

## Evaluation the effect of individual and demographic factors on awareness, attitude and performance of radiographers regarding principles of radiation protection

Amir Hossain Davoudian Talab<sup>1</sup>, Farshid Mahmodi<sup>2</sup>, Hamed Aghaei<sup>3\*</sup>,  
Leila Jodaki<sup>2</sup> and Davoud Ganji<sup>4</sup>

<sup>1</sup>Department of Occupational Health Eng, Behbahan Faculty of Medical Sciences, Behbahan, Iran, <sup>2</sup>Department of Radiology, Student Research Committee, Behbahan, Faculty of Medical Sciences, Behbahan, Iran, <sup>3</sup>Department of Occupational Health Eng, Faculty of Public Health Hamedan University of Medical Sciences, Hamedan, Iran and <sup>4</sup>Department of Occupational Health Eng, Bs, Shazand Health & Treatment Network, Arak University of Medical Sciences, Arak, Iran

**Abstract:** *Background:* In modern medicine, the use of ionizing radiation for diagnosis and treatment of diseases is increasing; on the other hand, harmful effects of this radiation for human have been demonstrated. Radiographers have vital role in application of principles of radiation protection and they can reduce unwanted exposure. *Materials & Methods:* Therefore, understanding the factors influencing awareness, attitudes and performance of radiographers regarding radiation protection principles was assessed by three special questionnaires. *Results:* The level of awareness, attitude and performance of radiographers regarding principles of radiation protection were 4.3%, 65.4% and 1.08%, respectively. Results showed that there is a significant difference between attitudes of the radiographers with high level of education and other groups. The level of education and training affects the attitudes, awareness and performance regards principles of radiation protection. *Conclusion:* So, to improve the level of awareness, attitude and performance of radiographers, it seems that the radiographers must spend retraining courses about radiation protection and technical issues; moreover, supervision and inspection authorities must be increased.

**Keyword:** Radiographers, Radiation protection, Awareness, Attitude, Performance.

### Introduction

The use of radiation in medical applications continues to increase worldwide. According to the latest The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) reports about 4 billion X-ray examinations are performed annually in the world [1]. Ionizing radiations is one of the most common and robust diagnostic tools for many diseases. Beside their advantages, as with any medical interventions, there are some potential risks in the application of ionizing radiations [2].

Ionizing radiations have been reported as carcinogen. The risk of radiation-induced cancers varies with the type of radiation, exposure time, exposed tissue and patient' age [3-4]. For instance, the overall lifetime risk of fatal cancer due to a single X-ray computed tomography (X-ray CT) of the abdomen is estimated to be 1 in 2000 [5]. Ionizing radiations may affect different

biological systems and organs such as gastrointestinal and central nervous systems, gonads or even whole body and result in somatic and genetic effects based on exposure and patients conditions [6].

Therefore, it is necessary to consider the principles of occupational radiation protection for all staffs of diagnostic imaging departments. As Low as Reasonably Achievable (ALARA) and the 10-day rule are important radiation protection principles which set to avoid unnecessary radiation exposure of the staff. The average annual dose for occupational exposure in medical staff is recommended to be 0.5 mSv/year [7].

As the first and most important staff, radiographers are responsible to avoid or at least reduce radiation exposure of themselves and patients in radiology diagnostic tests.

Since radiographers perform radiological tests they have an important role in the application of radiation protective principles [8-10]. From the patients point of view, direct speak with radiographers is an effective way to obtain information about radiation [11]. However, it is clear that the professional awareness of the radiographers are critical to achieve the followings: to give a simple and understandable explanation of radiography to the patients before commencement of radiography, compliance with the principles of radiation protection, and to reduce patients and population absorbed dose to the minimum possible value according to ALARA, [12-13]. The patient exposure dose may reduce up to 75% by trained physicians and staff and appropriate imaging techniques and devices [14]. Furthermore, performance, awareness and attitudes of radiographers about radiation protection principles are critical in the health protection of themselves and patients; therefore, identifying factors affecting these parameters can leads to develop effective strategies for promoting the radiographer’s professional behavior.

Given the above, the present study was undertaken to determine factors affecting awareness, attitude and performance of radiographers regarding the principles of radiation protection in diagnostic radiology tests.

**Material and Methods**

This descriptive-analytical cross-sectional study was conducted among 185 radiographers who work in various hospitals in Khuzestan Iran, 2014. The random cluster sampling was employed and then all of the hospitals having a diagnostic radiology center were identified. Next, questionnaires were distributed among the participants.

Data were collected by three questionnaires: a demographic information questionnaire (sex, age, shift work, type of hospital, marital status, level of education, years of professional experience), a questionnaire presented by Chaparyan et al. with validity and reliability about awareness, attitude and performance of the radiographers with regard to methods of radiation protecting [10] and last questionnaire consisted of various aspects of radiation protection, which included 11 questions about awareness, 10 questions about attitudes,

and 11 questions about performance. The average score for each specific question was obtained whit division correct scores gained by radiographers to specific question on the total expected score. Average scores over 75, 50 to 75 and below 50 were considered desirable, moderate and poor, respectively. The feedback questionnaire was about radiographers' comments who participated in education classes and receiving feedback on improving the improvement of radiation protection. Participants were asked to complete questionnaires regarding only their subjective data without referring to any books.

The participants were informed about the principles and objectives of the research and data confidentiality. Finally, data were extracted from the questionnaires and were analyzed whit SPSS 16.0 software. Pearson correlation test to correlation between variables and independent samples T-test to compare two independent groups was used.

**Results**

The participants included 69 males and 116 females with aged between 21 to 55 years old with mean age of 34. Forty-eight of radiographers had regular shift work and 129 of them had irregular shift work. Ninety-three of the staffs were associate degree and 92 were bachelor and 94.1% worked in public and 5.1% in private hospitals.

Level	Awareness (%)	Attitude (%)	Performance (%)
Weak	55.7	10.3	50.8
Moderate	40	24.3	48.1
High	4.3	65.4	1.08

As illustrated in Table 1, less than half of the radiographers had moderate and high level of awareness and performance, but more than 65.4% of them had high level of attitude. Statistical analyses showed the significant difference in the mean scores of awareness (p-value=0.043), attitude (p-value=0.045) and performance (p-value=0.045) between associate and bachelor degree participants.

A statistically significant difference was found between governmental and private hospitals in terms of the mean score of attitude (p-value=0.008). Data analyses showed there is a

weak negative correlation between age of radiographers and their awareness ( $R^2 = -0.0068$ ).

**Table-2: Level of Awareness, attitude and performance of radiographers regarding the type of hospital, level of education, marital status and shift work**

	Awareness		Attitude		Performance		Variable	
	Frequency	Percent	Frequency	Percent	Frequency	Percent		
Weak	94	54	15	8.6	87	50	Public	Type of Hospital
Moderate	73	42	43	24.7	85	48.9		
High	7	4	116	66.7	2	1.1		
Weak	9	81.8	4	36.4	7	63.6	Private	Type of Hospital
Moderate	1	9.1	2	18.2	4	36.4		
High	1	9.1	5	45.5	0	0		
Weak	59	64.13	12	13.04	54	58.69	Associate Degree	Level of Education
Moderate	30	32.6	28	30.43	38	41.3		
High	3	3.26	52	56.52	-	-		
Weak	43	47.25	7	7.69	39	42.85	Bachelor	Level of Education
Moderate	43	47.25	17	18.68	50	54.94		
High	5	5.49	67	73.62	2	2.19		
Weak	74	57.8	15	11.7	69	53.9	Married	Marital Status
Moderate	50	39.1	30	23.4	58	45.3		
High	4	3.1	83	64.8	1	0.8		
Weak	24	48	3	6	19	38	Single	Marital Status
Moderate	22	44	15	30	30	60		
High	4	8	32	64	1	2		
Weak	22	47.82	6	13.04	24	52.17	Regular Rotation	Type of Shift Work
Moderate	24	52.17	8	17.39	22	47.82		
High	-	-	32	69.56	-	-		
Weak	73	57.93	12	9.52	62	49.2	Irregular Rotation	Type of Shift Work
Moderate	45	35.71	36	28.57	62	49.2		
High	8	6.34	78	61.9	2	1.58		

As can be seen in Table 2, generally, the level of awareness and performance in governmental and private hospitals employees were same but the employees of public hospitals had better attitude level in comparison with private hospitals' employees. Generally, mean score of awareness, attitude and performance of single radiographers were higher than that of married radiographers, but this difference is not statistically significant. Both associate and bachelor radiographers had high scores of attitude, but their awareness and

performance were weak to moderate. More than 90% of regular and irregular shift work employees had weak and moderate score of awareness and performance, but more than 70% of them had high score of attitude. Among 33 questions of awareness, attitude and performance questionnaire, a few participants gave true answer to three questions:

- 1) Awareness about the biological effects of radiation used in radiology tests (7%).

- 2) Awareness of the maximum annual allowable dose of a non-radiographer person (17.3%).
- 3) Fluoroscopy where possible should be done "periodically" (22.7%).

Also, the majority of participants gave true answer to three questions: awareness about the 10-day rule during woman radiography (97.8%), rag radiology processing solutions reduces its performance and results in an increase in absorbed dose of patients (97.3%) and in children and low thickness body parts radiography grade should not be used (94%).

### Discussion

Based on the analysis of the data more than half of the workers had little awareness about the principles of protection, but only 4.3% of the people had a high score of awareness. These results show a lower awareness score compared to the studies of Su et al. with an average awareness score 65/83% [11], Slechta et al. with an average awareness score 82% [15] and Shah et al. with an average score of 75% [8]. Since the awareness about the radiation protection affect the behavior of radiographers, the radiographers, who do not have awareness of the principles of radiation protection, may cause damage to themselves or patients that refer to the diagnosis or treatment [16].

Moreover, the results showed that the employees, who recently graduated, have high level of awareness compared to those who had graduated earlier. In addition, a few of the radiographers in the feedback questionnaire reported that they have forgotten many things after a short time that they had learned during the course and stated that away from the education was one of the reasons for the lack of awareness about the principles of radiation protection. It reveals that training courses related to radiation protection are required. In line with our study, other studies had also shown that the awareness and training of radiographers in relation to the deleterious effects of ionizing radiation have a significant direct effect on employee protective measures [17]. The results showed that the level of education of radiographers affects their awareness regarding biological effects of radiation; this means that radiographers with high level of education have more awareness about biological effects of radiation. In line with this study, Mojiri [17] and

Amir Zadeh [16] have mentioned that there is a significant relationship between the level of education and awareness maximum permissible dose (MPD). Persuading and encouraging of radiographers to pursue high level of education is an important factor for improvement of their radiation protection in workplace.

Radiographers have high attitude towards the principles of radiation protection (65.4%). This shows that they try high to minimize the dose of the employee and patients [10]. The results showed that the type of hospital and level of education influence radiographers' attitude; the employee working in public hospitals and having high level of education had high level of attitude compared to the employee who working in private hospitals. In this study, 50.8% of the radiographers had poor performance level and only 1.08% of them had high performance level of the principles of radiation protection. This figure in comparison to other findings obtained by Chaparyan et al. study [10] with a score of 45.9%, Rahimi et al. with overall score of 46.8% [18] was by far lower. A Study by Reagan showed that performance levels of the employees and patients about radiation protection were 70% and 77%, respectively [19]. Also, in a similar study by Slechta [20] announced 72% of performance level for the employees.

Lack of necessary equipment for protection measures, crowded radiography section and time-consuming of some safety practices, heavy lead aprons [20], lack of awareness about personnel radiation protection, carelessness to the harmful effects of radiation and lack of cooperation of patients with radiographers could be the reasons for the poor performance level of radiographers. Since radiographers have vital role in protective measures and are directly responsible for the application of radiological examinations, their unsuitable performance could repeat imaging and lead to unnecessary exposures to radiation and loss of resources [8-10].

Statistical analysis showed that shift work had no effect on awareness, attitude of the

radiographers but the mean scores of awareness, attitude and performance level of the regular rotation employees were higher than those of irregular rotation employees. Shift work especially irregular shift work, can leads to sleepiness and affected employee's performance and life style [21]. It was also found that there was no statistically significant difference between awareness of the radiographers of public and private hospitals. However, between type of hospital and attitude of the radiographers was a significant difference as public hospital radiographers had higher level of attitude, that this may be result from hospital policies and organizational principles of effective safety programs in public hospital.

Data analysis also showed that the level of education affected on awareness, attitude and performance of the radiographers regarding principles of radiation protection. That is, by increasing the level of education awareness, attitude and performance of employees improved. Chaparyan [10] illustrated that the level of education had no significant relationship with attitude and performance, but the employees with higher level of education had high level of awareness about the principles of radiation protection. Similar results were found in studies by Su [15] and Mojiri [17].

Shah et al. [8] and Amirzadeh et al. [16] concluded that the higher the background information of radiographers, the higher level of their awareness. The results showed that between age of the radiographers and each variable of awareness, attitude and performance there was no significant relationship; similar findings were reached by Chaparyan et al. but age had a negative relationship with their awareness [10]. Sue et al. claimed that with increasing age of the radiographers, their awareness of radiation protection decreased [15]. Data analysis showed that there was no significant difference between average level of awareness, attitude and

performance of female and male radiographers. Chaparyan et al. [10] and Sue et al. [15] also showed that gender cannot influence the awareness, attitude and behavior of the individuals.

Chaparyan et al. stated that there was no significant relationship between professional experience and attitude and performance, but professional experience showed a negative relationship with level of awareness. In other words, employees with high professional experience have less level of awareness [10]. Shah et al. reported that those employees with 6-20 years of professional experience had more level of awareness [8]. This result was also seen in study by Sue et al. [15]. However, Mojiri et al. stated that there was direct relationship between professional experience and level of awareness [17]. Considering that most studies have demonstrated that awareness had negative or no relationship with increasing the age; this could be due to the radiographers are away from academic environments and have false pride stemmed from professional experience in workplace.

Since the results of this study showed that the level of education is an important factor affecting on awareness, attitude and performance level of radiographers, hence, training courses and continuing education of radiographers in relation to radiation protection will be improve their awareness, attitude and performance level which reduce radiation exposure [22]. Also, according to the results of the feedback questionnaire, in order to improve performance, awareness and attitude of radiographers, increase the efficiency of services and reduce unwanted exposure of patients and personnel, it is recommended: 1) increasing supervision and inspection of authorities, 2) replacing old and worn out devices with new and advanced ones and 3) implementing retraining courses.

## References

1. Radiation UNSCotEoA. Annex B: Exposures of the public and workers from various sources of radiation. UNSCEAR 2008 Report: *Sources of Ionizing Radiation*. 2008.
2. Thomas KE, Parnell-Parmley JE, Haidar S, Moineddin R, Charkot E, BenDavid G, et al. Assessment of radiation dose awareness among pediatricians. *Pediatric radiology*. 2006; 36(8):823-32.

3. Radiation NRCtAHRfEtLLoL. Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII-Phase 2: *Washington, DC*; 2005.
4. Radiation UNSCotEoA. Sources and effects of ionizing radiation: sources: *United Nations Publications*; 2000.
5. Remedios D, McCoubrie P. Making the best use of clinical radiology services: a new approach to referral guidelines. *Clinical radiology*. 2007; 62(10):919-20.
6. Vilenchik MM, Knudson AG. Radiation dose-rate effects, endogenous DNA damage, and signaling resonance. *Proceedings of the National Academy of Sciences*. 2006; 103(47):17874-9.
7. Radiation UNSCotEoA. UNSCEAR 2008 report to the General Assembly. *New York: United Nations*. 2010.
8. Shah AS, Begum N, Nasreen S, Khan A. Assessment of radiation protection awareness levels in medical radiation science technologists-a pilot survey. *JPMI*, 2007; 21(3):169-172.
9. Briggs-Kamara MA, Okoye PC, Omubo-Pepple VB. Radiation Safety Awareness among patients and Radiographers in three Hospitals in Port Harcourt. *Am. J. Sci. Ind. Res.*, 2013; 4(1): 83-88.
10. Chaparian A, Shamsi F, Heydari A. Assessment of awareness, attitude, and practice of radiographers about radiation protection in Yazd Province. *Occupational Medicine Quarterly Journal*. 2013; 5(1):16-23.
11. Kiguli-Malwadde E, Matovu PD, Kawooya MG, Byanyima RK. Radiation safety awareness among radiation workers and clientele at Mulago Hospital, Kampala, Uganda. *East and Central African Journal of Surgery*, 2006; 11(1):49-51.
12. Behrouzkhia Z, Shahbazi Gahrouei D. The rate of exposure of patients in common x-ray examinations in radiology centers of chaharmahal & bakhtiari province. *J Shahrekord Univ Med Sci*. 2005; 7(2):57-63.
13. Shahbazi Gahrouei D. Quality control of the radiological equipment in chaharmahal & bakhtiari hospitals. *J Shahrekord Univ Med Sci*. 2004; 5(4):11-18.
14. Shope TB. Radiation-induced skin injuries from fluoroscopy. *Radiographics*. 1996; 16(5):1195-9.
15. Su W-C, Huang Y-F, Chen C-C, Chang P-S. Radiation safety knowledge of medical center radiological technologists in taiwan. *Radiation Oncology*. 2000; 50:1-3.
16. Amirzadeh F, Tabatabaie SHR. Evaluation of healthy behavior in radiation employees in hospitals of Shiraz. *Iran J Nucl Med* 2005; 13(2):38-43.
17. Mojiri Maryam MA. Awareness and attitude of radiographers towards radiation protection. *Journal of Paramedical Sciences (JPS)*. 2011; 2(4):2.
18. Rahimi SA, Salar S, Asadi A. Evaluation of Technical, Protective and Technological operation of Radiologists in Hospitals of Mazandaran Medical Science Universities. *Journal of Mazandaran University of Medical Sciences*. 2007; 17(61):131-40.
19. Reagan JT, Slechta AM. Factors related to radiation safety practices in California. *Radiologic technology*. 2010; 81(6):538-47.
20. Slechta AM, Reagan JT. An examination of factors related to radiation protection practices. *Radiologic Technology*. 2008; 79(4):297-305.
21. Åkerstedt T. Sleepiness as a consequence of shift work. *Journal of Sleep Research & Sleep Medicine*. 1988; 11:17-34.
22. Rahimi S, Salar S. A study on the performance of recommended standards in the diagnostic radiology units of the hospitals affiliated to the Mazandaran University of Medical sciences. *J Mazandaran Univ Med Sci*. 2005; 15(49):69-76.

\*All correspondences to: Hamed Aghaei, Department of Occupational Health Eng, Faculty of Public Health, Hamedan University of Medical Sciences, Hamedan, Iran. E-mail: hamedaghaeih@gmail.com