

Assessment of Radiographers' Awareness about Radiation Protection Principles in Hospitals of Bandar Abbas, Iran

Erfaneh Kargar¹, Wrya Parwaie², Bagher Farhood³, Zahra Atazadegan¹,
Mahdieh Afkhami Ardekani^{2*}

Abstract

Introduction

This study was conducted to evaluate the radiographers' awareness of radiation protection principles in the radiology centers of the hospitals of Bandar Abbas, Iran.

Materials and Methods

This analytical cross-sectional study was conducted on 50 radiographers of three hospitals affiliated with Hormozgan University of Medical Sciences in 2015. The data were collected using a two-part questionnaire. The first part was related to the demographic information of the radiographers (i.e. age, gender, work experience, workplace, and passing related training courses). The second part consisted of questions related to the radiographers' awareness in three fields of radiology physics, radiation protection, and hazards of radiation.

Results

According to the results of the present study, the mean total scores of the radiographers' awareness about the radiology physics, radiation protection, and hazards of radiation was 18.41 ± 1.14 out of 22. However, the radiographers' awareness of the three investigated fields had no statistically significant relationships with the work experience ($P=0.244$) and gender ($P=0.386$). However, there was a significant relationship between the radiographers' awareness about the radiation protection and their education level ($P=0.034$). Moreover, a significant association was found between the radiographers' awareness and their workplace ($P=0.009$). Additionally, the participation in the radiation training courses was significantly correlated with the radiographers' awareness regarding the radiation hazards ($P=0.022$).

Conclusion

According to the findings of the present study, the awareness level of the radiographers about the radiation protection principles was relatively good. However, it seems that the education level of the staff should be enhanced through holding regular short-term radiation training courses.

Keywords: Awareness, Radiation protection, Radiation hazards, Radiographers, Radiology

1- Student Research Committee, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

2-Department of Radiology, Faculty of Para-Medicine, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

3- Department of Medical Physics and Biomedical Engineering, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

*Corresponding author: Tel: +98 9126496216; Fax: +98 21 66466383; Email: m.afkhami87@gmail.com

1. Introduction

Human beings constantly irradiate to natural cosmic radiation and radioactive substances existing in the Earth [1]. In addition to the natural resources, they expose to the industrial, medical, and other sources radiations. Among all the industrial sources, the diagnostic X-ray devices deliver the highest amount of radiation dose to the medical staff. These devices have the first rank among the artificial sources of radiation, which endanger the human life due to their dangerous radiations [2].

Radiography is a main diagnostic method in medical sciences, which must be performed under particular conditions. Although radiology is useful in diagnosing diseases, it acts as a source with potential hazards in terms of radiation protection. Exposing to excessive ionizing radiation may cause adverse effects on the body, and its effects may even appear in the subsequent generations [3]. Therefore, the radiation protection is one of the most important concerns of the radiographers since most of them leave their jobs because of the complications, which may occur due to ionization radiation [4]. In a study, Paolicchi et al. showed that the knowledge level of young radiographers (with less than 3 years of experience) about the radiation protection was higher than the more experienced ones [5]. In another study, Alhasan et al. concluded that there was no significant difference in the awareness level of the radiographers working at various hospitals except for the awareness of radiation dose. Furthermore, they showed that training courses and experience do not correlate significantly with the total score or the score of specific sections such as general radiation protection, radiation dose estimation, and radiation induced cancer risk [6].

This study aimed to evaluate the awareness of the radiographers working at radiology centers regarding the radiation protection principles at the hospitals in Bandar Abbas, Iran. We hope that our findings lead to the promotion of the radiographers' safety level in the radiology centers.

2. Materials and Methods

This analytical cross-sectional study was conducted on 50 radiographers of three hospitals (i.e., Shahid Mohammadi, Shariati, and Childcare hospitals) affiliated with Hormozgan University of Medical Sciences in 2015. The data were collected using a two-part questionnaire. The first part was related to the demographic information of the radiographers (i.e. age, gender, work experience, shift work, workplace, and passing retraining courses).

The second part of this questionnaire entailed questions related to the radiographers' awareness of three fields including radiology physics (such as inverse distance law, various types of ionizing radiations, etc.), radiation protection (such as As Low As Reasonably Achievable Principle, the most effective way to reduce exposure, wearing lead apron during working hours, etc.), and hazards of radiation (such as fetal sensitivity to radiation, side effects of radiation, sensitivity to radiation in different age periods, etc.).

The validity of this instrument was confirmed by two medical physicists. In addition, the reliability of this tool was evaluated as internal consistency using Cronbach's alpha coefficient, which rendered an acceptable internal reliability ($\alpha=0.742$). The data analysis was performed using the SPSS version 11.5.

3. Results

Out of the 50 radiographers, 44 (88%) subjects continued participating in the study and filled out the questionnaire. According to the results of the study, 30 subjects (68%) were female. Table 1 demonstrates the maximum, minimum, mean, and standard deviation (SD) of the scores related to the radiographers' awareness of radiation physics, radiation hazards, and radiation protection. As indicated in this table, the mean total scores of the radiographers' awareness in the preceding fields was 18.41 ± 1.14 out of 22.

Radiographers' Awareness about Radiation Protection Principles

Table 1. Maximum, mean, minimum, and SD score of the radiographers' awareness about radiation physics, radiation hazards and radiation protection

Radiographers' awareness	Mean	SD	Min	Max	Score range
Radiation physics	5.8	0.4	5	6	0-7
Radiation hazards	5.77	0.73	3	7	0-7
Radiation protection	6.65	0.77	5	8	0-8
Total score	18.41	1.16	16	21	0-22

Table 2. Radiographers' awareness about radiation physics, radiation hazards and radiation protection in Bandar Abbas hospitals in terms of work experience

Radiographers' awareness	Work experience						<i>p</i> -value
	1-10 yrs.		11-20 yrs.		21-30 yrs.		
	Mean	SD	Mean	SD	Mean	SD	
Radiation physics	5.8	0.4	5.8	0.4	5.7	0.5	0.949
Radiation protection	6.63	0.77	6.67	1	6.71	0.49	0.831
Radiation hazards	5.61	0.84	6.14	0.38	6	0	0.119
Total score	18.2	1.28	18.86	0.90	18.6	0.89	0.244

Table 3. Radiographers' awareness about radiation physics, radiation hazards and anti-radiation protection in Bandar Abbas hospitals in terms of gender

Radiographers' awareness	gender				<i>p</i> -value
	male		female		
	Mean	SD	Mean	SD	
Radiation physics	5.8	0.4	5.8	0.4	0.46
Anti-radiation protection	6.57	0.76	6.69	0.79	0.644
Radiation hazards	5.56	0.53	5.85	0.78	0.197
Total score	18	1.32	18.57	1.08	0.386

Table 4. Radiographers' awareness about radiation physics, radiation hazards and radiation protection in Bandar Abbas hospitals in terms of academic degree

Radiographers' awareness	Education						<i>p</i> -value
	Associate degree		B.Sc.		M.Sc.		
	Mean	SD	Mean	SD	Mean	SD	
Radiation physics	5.7	0.5	5.8	0.4	6	0	0.394
radiation protection	6.47	0.77	6.68	0.67	8	0	0.034
Radiation hazards	5.93	0.46	5.61	0.85	6	1.41	0.487
Total score	18.29	1.07	18.31	1.14	20	1.41	0.217

Table 5. Radiographers' awareness about radiation physics, radiation hazards and anti-radiation protection in Bandar Abbas hospitals in terms of workplace

Radiographers' awareness	Hospitals						<i>p</i> -value
	Shahid Mohammadi		Shariati		Childcare		
	Mean	SD	Mean	SD	Mean	SD	
Radiation physics	5.6	0.5	6	0	6	0	0.028
Radiation protection	6.52	0.92	7	0	6.75	0.46	0.238
Radiation hazards	5.5	0.83	6	0	6.25	0.46	0.014
Total score	17.88	1.36	19	0	19	0.53	0.009

The work experience of the radiographers ranged from 1-30 years. Table 2 illustrates the relationships between the radiographers' work experience and their awareness about radiation physics, radiation hazards, and radiation protection. The Kruskal-Wallis test showed no statistically significant relationship between the radiographers' work experience and their awareness in these three fields ($P=0.244$).

Table 3 demonstrates the relationships between the radiographers' gender and their awareness about the radiation physics, radiation hazards, and radiation protection. The Mann-Whitney U test demonstrated no relationship between the radiographers' gender and their awareness in the preceding fields ($P=0.386$).

Table 4 presents the relationships between the radiographers' academic degree and their awareness about the radiation physics, radiation hazards, and radiation protection. The Kruskal-Wallis test was used to evaluate the difference between the radiographers' academic degree and their awareness in the three investigated fields. There was a positive correlation between the radiographers' academic degree and their awareness of the radiation protection ($P=0.034$). However, there was no significant relationship between the radiographers' academic degree and their awareness of the radiation physics ($P=0.394$) and radiation hazards ($P=0.487$).

Table 5 displays the relationships between the radiographers' workplace and their awareness about the radiation physics, radiation hazards, and radiation protection. The Kruskal-Wallis test revealed a significant association between the

workplace of the radiographers and their awareness about radiation physics ($P=0.028$). Furthermore, there were significant differences between the awareness of the radiographers working at Shahid Mohammadi and Shariati hospitals ($P=0.043$) and those working at Shahid Mohammadi and Childcare hospitals ($P=0.033$). In addition, the results demonstrated that there was a significant relationship between the workplace of the radiographers and their awareness about the radiation hazards ($P=0.014$). Accordingly, Shahid Mohammadi and Childcare hospitals were found to have the maximum difference in this regard ($P=0.006$). However, no significant relationship was observed between the workplace of the radiographers and their awareness about the radiation protection ($P=0.238$).

Table 6 shows the relationship between the radiographers' participation in the radiation training courses and their awareness about the radiation physics, radiation hazards, and radiation protection. Out of the studied participants, 84% of the subjects participated in the training programs about radiation. The Mann-Whitney U test showed that there was a significant relationship between the radiation training course and the radiographers' awareness about radiation hazards ($P=0.022$). However, no significant relationship was observed between the radiation training course and the radiographers' awareness about radiation physics ($P=0.109$) and radiation protection ($P=0.835$).

Table 6. Radiographers' awareness about radiation physics, radiation protection and radiation hazards in Bandar Abbas hospital in terms of participation in radiation instructional course

Radiographers' awareness	Participation in radiation instructional course				<i>p</i> -value
	Yes		No		
	Mean	SD	Mean	SD	
Radiation physics	5.7	0.5	6	0	0.109
Radiation protection	6.65	0.73	6.67	1.03	0.835
Radiation hazards	5.86	0.74	5.32	0.52	0.022
Total score	18.52	1.12	17.8	1.30	0.206

4. Discussion

This study investigated the radiographers' awareness of the radiation protection

principles working in the radiology centers of the hospitals in Bandar Abbas. The radiation protection principles were investigated in three

fields including radiology physics, radiation protection, and hazards of radiation. In addition, we investigated the relationships between the radiographers' awareness of the three fields and such factors as gender, work experience, academic degree, workplace, and participation in radiation training courses.

Since the radiographers are directly responsible for performing the radiology tests, they have a vital role in applying the safety plans [7]. In radiography, there is a wide range of factors, which are controlled by the radiographers. These factors can minimize the dose delivered to the patient while still maintaining the imaging quality [8-11]. In addition, the awareness of the radiology device structure (i.e., machine power and heat capacity of the tube) and radiography artifacts (i.e., unsharpness, magnification, and noise) can improve the correct usage of the device and reduce its excessive workload [12].

Since the total awareness score of the radiographers about the radiation protection principles was relatively good, it seems that the radiographers' occupational skills about their specialized courses were rather desirable. In a study conducted by Amirzade, it was shown that the staff's awareness about the personal protective equipment such as using lead gloves and apron was at a moderate level. Therefore, they concluded that it is necessary for the staff to pass short-term courses to acquire excellent level of awareness [3].

According to the findings of the present study, no relationship was found between the work experience of the radiographers and their awareness level. This might be due to the fact that this study was conducted in three hospitals that provide educational services to the students in addition to delivering treatment and diagnostic services. As a result, the communication between the radiographers and the students may have facilitated the radiographers with a review of their trainings about the radiation protection principles. In a study carried out by Fattahi et al., a significant negative correlation was observed between the work experience and total awareness score.

This discrepancy between the findings of the mentioned study and those of our study can be due to the radiographers' being away from academic education, lack of persistent studies, as well as the unavailability of sufficient education facilities for the radiographers in the aforementioned study [13].

In addition, the findings showed that there was a relationship between the radiographers' academic degree and their awareness of the radiation protection, i.e., the total awareness scores increased by higher academic degree. In other words, the radiographers with higher academic degrees had less radiation exposure than those with lower degrees due to better recognition of the radiation protection rules. Therefore, it seems that continuing education is essential for the radiographers. Similarly, Saberi et al. reported a significant correlation between the education levels of staff and the repeat rate of the radiographic films, i.e., this rate reduced by increasing the radiographers' awareness level [14].

According to the results presented in Table 5, the radiographers working at Shahid Mohammadi Hospital had lower awareness about the radiation protection and radiation hazards, compared to those working at other hospitals. Shahid Mohammadi Hospital is a general hospital, which presents lots of services to the patients among all the hospitals of Bandar Abbas. Therefore, high workload in this hospital could be a reason for the obtained results. In other words, the radiographers in this hospital have little time for implementing every x-ray examination, compared to those working in the other two hospitals.

Moreover, the findings revealed that the participation of the radiographers in the workshops related to radiation was positively correlated with their awareness about the radiation hazards. These workshops may provide new information about the hazards of ionizing radiation and the experiences of other hospital staff in addition to presenting scientific and applicable principles about the radiation protection.

5. Conclusion

It is notable that the evaluation of the staff's awareness about the radiation protection principles in the radiology centers is essential. The findings of the current study demonstrated that the awareness level of the radiographers about the radiation protection principles is relatively good. Nevertheless, performing periodic medical examination and safeguarding of the staff against the hazards of

the radiation are important factors that should not be neglected. However, it seems that the education level of the staff should be enhanced through holding regular short-term radiation training courses.

Acknowledgements

The authors would like to thank all the radiographers who participated in the study.

References

1. Hu B, Wang C, Xu X, Zhang S, Bao S, Li Y. Assessment of radioactive materials and heavy metals in the surface soil around uranium mining area of Tongliao, China. *Ecotoxicol environ saf*. 2016; 130:185-92. DOI: 10.1016/j.ecoenv.2016.04.002.
2. Sharma, Sunil Dutt, et al. Measurement of entrance skin dose for diagnostic X-ray radiographic examinations and establishment of local diagnostic reference levels. *World Cong Med Phys Biomed Eng*, 2012, Beijing, China. Springer Berlin Heidelberg, 2013. DOI: 10.5539/gjhs.v7n5p202.
3. Amirzadeh F, Tabatabaie SM. Study of protection knowledge of technologists in Shiraz hospitals. *Iran J Nuclear Med*. 2006; 13(24): 38-44 .
4. Evaz-Zadeh N, Khoshdel A, Azma K, Fooladvand L. Evaluation of X-Ray factors and its effect on radiology department staff at Army hospitals in Tehran in the year 1385. *J Army Uni Med Sci*. 2008; 6(1): 71-3 .
5. Paolicchi F, Miniati F, Bastiani L, Faggioni L, Ciaramella A, Creonti I, et al. Assessment of radiation protection awareness and knowledge about radiological examination doses among Italian radiographers. *Insights Imaging*. 2016;7(2):233-42. DOI: 10.1007/s13244-015-0445-6.
6. Alhasan M, Abdelrahman M, Alewaidat H, Khader Y. Radiation dose awareness of radiologic technologists in major Jordanian hospitals. *Int J Radiat Res*. 2016;14(2):133-8. DOI: 10.18869/acadpub.ijrr.14.2.133.
7. 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 .
8. Dowd SB, Tilson ER. *Practical radiation protection and applied radiobiology*. 2nd ed. Philadelphia, PA: Saunders; 1999.
9. Rahimi S, Salar S, Asadi A. Evaluation of Technical, Protective and Technological operation of Radiologists in Hospitals of Mazandaran Medical Science Universities. *J Mazandaran Univ Med Sci*. 2007; 17(61): 131-40 .
10. Karami V, Zabihzadeh M. Radiation Protection in Diagnostic X-Ray Imaging Departments in Iran: A Systematic Review of Published Articles. *J Mazandaran Univ Med Sci*. 2016; 26(135):175-88.
11. Memarnia Z. The evaluation of radiology department performance management in Tehran University of Medical Science. *Tehran Univ Med Sci*. 2007 : 18-23.
12. Bashore, Thomas. *Fundamentals of x- ray imaging and radiation safety*. *Catheter CardiovascInterv*. 2001;54(1):126-35.
13. Fatahi-Asl J, Tahmasbi M, Karami V. The Protection knowledge and performance of Radiographers in some hospitals of Ahvaz County. *Jentashapir J Health Res*. 2013; 4(5): 405-12.
14. Saberi AH, Haghizadeh M., H. Nikpik, and A. Afrooz. Analysis if causes for reject of xray films in radiology department of Ahvaz Imam Khomeini and Golestan hospitals. *Ahvaz UnivMed Sci* .1998.