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Original Article

Efficacy of Educational Program Based on Protection Motivation Theory on Preventive Behavior of Radiation among Hospital Nurses

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Abstract

Background: Radiological examinations for patients who are hospitalized at hospitals' units are usually performed using portable radiography devices .However, they may require knowledge and safety precautions of nurses. Ionizing radiation has been increasingly used during the past decades for diagnosing and treating different medical conditions.

Objective: The study aims to investigate nurses' knowledge of radiation safety and their behaviors toward radiation protection, as well as determine the efficacy of an educational intervention in enhancing their protective behavior.

Methodology: From September 20, 2024, until January 25, 2025, a randomized controlled trial is carried out in a true experimental design to assess the degree to which nurses' behaviors regarding radiation safety precautions are improved by an educational program-based intervention. Nurses from five radiation-exposed hospitals participated in the study in two groups, intervention and control, utilizing a pretest-posttest design (three study and two control by random allocation). Statistical Package for Social Science (SPSS) program for Windows (Version 26) is used for data analysis. The Descriptive Statistical Data Analysis Approach and the Fisher Exact Test for Equality of Variances are the two methods used for the data analysis.

Results: According to the results, the overall mean score of nurses' radiation protection behavior before the program was fair (3.23), improved to good (4,58) after the intervention, and remained good (4,35) in the secondary test.

Conclusions: Before the educational program, nurses exhibited moderate radiation protection behavior. The program led to significant improvements, raising their behavior to a good level. In Post2-intervention, nurses maintained these improved behaviors, signifying a lasting positive change in radiation safety practices.

Keywords: Efficacy, Educational Program, Protection Motivation Theory, Preventive Behavior, Radiation , Nurses.

Introduction

Radiation is energy that moves from one place to another in a form that can be described as waves or particles[1-4] or is the emission of energy as electromagnetic waves or moving subatomic particles [5]. Radiation is a fact of life. It is present in nature and can be produced artificially. Radiation of natural origin exists in the whole environment, while radiation of artificial origin has been used for only a few decades[6,7].Natural and artificial radiation are neither different in type nor in effect. Natural radiation comes from many naturally occurring radioactive materials found in soil, water, air and in the body. Every day, people inhale and ingest forms of radiation from air, food and water[8] . Radiation can be categorized into two main types: ionizing radiation and non-ionizing radiation, depending on its ability to ionize atoms and molecules[9] . We are exposed to radiation in our everyday life. Some of the most familiar sources of radiation include the sun, microwave ovens in our kitchens and the radios we listen to in our cars Most of this radiation carries no risk to our health But some does[10] . Most of the radiation is of natural origin to which man has added in the last hundred years and the artificial ones due to his own activity. In general, radiation has lower risk at lower doses but can be associated with higher risks at higher doses[11]. Depending on the type of radiation, different measures must be taken to protect our bodies and the environment from its effects, while allowing us to benefit from its many applications[12] . Numerous human activities can result in occupational radiation exposure, such as work related to the various phases of the nuclear fuel cycle, the use of radiation in industry, scientific research, medicine, and agriculture, as well as jobs involving exposure from natural sources[13] . Human-made radiation sources are widely used in medicine, industry, and research[14].Today, the most common artificial sources of human exposure to radiation are X-ray machines and radiopharmaceuticals used for diagnostic or radiotherapy and other medical devices[15]. Radiation can cause serious adverse effects on hematopoietic, immune, reproductive, circulatory, respiratory, musculoskeletal, endocrine, nervous, digestive, and urinary systems[16] .The negative effects of radiation exposure generally, fall into two categories[17],deterministic effects or probabilistic effects. Although the deterministic effects are directly related to cell death, they occur as a result of exposure of cells to radiation. Deterministic effects may result in infertility, cataract, leukemia, skin burns and death. Probabilistic effects are associated with the accumulation of absorbed radiation in tissues and may occur even at the lowest dose. Probabilistic effects include genetic disorders and cancer formation[18] .The use of protective equipment plays a significant role in reducing radiation exposure . The use of masks ensures protection from respiratory hazards, the use of protective clothing ensures that the radioactive substance does not damage the skin and hair, and the use of personal dosimeters ensures the management of the duration of stay in an area with high radiation levels and the monitoring of accumulated doses[19] . The increasing use of ionizing radiation for diagnostic and therapeutic purposes, particularly in procedures involving higher doses, highlights its critical role in modern healthcare[20] .The importance of the study lies in its potential to improve the well-being and safety of hospital nurses exposed to radiation by applying the Protection Motivation Theory (PMT) to promote preventive behaviors.

Methodology

Study design

A randomized controlled trial is conducted in a true experimental design from September 20, 2024, to January 25, 2025, to evaluate the extent to which an educational program-based intervention improves nurses' behaviors regarding radiation safety precautions. Using a pretest-posttest methodology, nurses from five hospitals exposed to radiation were divided into two groups: intervention and control (three study and two control by random allocation).

Study Setting

The study was conducted in Al-Mosul city, the capital of Nineveh Governorate, Iraq, employing

an experimental design with control groups across five hospitals affiliated with the Iraqi Ministry of Health's Nineveh Health Department. These hospitals, where nurses were exposed to radiation, were distributed on both sides of the Tigris River. Specifically, three hospitals were located on the left side of Mosul: the Mosul Center for Cardiology and Cardiac Surgery, Al Salam Teaching Hospital, and Ibn Sina Teaching Hospital. The remaining two hospitals, Mosul General Hospital and Al Jumhury Teaching Hospital, were situated on the right side of the city. This setup enabled a comprehensive assessment of radiation exposure among nursing staff in diverse healthcare settings across Mosul.

Study sample

The nursing departments of the five selected hospitals in Mosul were consulted during the sample selection process for both the intervention and control groups. Lists of all nurses exposed to medical radiation in each hospital were compiled, and each nurse was assigned a unique identifier that excluded personal information such as name, years of service, gender, and educational background. Using a simple random sampling technique, the hospitals were selected based on the degree of medical radiation exposure and the availability of nursing staff meeting the inclusion criteria. The selected hospitals were then divided into two groups: the study group and the control group, ensuring a structured approach to data collection and analysis.

Data Collection Tools

The study used a two-part questionnaire to collect data. The first part focused on demographic variables, gathering information on age, gender, marital status, educational attainment, number of years employed in the unit, and participation in courses and workshops. The second part consisted of nine questions designed to assess nurses' behavior regarding radiation protection. This structured approach allowed for a comprehensive evaluation of both the participants' backgrounds and their practices related to radiation safety, providing a basis for analyzing potential correlations between personal characteristics and radiation protection behaviors.

Data Collection Period

The study instrument will be used to collect data from employees over a period spanning from early October 2024 to January 2025. The questionnaire, which takes approximately 30 to 40 minutes to complete per participant, will be administered during this timeframe. This duration allows for a thorough and efficient collection of data, ensuring that all necessary information is gathered within the specified period.

Analysis of statistical data

The data analysis for this study utilizes the Statistical Package for Social Science (SPSS) software for Windows (Version 26), employing two distinct methods. Fisher's Exact Test is used to analyze associations between categorical variables, particularly when sample sizes are small, providing precise probability calculations for observed data. Additionally, a Descriptive Statistical Data Analysis Approach is applied to summarize and describe the dataset, including measures of central tendency (mean, median, mode), variability (standard deviation, variance), and frequency distributions. This combination allows for a comprehensive analysis, identifying significant associations while detailing the overall characteristics of the data.

Results

Table 1 Test of Homogeneity Between Study and Control in Terms of Demographic Characteristics

Test of Homogeneity						
Variable	Category	Group			Test of Homogeneity	P-value
			No.	%		
Sex	Male	Control	22	73	Fisher's	0.779

		Study	20	67	exact test	
	Female	Control	8	27		0.779
		Study	10	33		
Age	20-29	Control	15	50	Fisher's exact test	0.796
		Study	17	57		
	30-39	Control	15	50		0.604
		Study	12	40		
	40-49	Control	0	0		1.000
		Study	1	3		
	50 years and above	Control	0	0		1.000
		Study	0	0		
Marital Status	Single	Control	9	30	Fisher's exact test	1.000
		Study	8	27		
	Married	Control	20	67		0.779
		Study	22	73		
	Widowed	Control	1	3		1.000
		Study	0	0		
	Divorced	Control	0	0		1.000
		Study	0	0		
Years of Experience	1-4 years	Control	23	67	Fisher's exact test	0.506
		Study	26	87		
	8-5 years	Control	7	23		0.506
		Study	4	13		
	9-12 years	Control	0	0		1.000
		Study	0	0		
Educational Level	Nursing preparatory school	Control	4	13	Fisher's exact test	1.000
		Study	4	13		
	Diploma	Control	10	33		1.000
		Study	9	30		
	Bachelor's	Control	16	54		1.000
		Study	17	57		
	Higher Degrees	Control	0	0		1.000
		Study	0	0		
Participation in Training	Yes	Control	0	0	Fisher's exact test	1.000
		Study	0	0		
	No	Control	30	100		1.000
		Study	30	30		

Table 2 evaluation of behaviors of nurses related to radiation protection across the different time periods of the study: Pre-Study, Post1-Study, and Post2-Study.

Dimension	Q	Scale	Pre -Study			Post1 -Study			Post2 -Study		
			N (%)	M	Ass.	N (%)	M	Ass.	N (%)	M	Ass.
behav.	Q1	Strongly	0(0)	4.00	Good	0(0)	4.53	Good	0(0)	4.30	Good

		Disagree								
		Disagree	0(0)			0(0)		0(0)		
		Neutral	1(3)			0(0)		2(6)		
		Agree	28(93)			14(47)		17(57)		
		Strongly agree	1(4)			16(53)		11(37)		
	Q2	Strongly Disagree	4(13)	3.36	Fair	0(0)	4.83	0(0)	4.37	Good
		Disagree	2(7)			0(0)		0(0)		
		Neutral	4(13)			0(0)		2(7)		
		Agree	19(63)			5(17)		15(50)		
		Strongly agree	1(3)			25(83)		13(43)		
	Q3	Strongly Disagree	4(13)	3.16	Fair	0(0)	4.67	0(0)	4.33	Good
		Disagree	1(3)			0(0)		0(0)		
		Neutral	13(43)			0(0)		2(7)		
		Agree	10(34)			10(33)		16(53)		
		Strongly agree	2(7)			20(67)		11(40)		
	Q4	Strongly Disagree	4(13)	3.00	Fair	0(0)	4.73	0(0)	4.50	Good
		Disagree	4(13)			0(0)		0(0)		
		Neutral	12(40)			0(0)		1(3)		
		Agree	8(27)			8(27)		13(44)		
		Strongly agree	2(7)			22(73)		16(53)		
	Q5	Strongly Disagree	0(0)	3.36	Fair	0(0)	4.40	0(0)	4.23	Good
		Disagree	4(13)			0(0)		0(0)		
		Neutral	11(37)			0(0)		2(7)		
		Agree	15(50)			18(60)		19(63)		
		Strongly agree	0(0)			12(40)		9(30)		
	Q6	Strongly Disagree	1(3)	3.26	Fair	0(0)	4.23	0(0)	4.30	Good
		Disagree	3(10)			0(0)		0(0)		
		Neutral	14(47)			1(3)		0(0)		
		Agree	11(37)			21(70)		21(70)		
		Strongly agree	1(3)			8(27)		9(30)		
	Q7	Strongly Disagree	0(0)	2.93	Fair	0(0)	4.50	0(0)	4.43	Good
		Disagree	7(23)			0(0)		0(0)		
		Neutral	18(60)			0(0)		0(0)		
		Agree	5(16)			15(50)		17(57)		
		Strongly agree	0(0)			15(50)		13(43)		
	Q8	Strongly Disagree	0(0)	2.93	Fair	0(0)	4.83	0(0)	4.37	Good

		Disagree	6(20)			0(0)			0(0)		
		Neutral	20(67)			0(0)			1(3)		
		Agree	4(13)			5(17)			17(57)		
		Strongly agree	0(0)			25(83)			12(40)		
	Q9	Strongly Disagree	0(0)	3.10	Fair	0(0)	4.50	Good	0(0)	4.33	Good
		Disagree	8(27)			0(0)			0(0)		
		Neutral	11(37)			0(0)			0(0)		
		Agree	11(37)			15(50)			20(67)		
		Strongly agree	0(0)			15(50)			10(33)		
Mean as all			3.23		Fair	4.58		Good	4.35		Good

N: Frequency, %: Percentage, M: Mean of total score, Poor= 0.00 – 1.6, Fair= 1.7 – 3.3, Good= 3.4 – 5

A Personal Behavioral Scale with nine questions (Q1 through Q9) serves as the basis for the assessment. The mean scores for every question increased markedly between the Pre-Study and Post1-Study and Post2-Study periods. With an overall mean score of 3.23 during the Pre-Study period, it was classified as "Fair." In the Post1-Study time, this improved to 4.58 ("Good"), and in the Post2-Study era, it slightly declined to 4.35 ("Good"), but it was still in the "Good" range. Q1 was in the "Good" category. According to these findings, nurses' adherence to radiation safety practices was improved by the intervention, with the biggest improvements happening right after the intervention and continuing over time, even with minor declines.

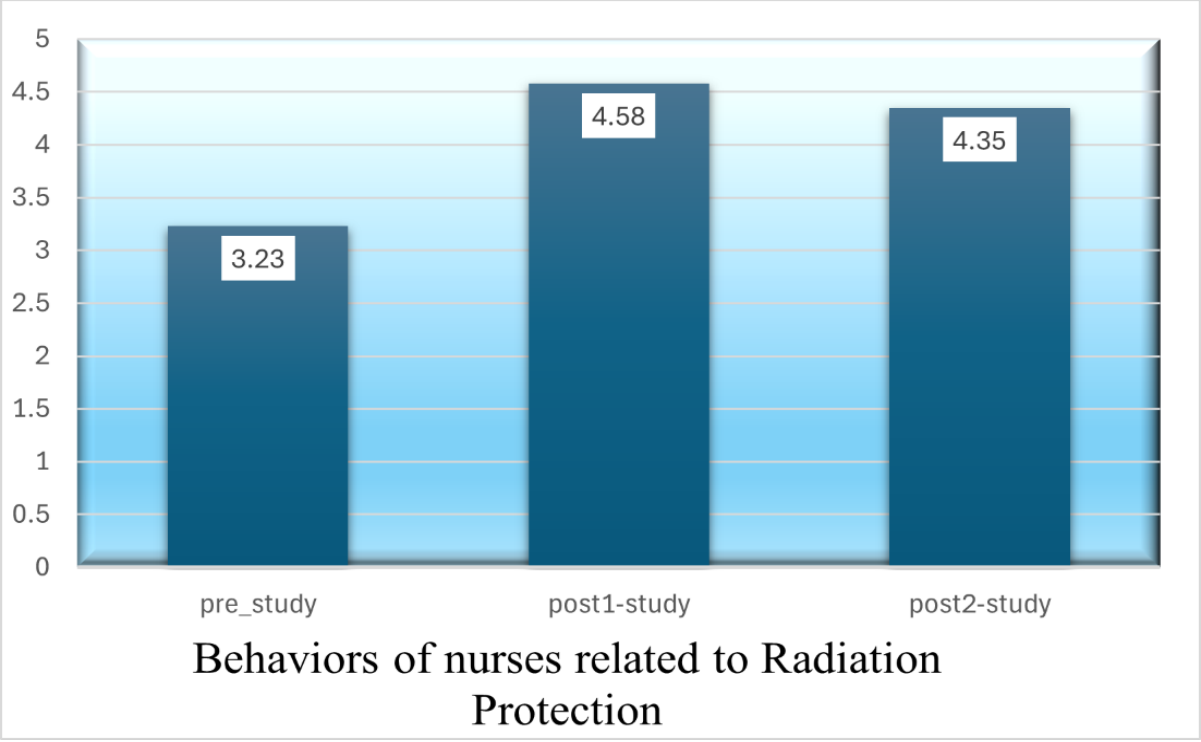

Figure (1) show the evaluation of behaviors of nurses related to radiation protection

Discussion:

The study utilized Fisher's Exact Test to evaluate baseline homogeneity between the experimental and control groups across various demographic and professional factors. The results in table (1) showed no statistically significant differences in gender distribution between the groups, with a p-value of 0.779. Similarly, homogeneity was maintained across four age categories, with p-values ranging from 0.604 to 1.000. The social status of participants, including marital status categories such as married, unmarried, widowed, and divorced, also demonstrated equivalent

distribution between groups, with p-values between 0.779 and 1.000. In terms of professional variables, the study found no significant differences in work experience among the groups. The experience categories, which included 1-4 years, 5-9 years, and 10-12 years, showed comparable distributions with p-values ranging from 0.506 to 1.000. Additionally, complete homogeneity was observed across different educational levels, including middle school, vocational institute, college, and bachelor's degree holders, with a p-value of 1.000. This high level of homogeneity extended to the operational aspect, where identical usage patterns emerged between groups for all assessment tools, also with a p-value of 1.000. These findings collectively indicate successful matching of samples across critical variables, thereby validating the internal consistency of the experimental design. The consistently high p-values signify the absence of systematic differences between groups at baseline, fulfilling key assumptions necessary for comparative analyses. Overall, the study's rigorous approach to ensuring homogeneity enhances the reliability and validity of its conclusions. Numerous studies that were carried out in Iraq and other nations were supported by the same homogeneity with regard to the study samples that were examined within the chosen categories[21] .An assessment of nurses' radiation protection practices during the Pre-Study, Post1-Study, and Post2-Study periods is shown in Table (2). Nine items (Q1 until Q9) from a Personal Behavioral Scale serve as the basis for the assessment. Between the Pre-Study and Post1-Study and Post2-Study periods, the mean scores for every question increased markedly. With an overall mean score of 3.23 during the Pre-Study period, it was classified as "Fair." In the Post1-Study time, it improved to 4.58 ("Good"), and in the Post2-Study era, it slightly declined to 4.35 ("Good"), but it was still in the "Good" range.These results indicate that educational efforts between the pre-study and Post1-Study successfully enhanced nurses' radiation protection behaviors, with long-lasting impacts seen in post2-study."Radiation Safety Practices and Improvement of Knowledge Level in Intensive Care Unit Working Conditions: An Experimental Study on Nurses" conducted by Batman University Faculty of Health Sciences Public Health Nursing in Batman, Turkey, in 2023 claims that, in comparison to the control group and the pre-training case, the training group's development of protective behaviors against ionized radiation increased significantly ($p<0.05$). This is in line with the findings in table (2), which demonstrate how well the program works to improve nurses' preventive behaviors[22] .

References:

1. Dianati M, Zaheri A, Talari HR, Deris F, Rezaei S. Intensive care nurses' knowledge of radiation safety and their behaviors towards portable radiological examinations. Nursing and midwifery studies. 2014;3(4):e23354.
2. Modi MKP, Baria DK, Chaudhary J, Morbia K. Study of Radiology safety awareness among hospital staff in a tertiary care rural hospital of Middle Gujarat, India. European Journal of Cardiovascular Medicine. 2023;13(2).
3. Karaca S. Nurses' Perspectives on Radiation: Drawing Expressions. Turkiye Klinikleri Journal of Nursing Sciences. 2020;12(1).
4. Beyzadeoglu M, Ozyigit G, Selek U. Radiation physics. Radiation Oncology: A MCQ and Case Study-Based Review: Springer; 2025. p. 1-74.
5. Karmaker N, Maraz KM, Islam F, Haque MM, Razzak M, Mollah M, et al. Fundamental characteristics and application of radiation. GSC Advanced Research and Reviews. 2021;7(1):064-72.
6. Bahnarel I, Tihon A. Ionizing and non-ionizing radiation. CEP Medicina; 2022.
7. Georgiou CD, Kalaitzopoulou E, Skipitari M, Papadea P, Varemmenou A, Gavriil V, et al. Physical differences between man-made and cosmic microwave electromagnetic radiation and their exposure limits, and radiofrequencies as

generators of biotoxic free radicals. Radiation. 2022;2(4):285-302.
8. Mishal ARA, Jabr MS, Muhammad ZI. Radiation: Types, Natural sources, and Industrial Sources. Current Clinical and Medical Education. 2024;2(5):89-94.
9. Intakhab B, Maqbool M. Types of Non-Ionizing Radiation and its. An Introduction to Non-Ionizing Radiation. 2023:21.
10. Kulkarni PP, Mahalle PN. Electromagnetic Radiations: Exposure and Impact: CRC Press; 2025.
11. Betlazar C, Middleton RJ, Banati RB, Liu G-J. The impact of high and low dose ionising radiation on the central nervous system. Redox biology. 2016;9:144-56.
12. Matthews EP. Radiation Physics, Biology, and Protection. Radiologic technology. 2019;90(5).
13. Yim M-S. Radiation hazards from the nuclear fuel cycle. Advanced Security and Safeguarding in the Nuclear Power Industry: Elsevier; 2020. p. 49-79.
14. Kurre D, Akhtar SA, Samantaray S. Investigating Marine Radiation: Sources, Classification, and Impacts on Ecosystems and Human Health. Radiation Status in the Marine World: Springer; 2025. p. 31-94.
15. Sharma SD. Radiation Environment in Medical Facilities. Handbook on Radiation Environment, Volume 2: Dose Measurements: Springer; 2024. p. 303-45.
16. Priya U. Radiation induced therapeutic effects in cancerous and tumor cells: a review. J Stem Cell Res Ther. 2023;8(1):1-12.
17. Nordlund K, Zinkle SJ, Sand AE, Granberg F, Averback RS, Stoller RE, et al. Primary radiation damage: A review of current understanding and models. Journal of Nuclear Materials. 2018;512:450-79.
18. Havránková R. Biological effects of ionizing radiation. Casopis lekaru ceskych. 2020;159(7-8):258-60.
19. Guide SS. Radiation protection and safety in medical uses of ionizing radiation. Specific Safety Guide SSG-46, IAEA, Vienna. 2018.
20. Thierry-Chef I, Cardis E, Damilakis J, Frija G, Hierath M, Hoeschen C, et al. Medical applications of ionizing radiation and radiation protection for European patients, population and environment. 2022.
21. Mahmood agha O, Bağçacı S, Şarlak N. Homogeneity Analysis of Precipitation Series in North Iraq. IOSR Journal of Applied Geology and Geophysics. 2017;05:57-63.
22. Balsak H, Beşer A. Radiation Safety Practices and Improvement of Knowledge Level in Intensive Care Unit Working Conditions: An Experimental Study on Nurses. 2024.