SHORT REPORT(S)

Evaluation of the Status of Knowledge, Attitude, and Performance of Radiology Department Staff Regarding Radiation Safety Principles at Hospitals in the North and Northeast of Iran

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Abstract

Purpose: Although ionizing radiation is useful in diagnosing various diseases, it can cause potential biological damage such as cancer, cataracts, and fetal damage for patients and staff working in radiology departments. Therefore, knowledge and practice about applying radiation protection principles are essential. This research investigates radiology personnel's knowledge, attitude, and performance regarding radiation protection in the north and northeast of Iran.

Materials and Methods: This descriptive-analytical cross-sectional study was conducted using a 30-item questionnaire among 435 radiology personnel in North Khorasan, Razavi Khorasan, Golestan, and Mazandaran provinces. This questionnaire included questions related to demographic information and the level of knowledge, attitude, and performance of radiology personnel regarding radiation protection. Data was also analyzed using SPSS-19 software.

Results: The participation rate of radiology personnel was 80.55%, and the mean and standard deviation of their knowledge, attitude, and performance regarding radiation protection were 45.9907 ± 1.294, 78.1531 ± 4.707, and 44.9368 ± 6.88, respectively. Based on the results of the study, there is no significant relationship between gender and knowledge (P = 0.781), attitude (P = 0.156), and performance of personnel (P = 0.87); however, a significant relationship was observed between education degree and attitude of personnel (P = 0.026), between working years and knowledge of personnel (P = 0.019), and also between job title and attitude of personnel (P = 0.003).

Conclusion: The results of this study revealed that there is a significant relationship between education degree and attitude of personnel, working years, and knowledge of personnel, and also between job title and attitude of the personnel. According to these results, our population, both personnel and patients have relatively poor performance and poor knowledge about radiation safety principles. Therefore, formal training in the use of ionizing radiation equipment is necessary for radiation safety.

Keywords: Knowledge; Attitude; Performance; Radiation Safety.

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1. Introduction

Radiological imaging is currently among the medical diagnostic tools whose wide applications in diagnosis and treatment have become inevitable over recent decades [1]. Still, using devices working with ionizing radiation may negatively impact biological systems and cause damage [2].

The environmental impacts resulting from exposure to the X-ray are classified into two groups stochastic and deterministic effects. Deterministic effects are a function of the dose given to the organ, exacerbate with increasing the dose, and are rarely observed in diagnostic radiology, whereas stochastic effects are independent of the absorbed dose value and have no threshold. These potential risks for the patients and radiation workers cannot be overlooked, highlighting the prominence of protection against radiation and the application of protection equipment, principles, and standards [1, 3, 4].

The International Commission on Radiological Protection introduced a system based on standards and guidelines to protect workers and patients in 1977, later updated in 1997 and 2007 [5]. The guidelines of this commission were registered as basic safety standards by the World Health Organization, the International Atomic Energy Agency, and Euratom and published in the form of training letters [6, 7].

The basic safety standard and the International Radiological Protection Commission have been founded on the three main pillars of justifiability, optimization, and dose limitation [8]. Justifiability points out that if a patient is referred for an ionizing radiation test, the test must be in the patient's favor, and its benefits must outweigh its drawbacks. Optimization refers to the fact that all radiation must follow the 'As Low as Reasonable and Achievable (ALARA)' rule, which means the radiation dose must be low yet adequate not to compromise image quality. Dose limitation means that the dose the workers are exposed to must not exceed the thresholds recommended by the commission [9].

Hence, applying protective measures and raising knowledge regarding radiation protection and the attitude of radiation workers are necessary when using ionizing radiation in medicine to minimize radiation risks. Results of some studies suggest that the workers are poorly informed of the radiation dose, and its potential impacts [10], and training the personnel could improve their performance and awareness [11]. Given that knowledge level of knowledge and attitude toward ionizing radiation can play a significant part in the planning required to prevent potential harm to the personnel, the present study investigated the attitude, awareness, and performance of the radiology department personnel as well as the need to train them toward this end.

2. Materials and Methods

The present study is a descriptive-analytical piece of cross-sectional research. Cluster sampling was performed on the radiology department employees of imaging clinics and hospitals (associated people including doctors, radiation workers, and receptionists) in northeast of Iran, including Northern Khorasan province (counties of Bojnord (Imam Ali (PBUH), Imam Hassan (PBUH), Bint Al-Hoda, Imam Reza (PBUH), and social security hospitals and Jawadalaimeh, Dr. Hekmati, Dr. Taj al-Dini, and Dr. Najarian clinics, Shirvan (Imam Khomeini and Hashemi hospitals and Dr. Burhani and Dr. Ramzani clinics), Faruj (Faruj Martyrs Hospital), Ashkhane (Pour Sina Hospital and Dr. Sadeghi Clinic) Jajarm (Javadalimah Hospital), Razavi Khorasan (Counties of Mashhad (Qaim, Razavi, and Imam Reza (PBUH), Imam Hossein (PBUH), Mader, Farabi, Mehr, Parsian, and 17 Shahrivar hospitals and Novin clinic), Neishabur (Bahman 22nd Hospital), Fariman (Hazrat Zahra (PBUH) Hospital), Gonabad (Allameh Bahloul Gonabadi Hospital)), Mazandaran province (counties of Sari (Imam Khomeini, BuAli Sina, Amir Mazandarani, Mehr, and Hekmat hospitals and Tubi, Negin, and Shahrvan clinics), Neka (Imam Hossein (PBUH) and BuAli hospitals), Behshahr (Mehr and Shohada hospitals), Qaemshahr (Razi and Waliasr hospitals), Babol (Shahid Yahiinejad and Shahid Beheshti hospitals), Amol (Imam Reza (PBUH) and 17 Shahrivar hospitals), and Golestan province (Counties of Gorgan (Shafa cardiology hospital, Sayad Shirazi, Falasfi, Taleghani, Dr. Mousavi, Panjom-e Azar, and Hakim Jarjani hospitals), Gonbad Kavos (Shahid Motahari, Shohada, Khatam al-Anbia, Holy Prophet (PBUH), and Ayatollah Taleghani hospitals), Azadshahr (Hazrat Masoumeh (PBUH) hospital), Minodasht (Fateme Al-Zahra (PBUH) hospital), and Kalaleh (Rasool Akram (PBUH) hospital) over 2020-2021. Samples were randomly taken (135 people per hospital) from each hospital in the mentioned provinces based on the sample size formula. The sample size was calculated to be 531 people based on the following formula (Equation 1) [12].

$$n = \frac{z^2 P(1-P)}{d^2} \quad (1)$$

This sample size satisfies the requirement for the formula for estimating a single population proportion with the assumption that the maximum proportion of radiology department employees of imaging clinics and hospitals (associated people, including doctors, radiation workers, and receptionists) is (p = 0.5) with 95% confidence interval and 5% marginal error.

A sample size of 540 was thus considered based on the possibility of attrition. Four-part 30-item questionnaires, including sections on demographic information (gender, age, time spent since graduation, job, and job experience (7 questions)), knowledge on radiation protection (5 questions), radiation protection attitude (9 questions), and radiation protection performance (9 questions) were distributed among the participants. The questionnaire has been used in several previous studies. Validity of the questionnaire was confirmed by10 faculty members of North Khorasan University of Medical Sciences and Pearson correlation coefficient showed the acceptable reliability of the scale (r = 0.81, P < 0.001) [13, 14]). The score obtained from each questionnaire ranged between 0 and 100, and statistical analysis was performed on the questionnaire results. Data were examined in SPSS-19 using descriptive (frequency, percentage, mean, and standard deviation) and analytical (ANOVA and t-test) statistical tests.

3. Results

Out of the 540 distributed questionnaires in radiography, radiotherapy, CT scan, and departments of hospitals in north and northeast Iran, 435 participants completed the questionnaires which indicated a participation rate of 80.55%, among whom 227 participants (52.18%) were female. In terms of job position, 411 participants (94.48%) were radiation workers and other staff of radiology department constituted 5.51% of the sample (24 people).

Table 1 demonstrates evaluation results of personnel's knowledge about the radiation safety principles for different variables. According to Table 1, the results indicated that a significant positive relationship was observed between knowledge and years of working with radiation (P = 0.019). Meanwhile, gender (P = 0.87), academic degree (P = 0.27), job position (P = 0.37) and age (P = 0.463) were revealed to have no significant relationship with the personnel's knowledge.

Table 2 demonstrates evaluation results of personnel's attitude about the radiation safety principles for different variables. According to Table 2, there is a significant relationship between the academic degree and performance about the Radiation Safety Principles (P = 0.026). Also, attitude was revealed to have significant relationships with job position (P = 0.003) and age (P = 0.048). Meanwhile, the gender (P = 0.156) and the years of working (P = 0.62) with radiation have no significant relationship with the personnel's attitude toward the Radiation Safety Principles.

Table 3 demonstrates evaluation results of personnel's performance regarding the radiation safety principles for different variables. According to Table 3, performance was revealed to have no significant relationships with gender (P = 0.781), academic degree (P = 0.29), years of working with radiation (P = 0.56), job position (P = 0.99), and age (P = 0.605).

Table 1. Evaluation results of Personnel's knowledge about the radiation safety principles for different variables

Variable	Characteristic	N (%)	Mean	SD	P-Value	Correlation Ratio (r)
Gender	Male	208 (47.8%)	46.06	1.36	0.87	0.125
	Female	227 (52.2%)	46.21	1		
academic degree	Bachelor's degree and below	412 (94.7%)	46.14	1.19	0.27	0.027
	Master's degree and above	23 (5.3%)	46.125	0.957		
Years of working with radiation	≥15	308 (70.8%)	46.16	1.13	**0.019**	0.325
	15>	127 (29.2%)	46.06	1.29		
job position	Radio Technologist	411 (94.5%)	46.129	1.18	0.37	0.601
	Other	24 (5.5%)	44.37	0.74		
Age	below and equal to 30 years	155 (34.8%)	45.09	1.16	0.463	0.004
	Over 30 years old	290 (66.6%)	44.17	1.18		

Table 2. Evaluation results of Personnel's attitude toward the radiation safety principles for different variables

Variable	Characteristic	N (%)	Mean	SD	P-Value	Correlation Ratio (r)
Gender	Male Female	208(47.8%) 227(52.2%)	78.65 78.44	4.2 4.69	0.156	0.203
academic degree	Bachelor's degree and below Master's degree and above	412(94.7%) 23(5.3%)	78.62 77.81	4.34 5.52	**0.026**	0.220
Years of working with radiation	≥15 15>	308(70.8%) 127(29.2%)	78.43 78.49	4.54 4.1	0.62	0.242
job position	Radio Technologist Other	411(94.5%) 24(5.5%)	78.70 75.37	4.3 6.4	**0.003**	0.835
Age	below and equal to 30 years Over 30 years old	155(34.8%) 290(66.6%)	77.33 79.41	5.00 3.81	**0.048**	0.235

Table 3. Evaluation results of Personnel's performance regarding the radiation safety principles for different variables

Variable	Characteristic	N (%)	Mean	SD	P-Value	Correlation Ratio (r)
Gender	Male Female	208(47.8%) 227(52.2%)	45.6 44.67	8.03 4.9	0.781	0.415
academic degree	Bachelor's degree and below Master's degree and above	412(94.7%) 23(5.3%)	45.08 44.93	5.8 11	0.29	0.035
Years of working with radiation	≥15 15>	308(70.8%) 127(29.2%)	44.89 45.62	6.17 7.3	0.56	0.001
job position	Radio Technologist Other	411(94.5%) 24(5.5%)	44.87 49.25	5.9 13.6	0.99	0.031
Age	below and equal to 30 years Over 30 years old	155(34.8%) 290(66.6%)	44.91 45.18	7.07 6.02	0.605	0.0256

Results of the evaluation in Golestan, North Khorasan, Razavi Khorasan, and Mazandaran provinces indicated no significant difference between the provinces in terms of knowledge, attitude, and performance. Figure 1 demonstrates the results of examining knowledge, attitude, and performance in the four provinces. As Figure 1 demonstrates, attitude (P = 0.001) and knowledge (P = 0.017) were significantly higher in Northern Khorasan compared to the other provinces. Besides, the performance index was significantly higher in Razavi Khorasan province compared to the others (P = 0.011).

4. Discussion

The present study was conducted to investigate the knowledge, attitude, and performance of the staff of the radiology wards of Hospitals in the North and North East of Iran on the principles of radiation protection during 2021-2022. Results of the present study showed the strengths and weaknesses of knowledge, attitude, and performance of the staff of the radiology wards of the North and North East of Iran. The mean and standard deviation score of

knowledge of the radiation technicians was 46.3 ± 1.294 regarding radiation protection which was inconsistent with the results of Keshtkar *et al.*'s study [12]. This difference may be attributed to the different sample sizes and the target population. The mean score and standard deviation score of attitudes of the radiation technicians were 78.15 ± 4.70 regarding radiation protection which was appropriate. Thus, it seems that the radiology staff is relatively unaware of the important points of radiation protection which is consistent with the results of Dadsetadi Asl *et al.*'s study [15].

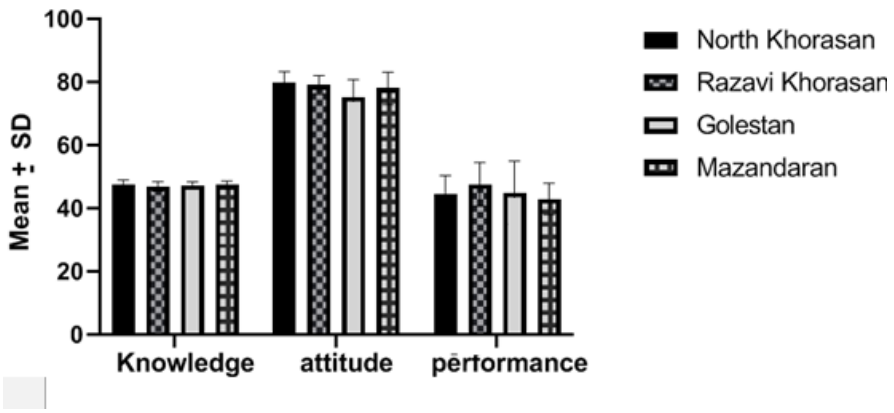

Figure 1. Mean and standard deviation of knowledge, attitude, and performance in four regions of the north and northeast of Iran

Calculated correlation coefficients confirm a significant direct relationship between age, academic degree, job position, and the attitudes of the radiographers toward the principles of radiation protection. In other words, the results of the present study showed the relatively lower attitude of radiographers with a lower academic degree, reflecting the necessity of re-education courses and educational workshops, which is in line with the results of Alipour et al.'s study [14], while Chaparian et al. reported no significant relationship between the educational level of radiographers and their attitude and performance, though they recommended holding re-education courses and educational workshops [16].

A significant direct relationship was found between the working experience and the knowledge score of the radiographers, i.e., radiographers with lower working experience or lack of participation in re-education courses had lower knowledge scores, which was in line with the findings of Su *et al.*'s study [17].

On the other hand, the present study showed no significant relationship between the performance of radiographers and gender, educational level, working experience, job title, and age which was consistent with the findings of Karami *et al.*'s study [18]. No significant relationship was found between gender, and the knowledge, attitude, and performance of the radiology staff, which was in line with studies of Alipour *et al.*, Su *et al.*, and Mojiri *et al.* [3, 14, 17].

One of the implementation challenges of the present study was the improper cooperation of some of the radiology staff in completing the questionnaire, which was mostly due to their concern regarding the non-confidentiality of their information. To solve this problem, an attempt was made to explain the necessity of the study and reassure the participants of the confidentiality of their information to improve their cooperation and participation. It can be concluded that despite the knowledge and attitude of the radiology staff and their knowledge of the importance of radiation protection, other factors, including lack of personal protection equipment in the wards and the number of forces, are also highly important in this regard. Therefore, it is suggested to conduct studies to determine the factors affecting the performance of radiographers and plan for the management of available resources.

5. Conclusion

The results of this study revealed that there is a significant relationship between education degree and attitude of personnel, working years and knowledge of personnel and also between job title and attitude of personnel. We have concluded that formal training in the use of ionizing radiation equipment is essential for the safety of both staff and patients given our population's poor performance. Radiology ward staff with lower work experience should be encouraged to participate in courses and workshops on personal radiation protection. Additionally, it is recommended to consider educational programs on radiation protection in the in-service training periodically for the radiology ward personnel. We should also make personal protective equipment more readily available to the health professionals who use these machines.

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References

1- "The 2007 Recommendations of the International Commission on Radiological Protection. ICRP publication 103." (in eng), *Ann ICRP,* Vol. 37 (No. 2-4), pp. 1-332, (2007).

2- seyed ali Rahimi, "Considering Dose Rate in Routine X-ray Examination by Thermoluminescent Dosimetry (TLD) in Radiology units of Mazandaran Hospitals." *IFMBE Proceedings,* Vol. 20pp. 582-85, 01/01 (2008).

3- Maryam Mojiri and Abbas Moghimbeigi, "Awareness and attitude of radiographers towards radiation protection." *Archives of Advances in Biosciences,* Vol. 2 (No. 4), 12/21 (2011).

4- Mehravar Rafati, Amir Eftekhari-Moghadam, Ghazal Mehri-Kakavand, Hadi Hasanzadeh, and Afsaneh Maftoon, "Dosimetry of organ at risks in Orthopantomography." *Koomesh,* Vol. 17 (No. 1), pp. 262-66, (1394).

5- J. A. Christner, J. M. Kofler, and C. H. McCollough, "Estimating effective dose for CT using dose-length product compared with using organ doses: consequences of adopting International Commission on Radiological Protection publication 103 or dual-energy scanning." (in eng), *AJR Am J Roentgenol,* Vol. 194 (No. 4), pp. 881-9, Apr (2010).

6- Philippe Sands and Jacqueline Peel, Principles of International Environmental Law. 3 ed. Cambridge: *Cambridge University Press*, (2012).

7- Nutthapong Moonkum, Chalermchai Pilapong, Krai Daowtak, and Gunjanaporn Tochaikul, "Radiation Protection Device Composite of Epoxy Resin and Iodine Contrast Media for Low-Dose Radiation Protection in Diagnostic Radiology." *Polymers,* Vol. 15p. 430, 01/13 (2023).

8- S. G. Barnard, E. A. Ainsbury, R. A. Quinlan, and S. D. Bouffler, "Radiation protection of the eye lens in medical workers--basis and impact of the ICRP recommendations." (in eng), *Br J Radiol,* Vol. 89 (No. 1060), p. 20151034, (2016).

9- D. L. Miller, "Make Radiation Protection a Habit." (in eng), *Tech Vasc Interv Radiol,* Vol. 21 (No. 1), pp. 37-42, Mar (2018).

10- Margaret A. Briggs-Kamara, P.C.N. %J American Journal of Scientific Okoye, and Industrial Research, "Radiation safety awareness among patients and radiographers in three hospitals in Port Harcourt." Vol. 4pp. 83-88, (2013).

11- A. Tok *et al.*, "Are the urology operating room personnel aware about the ionizing radiation?" (in eng), *Int Braz J Urol,* Vol. 41 (No. 5), pp. 982-9, Sep-Oct (2015).

12- Keshtkar Mohammad and Masoumi Hamed, "Evaluation of Knowledge and Practice of Radiographers and Operating Room Personnel about Radiation Protection: Importance of Training Courses." *Frontiers in Biomedical Technologies,* Vol. 8 (No. 4), 11/08 (2021).

13- Hamed Masoumi *et al.*, "A Survey on the Radiation Protection Status among Radiology Staff." (in en), *Iranian Journal of Medical Physics,* Vol. 15 (No. 3), pp. 176-82, (2018).

14- Reza Alipoor, Ghazal Mousavian, Ali Abbasnezhad, Seyede Farnaz Mousavi, and Gholamhasan Haddadi, "Knowledge, Attitude, and Performance of Radiographers about the Principles of Radiation Protection and Following Protective Standards in Medical Imaging Centers of Hospitals in Fasa in 2015." *JABS,* Vol. 5 (No. 4), pp. 564-70, (2015).

15- Amin Asl, Mohammad Bakhshian, Amin Banaei, Mohammad Cheraghi, and Maziar Barkhordari, "Assessment the Radiation Protection Knowledge, Attitude and Performance of Radiology Technologists in Tehran Military Hospitals and Their Relationship with Age, Sex, Level of Education and Work Experience." Vol. 13pp. 20-26, 01/01 (2018).

16- saeed Asadian and Hassan Zarghani, "Evaluation of Knowledge, Attitude, and Performance of Radiographers towards Radiation Protection in Southern Khorasan Province, Iran." (in en), *Iranian Journal of Medical Physics,* Vol. 15 (No. 4), pp. 222-25, (2018).

17- Fatemeh Shabani *et al.*, "Radiation Protection Knowledge, Attitude, and Practice (KAP) in Interventional Radiology." (in eng), *Oman medical journal,* Vol. 33 (No. 2), pp. 141-47, (2018).

18- asra karami, sarshin ghaderi, shima moradiyan, shiva mostafaee, Fardin Gharibi, and Farideh Elahimanesh, "Evaluation of level of knowledge, attitude and performance of Radiologists in Sanandaj city regarding radiation protection in 2014." *SJNMP,* Vol. 2 (No. 4), pp. 24-32, (2017).