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The investigation of radiation safety awareness among healthcare workers in an education and research hospital

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► ***Original article***

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ABSTRACT

Background: This study is conducted with the aim of determining the knowledge, attitude and behaviors of the personnel on radiation safety, who are exposed to radiation and working in a university hospital in Istanbul. ***Materials and Methods***: In this research, which is descriptive, a questionnaire that consists of 20 questions conducted to 101 healthcare personnel who are working with radiation source in operating room, endoscopy, radiology units. The obtained data is analyzed with Statistical Package for the Social Sciences (SPSS) 22.0 program and chi-square test is applied. ***Results:*** 58.4% of the participants are women and 41.6% of them are men. 32.7% of the participants stated that they got fluoroscopy education and 50.5% of them stated that they got dosimeter education. 64.4% of the participants stated that they use in fluoroscopic environment at least two times a day and 78.2% of them stated that they did not use legal ray permission. 2% of the participants stated that they do not know about the protective equipment that should be used during fluoroscopy. 74.3% of the participants stated that they do not feel qualified enough about radiation measuring and dosage units. ***Conclusion:*** Findings indicate that the healthcare personnel, who participated in this research and working with ionizing radiation sources, do not have the adequate knowledge about radiation safety. For this reason, the most important subject is that the managements of the institutions which are practicing radiation should take precautions with providing either personnel or necessary substructure in terms of equipment and necessary trainings.

Keywords: *Radiation professionals, dosimetry, radiation safety.*

INTRODUCTION

Today, many healthcare personnel, who are working in hospitals, oral and dental health hospitals and veterinary field, are exposed to radiation in some medical procedures. It is estimated that there are 2.3 million healthcare personnel in the world who are working with radiation related practices, and half of them are exposed to human-made artificial radiation and ionized radiation [1].

In modern life the resistivity of radiation is impossible and the adverse effects of ionized radiation are known by majority. The international institutions which are authority on radiation and its practice fields are determined the minimum allowed dosage ranges for professionals who are working with radiation [2,3]. Healthcare institutions have to take precautions with the aim of protecting those who are exposed to radiation because of professional reasons with abiding the regulations [4-6]. Sanitarians who are working in units that exposed to radiation should also take personnel precautions beside these precautions in order to avoid radiation sources.

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In the researches that conducted, it is determined that the most complained problems in radiology unit workers are thyroid problems, hair loss and eye diseases [7-10]. It is determined that the X-rays that used in fluoroscopy especially harms DNA, which organizes all vital and genetic activities in cells, directly or indirectly. In direct effect; radiation energy breaks chemical bonds of DNA molecules and therefore damages the molecule structure. Radiation causes the creation of free radicals with radiolysis of water molecules around the molecule in indirect effect [11-12]. If these effects cannot be neutralized by the body, it leads to serious health problems.

This study was carried out to determine the knowledge, attitudes and behavior of health personnel working with ionizing radiation sources on the risks and radiation safety of ionizing radiation.

MATERIALS AND METHODS

This descriptive study was conducted between June 2017 and December 2017. The sample of the study consisted of 101 health personnel working in radiology, operating room and endoscopy units of an education and research hospital in Istanbul. Ethics Committee Approval and informed consent were obtained from the participants.

"Knowledge Level of Healthcare Professionals Exposed to Radiation" questionnaire consists of 20 questions was used as the data collection tool. In the analysis of the data obtained from the questionnaire, descriptive statistical methods were used by using Statistical Package for the Social Sciences (SPSS) 22.0 package program and chi-square test was used in the analysis of qualitative data.

RESULTS

When the education level of the health personnel participating in the study is examined, it is determined that 30.7% (n=31) of the participants have master's degree, 39.6% (n=40) of them have bachelor's degree, 15.8% (n=16) of them have associate degree, 6.9% (n=7) of them are graduated from high-school and, 6.9% (n=7) of them are graduated from middle school. According to information question data, the radiation safety knowledge level of healthcare workers does not show any significant difference according to gender variable ($p>0.05$). When the study year of the health personnel participating in this study is examined, it is seen that 69.3% of them worked for 0-5 years, 13.9% of them worked for more than 15 years, 9.9% of them worked for 11-15 years and 6.9% of them worked for 6-10 years. 98% of the health personnel who participated in the study stated that they used protective equipment during scopy.

Table 1 shows the relation between the exposure of fluoroscopy and the demographic characteristics of healthcare professionals and table 2 shows the distribution of responses to information questions.

Fluoroscopic training rate of the participants according to age groups did not show a significant difference ($x^2=1.585$; $p > 0.05$). There was no significant difference ($x^2=3.390$; $p> 0.05$) between men and women in terms of fluoroscopic training. When fluoroscopy training rate was examined according to educational level, there was no significant difference ($x^2= 0.280$; $p > 0.05$). When the ratio of fluoroscopy training was examined according to the working time in the profession, there was no significant difference ($x^2=1.391$; $p > 0.05$). Fluoroscopic training in the radiology unit was significantly higher ($x^2= 7.409$; $p < 0.05$) in the operating room-endoscopy unit. According to the working time in the unit, fluoroscopic training was not significantly different ($x^2= 1.391$; $p > 0.05$). Fluoroscopic training in radiology technicians was found to be significantly higher than doctor-nurse-auxiliary staff group ($x^2= 3.916$; $p < 0.05$).

94.1% of the healthcare personnel have knowledge basic radiation icon colors and 69.3% have knowledge annual effective radiation dose. Although 91.1% of radiology workers stated that they had warning signs in their environment, 40.6% of the operating room

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workers stated that they were not aware of the warning signs. 75.2% of the health personnel participating in the study was found to give the correct response as "gonad" to the question of which is the most sensitive tissue to radiation. This result were no show significant difference at according to occupation groups (x^2=1.657; p>0.05). 91.1% of participants were found to have sufficient knowledge by giving correct answer as "Turkey Atomic Energy Agency" to the question which is essentially corporate information about the working principles of radiation in Turkey. 90% of the participants answered the questions about the principles of radiation protection. Especially doctors and nurses have sufficient knowledge about this issue. 50.5% of the participants determined that give the correct response as "work with the highest number of images per second" to the question "which is not done for radiologists to get at least X-ray".

74.3% of the healthcare personnel participating in the study stated that they did not have enough information about radiation measurement and dosage units. 77.2% of the participants stated that they did not take courses or seminars about radiation safety and/ or radiation protection of the employee or the patient. In addition, 78.2% of the health personnel participating in the study stated that they did not use legal ray permission.

Table 1. The relation between the exposure of fluoroscopy and the demographic characteristics of healthcare professionals in last one year.

		Did you exposed to fluoroscopy in last one year?				x^2	p
		Yes		No			
		n	%	n	%		
Age	18-30	40	87.0%	6	13.0%	0.171	0.918
	31-40	30	88.2%	4	11.8%		
	40+	19	90.5%	2	9.5%		
Gender	Female	50	84.7%	9	15.3%	1.542	0.214
	Male	39	92.9%	3	7.1%		
Education	Middle-High School	12	85.7%	2	14.3%	7.015	**0.008**
	Associate Degree	10	62.5%	6	37.5%		
	Bachelor's Degree	37	92.5%	3	7.5%		
	Master's Degree	30	96.8%	1	3.2%		
Working Year	0-5	38	80.9%	9	19.1%	5.443	0.142
	6-10-	16	100.0%	0	0.0%		
	11-15-	16	88.9%	2	11.1%		
	15+	19	95.0%	1	5.0%		
The Department where He/She Works	Operating Room	67	97.1%	2	2.9%	19.116	**0.000**
	Endoscopy	5	100.0%	0	0.0%		
	Radiology	17	63.0%	10	37.0%		
The Years that He/She Worked in Radiology	0-5	60	85.7%	10	14.3%	0.622	0.430
	6-10-	7	100.0%	0	0.0%		
	11+	22	91.7%	2	8.3%		
Occupation	Doctor	28	96.6%	1	3.4%	21.648	**0.000**
	Nurse	46	97.9%	1	2.1%		
	Auxiliary staff	9	64.3%	5	35.7%		
	Radiology Technician (BSc.)	6	54.5%	5	45.5%		

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Figure 1. Modified Ondo Google Satellite Map Showing Zones of Sample Collection. Map data ©2017 Google (14)

		n	%
Did you get fluoroscopic training?	Yes	33	32.70%
	No	68	67.30%
Do you have radiation hazard warning signs in your work area?	Yes	92	91.10%
	No	9	8.90%
Are there any protective equipment to be used during fluoroscopy?	Yes	99	98.00%
	No	2	2.00%
If there is, is the integrity of these equipment checked?	Yes	84	83.20%
	No	17	16.80%
How often is it controlled?	Monthly	3	3.00%
	Every six months	59	58.40%
	I don't know	36	35.60%
	Does not check	2	2.00%
	No comment	1	1.00%
Do you have an operating room which is radiation safe?	Yes	6	5.90%
	No	31	30.70%
	No comment	64	63.40%
Do you use a dosimeter?	Yes	51	50.50%
	No	50	49.50%
Do you follow dosimeter controls?	Yes	2	2.00%
	No	46	45.50%
	No comment	53	52.50%

DISCUSSION

The personnel authorized to use radiation sources should have at least the basic vocational training at the level of Medical Vocational High School in the field of radiology and their diplomas must be registered by the Ministry of Health. In this study, only 10.9% of the participants were radiology technicians, 28.7% of them were doctors, and 13.9% of them were the ones who are working in a field that they are not professional, they are auxiliary staff. When planning human resources in health institutions, the appointment of employees according to their education and expertise areas is very important in terms of both personnel and patient safety.

While the duration of work in the profession increased, it was expected that the right attitudes and practices would increase with experience, while there was no significant difference between knowledge, attitudes and practices in this study and the duration of work in the profession. Similarly, in the studies of Slechta *et al.* and Reagan *et al.*, no difference was observed between the duration of work in the profession and the information and application scores related to individual precautions about radiation safety [13,14].

Radiation safety in Turkey by the Turkish Atomic Energy Agency ALARA (As low as Reasonably Achievable) measures have been introduced [15]. However, researches reveal that the knowledge levels of health workers are insufficient in terms of radiation safety [16,17]. The results of our study are parallel to previous studies. According to the findings, the gender variable is not a decisive factor on the radiation security knowledge levels of healthcare workers. Some studies supported this result [17-20].

In a study conducted by Guden *et al.*, it was determined that 90% of the employees were exposed to ionizing radiation in last one year [21]. This result is similar to our research outcome. Because it was determined that 88.1% of the participants were exposed to radiation in last one year in our study. It is thought that the causes of radiation exposure of employees should be determined and necessary precautions should be taken. One of the reasons for this situation can be explained by the fact that the

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participants' level of knowledge is not sufficient and they do not take the necessary measures.

In our study, it was found that the rate of exposure to fluoroscopy in the radiology unit personnel working in the operating room was significantly lower in the last one year (x^2 =19.116; $p < 0.05$) than the working in the operating room and endoscopy unit personnel. The reason for that, radiology technicians are less exposed to scopies than other personnel because they work behind the protective lead wall during imaging. Therewithal, the rate of exposure to fluoroscopy in doctors and nurses was found to be significantly higher than the exposure rate of radiology technicians in this study, (x^2 = 21.648; $p < 0.05$) in last one year. It can be thought that exposure to fluoroscopy is significantly higher than other occupational groups, especially in orthopedics operating room due to high extremity fracture operations, use of fluoroscopy to determine the level of implants and screws used in surgery, and doctors and nurses are in the operation team. This result is consistent with other studies [22,23].

In this study, the answers of the participants differ according to the information questions table 2. These results can be explained by the fact that the personnel is not sufficiently informed about this issue or the employees do not show the necessary sensitivity.

It is important to use lead apron, thyroid protector, goggles and gloves to protect against radiation. According to the results of research conducted by Vural *et al.*, 96% of the participants reported that there were no glasses or gloves in the operating room, and 70% of the participants stated that there was no thyroid protector in the operating room. While all of the nurses have knowledge about the presence of thyroid protective, 39% of the other health workers have knowledge [24]. In our study, 98% of health care workers were found to have higher levels of knowledge and awareness about protective equipment. In a study conducted by Vural *et al.*, it was determined that only 10% of the personnel working in the operating rooms received training on radiation safety [24]. And in our study, 32.7% of the participants stated that they had received radiation and safety training. This is due to the fact that over time, health workers have increased awareness and knowledge about radiation safety. In addition, management of the health care institution is thought to play an important role in this issue. It can cause life threatening risks to work personnel who are working in this field without giving necessary training, trainings related to radiation safety should be planned.

We find that an awareness of the health risks associated with ionising radiation is lacking, and furthermore, that this is in general agreement with the results of other similar surveys [17, 25-27].

Poor knowledge and underestimation of radiation doses may lead to ionising imaging examinations being prescribed unnecessarily, resulting in an increased risk for patients [28]. It is also apparent that this lack of knowledge will make it difficult to inform patients about the risks and benefits of a radiological examination. Ukkola *et al.* (2016) showed that the majority of patients wanted to know about radiation dose and the risks associated with this radiation [29] and instructing patients about radiation and its effects is an integral part of the medical personnel's responsibility. The referrer should ensure that the patient is provided with adequate information about the benefits and risks associated with the radiation dose from medical exposure prior to the examination [30]. Without this information, the patient is unable to make decisions about alternative treatments based on the advantages and disadvantages of a particular procedure. This is also important for both health workers and patients.

CONCLUSION

In order to understand the level of information about radiation safety of health workers, the number of scientific studies carried out in Turkey is very limited. In this study were investigated information levels and attitudes of health workers regarding radiation safety. As a result, healthcare personnel working with ionizing radiation sources have a problem in transforming their knowledge and attitudes about radiation safety into behavior. Failure to

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provide the necessary personnel protective equipment to healthcare personnel and to ensure that their working time is not regulated in accordance with the regulation may create problems in terms of both occupational safety and legal aspects. Therefore, due to negligence of the healthcare institution, there may be a variety of criminal sanctions as a result of possible negative consequences. In order to prevent risks, human resources planning should be done correctly, risk analysis methods should be applied and internal training should be realized.

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Conflicts of interest*: *Declared none.

REFERENCES

1. Scientific committee on effects of atomic radiation, United Nations. Sources and effects of ionzing radiation: UNSCEAR 2000 Report. New York, United Nations, 2000. [Date of Access: 05.04.2018].
2. The 2007 Recommendations of the international commission on radiological protection. ICRP publication 103. *Ann ICRP,* ***37(2-4):*** *1-332.*
3. Wong C, Huang B, Sin H, *et al.* (2012) A questionnaire study assessing local physicians, radiologists and interns' knowledge and practice pertaining to radiation exposure related to radiological imaging. *Eur J Radiol*, ***81:*** *264-268.*
4. Shahbazi-Gahrouei D (2006) Entrance surface dose measurements for routine X-ray examinations in Chaharmahal and Bakhtiari hospitals. *Iran J Radiat Res*, ***4 (1):*** *29-33.*
5. Osullivan J, Oconnor O, Oregan K, *et al.* (2010) An assessment of medical students' awareness of radiation exposures associated with diagnostic imaging investigations. *Insights Imaging,* ***1(1):*** *86-92.*
6. Baumann B, Chen E, Mills A, *et al.* (2011) Patient perceptions of computed tomographic imaging and their understanding of radiation risk and exposure. *Ann Emerg Med,* ***58:*** *1-7.*
7. Blakely EA, Kleiman NJ, Neriishi K, *et al.* (2010) Radiation cataractogenesis: Epidemiology and biology. *Radiation Research,* ***173(5):*** *709-717.*
8. Hammer GP, Scheidemann-Wesp U, Samkange-Zeeb F, *et al.* (2013) Occupational exposure to low doses of ionizing radiation and cataract development: A systematic literature review and perspectives on future studies. *Radiation and Environmental Biophysics,* ***3:*** *303-319.*
9. Brent GA (2010) Environmental exposures and autoimmune thyroid disease. *Thyroid,* ***20(7):*** *755–761.*
10. Imaizumi M, Usa T, Tominaga T, *et al*. (2006) Radiation dose-response relationships for thyroid nodules and autoimmune thyroid diseases in Hiroshima and Nagasaki atomic bomb survivors 55–58 years after radiation exposure. *JAMA,* ***295:****1011-1022.*
11. Rahman N, Dhakam S, Shafqut A, *et al.* (2008) Knowledge and practice of radiation safety among invasive cardiologists. *J Pak Med Assoc,* ***58:*** *119-22.*
12. Johnson RH (2001) The role of the radiation safety specialist as witness: risk communication with attorneys, judges, and jurors. *Health Phys,* ***81:*** *661-9.*
13. Slechta AM, Reagen ST (2008) An Examinatian of Factors Realated to Radiatian Protection Practices. *Rad.Tech,* ***79 (4):*** *297-305.*
14. Reagen JT, Slevhta AM (2010) Factors Reated To Radiation Safety Practices in Colifornia *Radiologic Tecnology,* ***81(6):*** *538-547.*
15. Kahraman G, Ozyigit G, Kaya S (2016) The Awareness of Health Employees Working in Units of Radiology, Radiotherapy and Nuclear Medicine in Hospitals. *Hacettepe Saglik Idaresi Dergisi*, ***19(3):*** 305-324.
16. Alotaibi M, Saeed R (2006) Radiology nurses' awareness of radiation. *Journal of Radiology Nursing* ***25(1):*** 7-12.
17. Yurt A, Cavusoglu B, Gunay T (2014) Evaluation of awareness on radiation protection and knowledge about radiological examinations in healthcare professionals who use ionized radiation at work. *Molecular Imaging and Radionuclide Therapy* ***23(2):*** 48-53.
18. Tuzuner VL, Ozaslan BO (2011) A research based on the evaluation of occupational safety and health applications in hospitals. Journal of Istanbul University School of Business Administration, ***40(2):*** 138-154.
19. Devebakan N, Pasali N (2015) Evaluation of Service Quality Standards in Health Care Organizations by Health Care Professionals: A Research on Izmir Province. Hacettepe Sağlık İdaresi Dergisi, ***18(2):*** 123-142.
20. Hisar A (2013) The effect of risk management on occupational safety in healthcare services and a case study. Dokuz Eylül University, Institue of Social Sciences Master Thesis.
21. Guden E, Oksuzkaya A, Balci E, *et al.* (2012) Behavior, Attitude and Knowledge of Staffs of Radiology Unit About Safety of Radiology. *Sağlıkta Performans ve Kalite Dergisi,* ***(3):*** *29-45.*
22. Keijzers GB, Britton CJ. (2010) Doctors' knowledge of patient radiation exposure from diagnostic imaging

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requested in the emergency department. Med J Aust, ***193 (1):*** 450-453.
23. Alotaibi M, Saeed R (2006) Radiology nurses' awareness of radiation. J Radiol Nurs **25(1):** 7-12.
24. Vural F, Fil S. Ciftci S, *et al.* (2012) Radiation safety in operating units; knowledge, attitude and behaviors of operating room staffs. *Balıkesir Sağlık Bilim Derg, **1(3):** 131 -136.*
25. Arslanoğlu A, Bilgin S, Kubalı Z, *et al.* (2007) Doctors' and intern doctors' knowledge about patients' ionizing radiation exposure doses during common radiological examinations. *Diagn Interv Radiol **13:*** 53-55.
26. Ozturk YE, Turktemiz H, Akdag T (2017) The Effect of Workload on Risk Perception of Ionizing Radiation in Healthcare Workers Who Carry the Dosimeter. *Hacettepe Sağlık Idaresi Dergisi, **20(2):** 143-155*.
27. Uzuntarla Y and Doğan F (2019) Determination of risk perception and knowledge level of ıonizing radiation of health personnel who carry the dosimeter in a training and research hospital. *Journal of Health Science and Profession, **6(1):** 34-41*.
28. Kada S (2017) Awareness and knowledge of radiation dose and associated risks among final year medical students in Norway. *Insights Imaging, **1(8):** 599–605*.
29. Ukkola L, Oikarinen H, Henner A, *et al.* (2016) Information about radiation dose and risks in connection with radiological examinations: what patients would like to know. *Eur Radiol, **26(1):** 436–443*.
30. Paolicchi F, Miniati F, Bastani L, *et al.* (2016) Assessment of radiation protection awareness and knowledge about radiological examination doses among Italian radiographers. Insights Imaging ***7(2):*** 233–242.

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