This study was conducted in two departments diagnostic radiation and oncology & nuclear medicine at 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:-

Frist tool: - 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 etc....

Part (2): It include nurses and technicians knowledge about radiation and radiation therapy such as: definition, types, and causes of radiation pollution, uses, effect of radiation therapy on cells, most common diseases associated with radiation, sources of information, types of occupational hazards and the effect of radiation on health.

Knowledge about radiation safety measures such as: health safety measures of radiation unit , personal protective equipment. Another question related to

using safety measures such as 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 which include 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).

Second tool: -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% (Aidarooos 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 (Aidarooos 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 12 of study participants at setting of radiation in two departments. 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. A pilot study participants included in the study sample.

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.

Collection of data phase: An explanation of the purpose of the research was done to nurses and technicians to gain their co-operation before starting data collection. Preparation of the in- service training program materials, data collection with pre-test, immediate post-test and follow up test after three months from implementation of the program by using tools (tool(1) and tool (2)) and differentiate between pre , post and follow up tests.

In –services training program

In – service training program developed based on the relevant literature and available resources .

Program's objectives:-

1. Assess knowledge of nurses and technicians about radiation hazards.
2. Assess knowledge of nurses and technicians about safety measures
3. Design and implement the in –service program about radiation safety measures
4. Evaluate the in –service program about radiation safety measures.

Content of the program: include 2 parts;

- A) Theoretical parts include: Definition , uses, types of radiation, sources of radiation at hospital, criteria of radiation unit , medical uses of radiation, health hazards of radiation , safety measures at the unit of radiation and prevention of radiation hazards.
- B) Practical part include: Use the correct method for protective measures for hand washing , wearing gloves , mask , applying gown and apron

The program phases:

Assessment phase:

Based on pretest assessment of nurses and technicians about radiation safety measures. Design the in –service training program to improve the knowledge and practices of nurses and technicians about radiation safety measures by studied tools (tool (1) and tool (2))

Planning phase:

The arrangement of conducting the program was done during this stage; the sessions and time of the program were decided. The studied sample were divided into seven groups including (15) participants in each group that was taking 2weeks, first week for pretest knowledge ,observation checklist and training program through 3days/week include 2session /day take one hours and half contain explanation knowledge and demonstrate practice about radiation safety measures and ended by post test knowledge in the 3rd day . A second week for the same group which divided for (5) participant for post test observation checklist to observe the performance of procedure through 3days/week. Follow up test was done after three months later from finishing the program which finished at the end of June 2021.

Teaching place:

The program was conducted at residence of technicians and nursing room in each department those arrangements were done with the department and study sample

Teaching methods and materials:

Before implementing the in-service training program the researchers prepared simple teaching methods and audio –visual to be used; as lecture, discussion and brain storming. The materials used as power point presentation and videos. Handouts for each participant to help and facilitate teaching .

Implementation phase:

The period of program started from first of December 2020 to the end of June 2021. Phase of delivery of in service training program was implemented to each group. The contents of the program divided into six sessions: **The 1st included:** Pre-test, orientation and introduction about radiation . **The 2nd included:** Definition , uses, types of radiation, sources of radiation at hospital, criteria of radiation unit **The 3rd included:** medical uses of radiation, health hazards of radiation , safety measures at the unit of radiation. **The 4th included:** Use the correct method for protective measures for hand washing and wearing gloves **The 5th included:** Methods of prevention of radiation hazards **The 6th and the last one:** Use the correct method for protective measures for wearing mask applying gown & apron and post test

Evaluation phase:

The evaluation was done through pretest before starting program and immediate posttest which was done after completing the in –service training program to assess the knowledge and practices of nurses and technicians about radiation safety measures. Follow up test was done for each study group after 3 months later of completing the program

for study sample to evaluate the outcome of the program by using tools of the study tool (1) and tool (2).

Statistical analysis: The data obtained were reviewed, prepared for computer entry, coded, analyzed and tabulated by using computer program SPSS version 22. Descriptive statistics (i.e., percentage and mean standard deviation, etc.) Chi-square test used to compare differences in the distribution of frequencies among qualitative variables it is considered * significant when P-values were less than 0.05. Paired samples t-test was done to compare quantitative data between pre-test and post-test .P-value considered statistics statistically significant when $P < 0.05$.

Results

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:		
Nuclear medicine and oncology unit	25	23.8%
Diagnostic radiation	80	76.2%
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): Relationship of the study nurses and technicians Knowledge's about radiation in pre, post and follow-up tests at Main Assiut university hospital 2021.

Knowledge about radiation	Pre-test (n= 105)		Post-test (n= 105)		Follow-up (n= 105)		P-value ¹	P-value ²
	No.	%	No.	%	No.	%		
Definition of radiation:	35	33.3	105	100.0	85	81.0	0.000*	0.000*
Types of radiation:	26	24.8	103	98.1	98	93.3	0.000*	0.000*
Causes of radiation pollution :≠								
The survey meter is not used correctly	45	42.9	104	99.0	72	68.6	0.000*	0.000*
The film badage is not used correctly	37	35.2	104	99.0	36	34.3	0.000*	0.885
The alarm rate meter is not used correctly	33	31.4	104	99.0	37	35.2	0.000*	0.558
A symptom resulting from an overexposure to radiation:≠								
Somatic effects	64	61.0	105	100.0	54	51.4	0.000*	0.164
Biological effects	49	46.7	105	100.0	28	26.7	0.000*	0.003*
Latent effects	65	61.9	105	100.0	72	68.6	0.000*	0.310
Genealogy effects	43	41.0	105	100.0	25	23.8	0.000*	0.008*

More than one answer was allowed.

Test of significant: Chi- square test.

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

P1-value: the relation between pretest and post-test.

P2-value: the relation between pretest and follow up test

Table (3): Relationship of the study nurses and technicians knowledge's about Radiation unit safety measures in pre, post and follow-up tests at Main Assuit university hospital2021.

Knowledge about Radiation unit safety measures	Pre-test (n= 105)		Post-test (n= 105)		Follow-up (n= 105)		P-value ¹	P-value ²
	No.	%	No.	%	No.	%		
Know safety measures of unit radiation:	90	85.7	105	100.0	105	100.0	0.000*	0.000*
Radiation unit safety measures:#								
A warning signs	32	35.6	88	83.8	95	90.5	0.000*	0.000*
The department separate & ventilated	21	23.3	88	83.8	63	60.0	0.000*	0.000*
The space must be sufficient	19	21.1	47	44.8	44	41.9	0.000*	1.000
The work surface is separated	28	31.1	54	51.4	47	44.8	0.000*	0.000*
A wash sink in room	9	10.0	57	54.3	15	14.3	0.000*	0.364
Lead walls and glass	59	65.6	91	86.7	96	91.4	0.000*	0.000*
A protective barrier	42	46.7	51	48.6	56	53.3	0.791	0.353
Special containers for keeping radioactive materials	7	7.8	59	56.2	43	41.0	0.000*	0.000*
Sewage system	11	12.2	68	64.8	55	52.4	0.000*	0.000*
Monitoring devices	26	28.9	94	89.5	90	85.7	0.000*	0.000*
Disposing of radioactive waste	21	23.3	47	44.8	42	40.0	0.000*	0.000*
Not eating and drinking in room	18	20.0	90	85.7	48	45.7	0.000*	0.000*
Warning devices	28	31.1	80	76.2	50	47.6	0.000*	0.000*
Know safety characteristics for radiation devices:	84	80.0	105	100.0	96	91.4	0.000*	0.018*

More than one answer was allowed.

Test of significant: Chi- square test .

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

P1-value: the relation between pretest and post-test.

P2-value: the relation between pretest and follow up test

Table (4): Relationship between total score of nurses and technicians knowledge about radiation hazards and their personal characteristics At Main Assuit university hospital 2021.

Variables	Knowledge score		
	Pre-test	Post-test	Follow-up
	Mean \pm SD	Mean \pm SD	Mean \pm SD
Work place:			
Diagnostic radiation	19.70 \pm 6.34	54.65 \pm 2.00	35.14 \pm 4.86
Nuclear medicine and oncology unit	27.52 \pm 5.25	55.16 \pm 1.95	38.68 \pm 3.08
P-value	0.000*	0.266	0.001*
Age: (years)			
< 30	20.20 \pm 7.24	54.90 \pm 1.57	35.40 \pm 5.41
30 – 40	23.30 \pm 8.07	54.73 \pm 1.93	37.80 \pm 3.92
> 40	21.63 \pm 5.15	54.66 \pm 2.47	35.09 \pm 4.22
P-value	0.181	0.866	0.042*
Sex:			
Male	20.24 \pm 6.66	54.56 \pm 1.82	36.14 \pm 4.60
Female	23.55 \pm 6.94	55.10 \pm 2.21	35.74 \pm 4.99
P-value	0.016*	0.175	0.670
Marital status:			
Single	20.38 \pm 7.13	55.08 \pm 1.52	35.81 \pm 4.76
Married	21.95 \pm 6.87	54.67 \pm 2.12	36.04 \pm 4.76
P-value	0.321	0.370	0.831
Years of marriage:			
< 10	21.70 \pm 8.56	54.73 \pm 1.66	36.55 \pm 5.45
10 – 20	24.53 \pm 5.37	54.79 \pm 2.23	37.16 \pm 4.19
> 20	20.44 \pm 4.91	54.52 \pm 2.58	34.63 \pm 3.98
P-value	0.134	0.897	0.151

Variables	Knowledge score		
	Pre-test	Post-test	Follow-up
	Mean ± SD	Mean ± SD	Mean ± SD
Educational status:			
University education	27.38 ± 6.58	55.00 ± 2.10	37.13 ± 3.22
Secondary education	24.50 ± 4.02	55.44 ± 2.18	38.17 ± 3.49
Technical institute of health	19.51 ± 6.63	54.55 ± 1.90	35.17 ± 5.10
P-value	0.000*	0.208	0.031*
Occupation:			
Nurse	25.36 ± 4.95	55.16 ± 2.39	38.04 ± 3.65
Technician	20.37 ± 7.06	54.65 ± 1.85	35.34 ± 4.87
P-value	0.001*	0.266	0.012*
Years of experience in radiation therapy:			
< 10	20.87 ± 7.01	54.89 ± 1.85	36.50 ± 4.85
10 – 20	23.92 ± 7.83	55.08 ± 1.82	35.48 ± 4.68
> 20	20.73 ± 5.44	54.23 ± 2.37	35.38 ± 4.61
P-value	0.150	0.261	0.516
Training courses:			
Yes	24.63 ± 5.97	54.25 ± 2.25	38.50 ± 1.93
No	21.31 ± 6.97	54.81 ± 1.98	35.77 ± 4.84
P-value	0.195	0.444	0.118

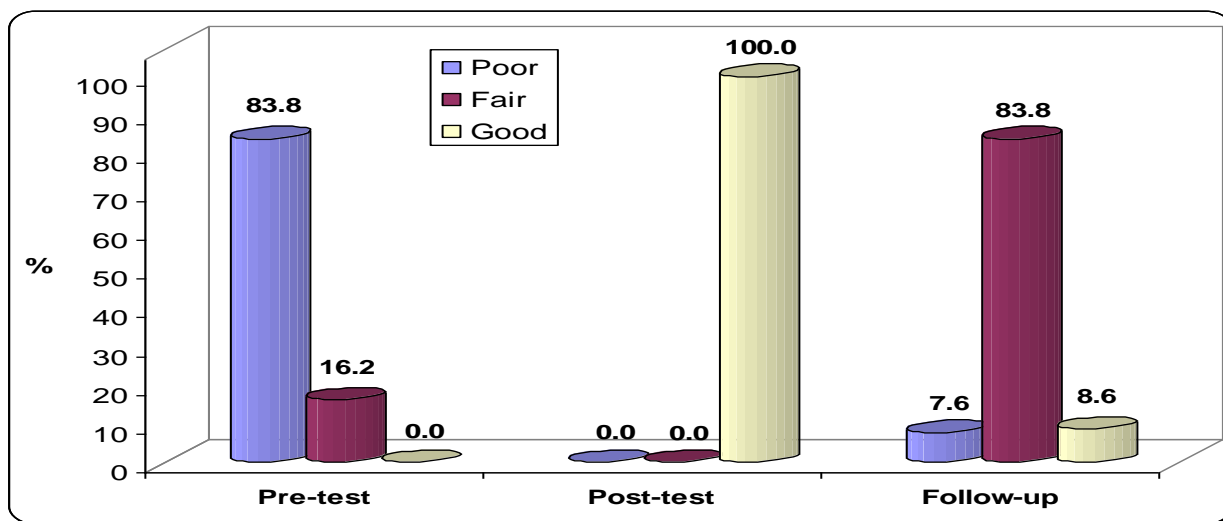


Fig (1): Total score of knowledge's about radiation hazards among nurses and technicians in pre , post and follow up tests at Main Assuit university hospital2021.

Table (5): Comparison between pre, post and follow up test of Mean ± SD of practice about safety measures among nurses and technicians at Main Assuit university hospital 2021

Practice score	Pre-test (n= 105)	Post-test (n= 105)	Follow-up (n= 105)	P-value ¹	P-value ²
	Mean ± SD	Mean ± SD	Mean ± SD		
Hand washing	8.14 ± 0.64	14.43 ± 0.50	12.25 ± 0.82	0.000*	0.000*
Wearing gloves	4.30 ± 1.86	8.48 ± 3.61	6.75 ± 2.95	0.000*	0.000*
Wearing mask	2.67 ± 0.66	6.00 ± 0.00	4.57 ± 0.86	0.000*	0.000*
Applying gown and apron	1.34 ± 1.91	4.00 ± 2.84	4.00 ± 2.84	0.000*	0.000*

Test of significant: Paired sample t- test .

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

P1-value: the relation between pretest and post-test.

P2-value: between pretest and follow up test

Table (6): Relationship between total score of nurses and technicians practices about radiation safety measures and their personal characteristics at Main Assiut university hospitals 2021.

Variables	Practice score		
	Pre-test	Post-test	Follow-up
	Mean ± SD	Mean ± SD	Mean ± SD
Work place:			
Diagnostic radiation	15.19 ± 2.73	31.80 ± 6.35	26.37 ± 5.63
Nuclear medicine and oncology unit	20.48 ± 2.28	36.44 ± 0.51	31.40 ± 1.32
P-value	0.000*	0.000*	0.000*
Age: (years)			
< 30	16.35 ± 2.01	34.85 ± 2.62	29.20 ± 2.89
30 – 40	17.67 ± 1.99	35.40 ± 2.24	30.13 ± 2.93
> 40	15.51 ± 5.14	28.54 ± 8.01	23.51 ± 6.79
P-value	0.041*	0.000*	0.000*
Sex:			
Male	15.78 ± 3.44	32.68 ± 5.98	27.32 ± 5.25
Female	17.45 ± 3.28	33.24 ± 5.79	27.95 ± 5.64
P-value	0.014*	0.638	0.557
Marital status:			
Single	16.65 ± 2.42	35.15 ± 2.41	29.69 ± 2.54
Married	16.38 ± 3.75	32.16 ± 6.48	26.87 ± 5.89
P-value	0.728	0.024*	0.020*
Years of marriage:			
< 10	16.70 ± 1.83	35.09 ± 2.47	29.45 ± 3.01
10 – 20	18.63 ± 2.31	34.89 ± 2.69	29.42 ± 3.32
> 20	14.41 ± 5.15	26.67 ± 8.12	21.93 ± 6.83
P-value	0.000*	0.000*	0.000*
Educational status :			
University education	19.50 ± 2.88	36.13 ± 1.71	30.81 ± 1.97
Secondary education	19.39 ± 0.70	36.39 ± 0.50	31.28 ± 1.36
Technical institute of health	15.01 ± 3.08	31.30 ± 6.53	25.90 ± 5.76
P-value	0.000*	0.000*	0.000*
Occupation:			
Nurse	19.52 ± 0.65	36.44 ± 0.51	31.28 ± 1.21
Technician	15.49 ± 3.42	31.80 ± 6.35	26.41 ± 5.67
P-value	0.000*	0.000*	0.000*
Years of experience in radiation therapy:			
< 10	16.93 ± 2.28	35.54 ± 2.13	30.15 ± 2.25
10 – 20	17.56 ± 1.78	34.12 ± 2.89	28.24 ± 3.62
> 20	14.38 ± 5.44	26.27 ± 8.01	21.58 ± 6.74
P-value	0.001*	0.000*	0.000*
Training courses:			
Yes	19.75 ± 3.99	35.88 ± 2.03	30.13 ± 2.64
No	16.18 ± 3.29	32.66 ± 6.03	27.36 ± 5.51
P-value	0.004*	0.138	0.165

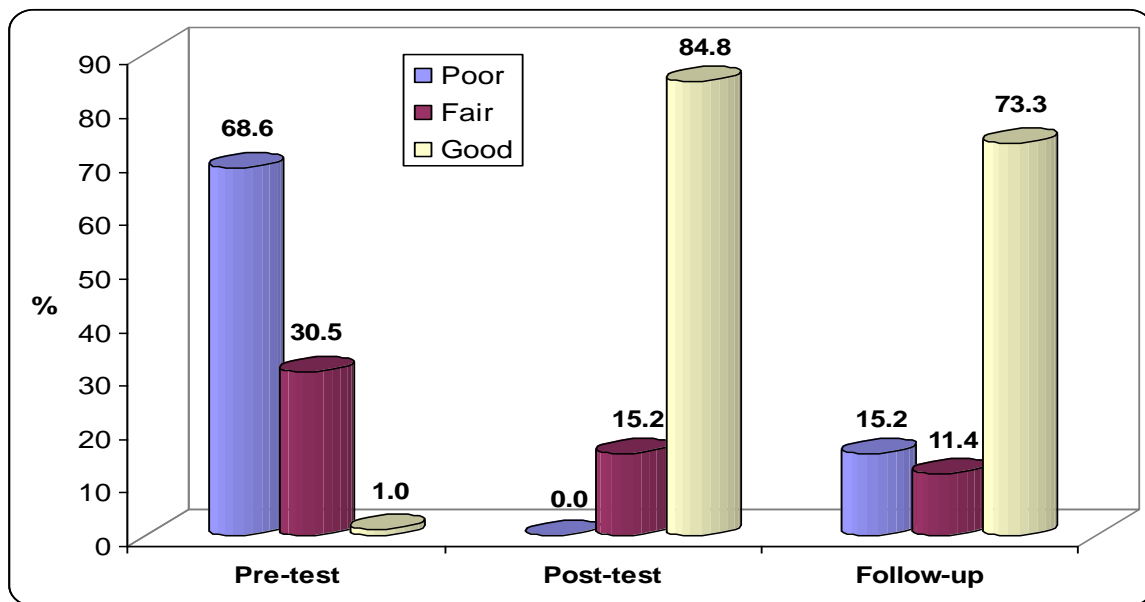


Fig (2):Total score of practice about radiation safety measures among study nurses and technicians in pre , post and follow up tests at Main Assuit university hospital 2021.

Table (1): Shows 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 them had technical institute. Also 51.4% had job experience less than 10 years 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): Shows that on pre test , it was revealed that 33.3%of study nurses and technicians defined radiation. While 24.8% of them had right knowledge's about the types of radiation. Regarding the causes of radiation pollution it was noticed that the survey meter and the film badge that not used are the main cause 42.9%, 35.2% respectively. As well as 61.9%, 61.0% respectively of them said that the latent and somatic effects are symptoms resulting from an over exposure to radiation. On post test , the knowledge of the study nurses and technicians about radiation were improved from pre to post test that 100% of them knew the correct meaning of radiation , 98.1% knew all the types of radiation . Regarding the causes of radiation pollution it was noticed that 99% of them said the survey meter and the film badge that not used correctly are the main cause . In addition 100.0% of them said that the latent and somatic effects are symptoms resulting from an over exposure to radiation

Table (3): Clears that on the pre test, it was found that 85.7% of study nurses and technicians know safety measures for radiation unit . The results also revealed 65.6 % of them stated that was lead walls and glass for

safety characteristics of radiation unit, also 46.7% 35.6% 31.1% 28.9% respectively mentioned a protective barrier, as warning signs, work surface is separated and warning devices and monitoring devices. The knowledge was improved from pre to post test that means presence of statistically significant difference between pre &post test in all knowledge about safety measure of radiation unit $p1=0.000$. Also the knowledge follow up test was decline than post test but still better than pre test with statistically significant difference in all knowledge's $p2=0.000$ expect wash sink in room and a protective barrier $p2(0.364, 0.353)$.

Table (4): This table shows that there was statistical significant difference were found between nurses and technicians work place, sex , educational status and occupation in pre test P. value (0.000, 0.016, 0.000 and 0.001) respectively. While in follow up test was statistical significant difference were found between work place , age , education status , and occupation and their total score of knowledge about radiation hazard. P. value (0.001, 0.042, 0.031 and 0.021) respectively .

Fig (1): Clears distribution of total score of knowledge's among nurses and technicians about radiation hazards in pre , post and follow up tests , there was statistically significant difference between pre and post test $p1=0.000$ also between pre and follow up test ($p2=0.000$)

Table (5): Represents comparison between pre, post and follow up tests in Mean \pm SD of practice about safety measures among study nurses and technicians it was found that there was statistically significant

difference in pre & post test $p1=0.000$. Also with pre test and follow up test $p2=0.000$.

Table (6): This table shows that there was statistical significant difference were found between nurses and technicians work place, age, sex, educational status, occupation, years of experience in radiation therapy and training courses in pre test P. value (0.000, 0.041, 0.014, 0.000, 0.001 and 0.004) respectively. While in post test was statistical significant difference were found between work place, age, education status, occupation and years of experience in radiation therapy. P. value (0.000, 0.000, 0, 000, 0.000, and 0.000) respectively. As well as in follow up test was statistical significant difference were found between work place, age, education status, occupation and years of experience in radiation therapy and their total score of nurses and technicians practices about radiation safety measures. P. value (0.000, 0.000, 0, 000, 0.000, and 0.000) respectively.

Fig (2): Reveals the total score of practice about radiation safety measures among study nurses and technicians there was statistically significant difference in pre & post $p1=0.00$ Also with pre and follow up test ($p2=0.000$)

Discussion Education and training of staff are important elements to create safety measures as potential contributing factors to risks and hazards of health care associated injury or harm and as intervention used in eliminating or preventing harm. Staff working in radiation wards should have adequate knowledge about the risks and safety measures of radiation exposure to protect their health and help the patient to get the correct data about radiation exposure (**Morishima et al., 2017**).

The findings of the present study showed that about one third of the studied nurses and technicians age were less than 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 et al (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 status 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 unit rather than oncology unit 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 them 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 attended radiation safety training. This can be rationalized by that department didn't made lectures or training courses for the workers.

Regarding to the present study participant knowledge about radiation, types, causes, and symptoms arising from radiation overexposure, the current study found a significant difference between pretest and posttest, as well as between pretest and follow-up test. It agree with studied conducted by **Girgin, (2021)** who study the current knowledge and attitudes of health staff on ionizing radiation., **Kumar et al, (2021)** who study the Effect of Structured Educational Program on Practices of Radiation Safety Measures Among Health Care Provider and **Ahmed & Coll, (2021)** who study the Awareness and implementation of ionizing radiation safety measures, all of them agree with these findings a significant difference.

As regard to studied nurses and technicians knowledge about radiation unit safety measures the findings of the present study revealed that more than

two third of them know safety measures of radiation unit and it is include 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 . As well as the safety characteristics of radiation devices and radiation units .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 that decreasing the exposure to radiation hazards . This can be rationalized by the participants didn't attending training courses about radiation safety measures

Regarding to the distribution of total score of knowledge's among nurses and technicians about radiation hazards in pre, post and follow up tests indicate a statistically significant difference between pre and posttest as well as pre and follow up tests, 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 with significant difference in posttest and indicated that the training program was more important. These findings may explained by in this study occur improving in post test but some decline in follow up later due to study participants forgotten some information .

In relation to the comparison of the Mean and standard deviation of practice about safety measures among nurses and technicians pre, post, and the follow up tests, The study's findings revealed significant variations in hand washing, wearing gloves, wearing a mask, and applying gown and apron at the P-value (0.000) level between the pretest, posttest, and follow-up test, which agree with **Eldein & Eldahshan, (2015) & Ahmed et al, (2019)**, Who studies about Effect of Educational Program about Infection Control Precautions for Nurses in radiation Units and evaluating the influence of educational training and safety precautions

In pre, post, and follow-up test, the total score of practice about radiation safety measures among study participants was shown to be extremely significant improvement in practice level. These findings are similar to those of **Aboelfetoh & Shakweer, (2021) & Hirvonen et al, (2019)**, who study conducted about Nurses' knowledge of radiation protection and both valid the importance of education in establishing safe medical radiation procedures are critical. These findings may explained by the program implemented had positive impact on the participants and increase the awareness about importance of safety measures .

Conclusion

Based on the results of present study, it can concluded that :

Regarding the total score of knowledge and practice about radiation safety measures among nurses and technicians . It was clear that they had poor knowledge and practice before implementation the in service program. With improvement in their knowledge and practice occur in post test after implementation the program. In follow up test after three months later some decline occur in their knowledge and practice but still better than pre test.

Recommendations

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

- Refreshment courses through Periodic in-service training program for nurses and technicians about radiation safety measures should be done every six months.
- Providing closed supervision for compliance follow safety measures in working place by safety officer.
- Periodic evaluation for nurses and technicians who working in radiation setting regarding radiation safety measures should be done.
- Posters about methods of radiation prevention should be available at their work place.

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