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Research Article

Evaluation of Radiation Protection Knowledge and Attitudes of Health Services Vocational School Students Participating in Practice in Radiated Environments

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Abstract:

The use of new diagnostic and treatment methods in the field of health exposes many health workers to the dangers of ionizing radiation. In this study, the radiation protection knowledge and attitudes of the students of the Health Services Vocational School, which trains health technicians at the associate degree level, were evaluated by survey method. The research population consists of 123 students who are receiving education in the Radiotherapy and Medical Imaging Techniques programs of the Istanbul Okan University Health Services Vocational School and who are doing internship, practice or skill training in the radiation environments of hospitals. A survey consisting of 36 questions was prepared within the scope of the research and the survey questions were applied through face-to-face interviews. A significant relationship was found between the participants' internships in diagnostic radiology units such as fluoroscopy and scopy, which have high radiation intensity, and their knowledge levels. While a statistically significant difference was found between the programs in terms of the students' radiation protection knowledge ($p<0,05$), no such difference was observed in terms of their attitudes.

1. Introduction

Today, the importance of occupational health and safety in the health sector has been better understood. Not only doctors and nurses, but also personnel from many different professional groups work in the health sector. The health sector stands out as one of the most dangerous occupations among countries, and employees are constantly faced with various dangers and risks. According to the modern approach, laws enacted in many countries emphasize that individuals have social, cultural, economic, political and civil rights. The right to health is considered one of the most prioritized among basic human rights. This situation brings with it the demand of people from societies, public administrations and workplaces to protect their health, to be treated and to be secured in this process [1].

Occupational health is a branch of science that examines the interaction between employees' work life and their health status and investigates the factors that may have negative effects on health in the work environment. At the same time, it conducts studies to determine the measures that will protect employees from these negative factors. The main purpose of occupational health services is to maximize the work efficiency of healthcare workers, to prevent health problems that may be caused by hazards and risks, and to ensure that the work is adapted to the individual capacity, physiological and psychological abilities of the worker [2].

Many studies have been conducted worldwide on the level of knowledge regarding radiation safety practices. One of these was conducted by Foley et al. in 2013. In this study, questions were asked to computed tomography (CT) technicians and radiologists about the irradiation parameters that affect patient dose and image quality. The study revealed that there were significant differences in the understanding of CT parameters, and in particular, there was diversity in the effects of automatic irradiation and kV and mAs parameters on patient dose and image quality. As a result of the study, it was determined that radiologists were not aware of the reference dose levels. The researchers drew attention to three important points as a result: First, CT users should be able to adapt the parameters to reduce patient dose and increase image quality. Second, the effects of some parameters are not fully understood. Finally, it was stated that regular in-service practical training is needed for dose optimization [3].

Another study was conducted by Ramanathan and Ryan in 2014. In this survey, only 48% of the participants could reach a 50% correct answer rate. In addition, the participants' dose estimates for the examinations were 50-70% lower than the actual doses. It was observed that there were differences and deficiencies in the knowledge levels of the technicians regarding radiation doses during pregnancy. It was determined that the technicians had less information about radiation dose and cancer risk than radiologists and other healthcare professionals. It was concluded that the lack of information and low dose estimates, especially about dose and cancer risk, could lead to unnecessary and excessive dose use [4].

One of the professional groups that apply radiation to patients in the healthcare sector is medical imaging technicians and radiotherapy technicians. The training periods, professional names and responsibilities of Medical Imaging and Radiotherapy Technicians vary from country to country around the world. These differences have led to the need to establish common standards for Radiation Safety and Protection training. The first step taken in this direction was carried out by the European Union and the European Commission published a recommendation decision that determines the basic headings of radiation protection training and defines Radiation Safety and Protection competencies in all health professions.

The aim of this study is to determine the knowledge levels and attitudes of students studying in the Medical Imaging and Radiotherapy programs of Istanbul Okan University Health Services Vocational School on radiation safety during their internships and skills training in areas with ionizing radiation in the hospital environment.

2. Material and Methods

The universe of the study consists of 123 students who are receiving education in the Radiotherapy and Medical Imaging Techniques programs of Istanbul Okan University Health Services Vocational School and who are doing internship, practice or skill training in radiation environments in hospitals. No sample was selected, the entire universe was included in the study. A 36-question survey form was prepared by the researchers as a result of literature review and examination of previous thesis studies as a data collection tool. The form was revised in line with the opinions and criticisms of public health experts, radiologists, radiology workers, and occupational health and safety experts. The survey includes 12 questions examining the socio-demographic characteristics of the participants, 4 questions examining their attitudes towards radiation protection, and 20 questions evaluating their radiation knowledge. The questions measuring the level of knowledge are in the form of 20 propositions focusing on general radiation knowledge, biological effects, and legal dose limits depending on factors such as pregnancy and age, where wrong does not cancel right. Each correct answer is worth 5 points, and this section is evaluated out of 100 points. The survey was applied by face-to-face interview method. In the analysis of data, within the scope of descriptive statistics, number and percentage distributions, means and standard deviations were calculated. For analytical statistics, Independent Groups t Test and Chi-Square Tests were used to evaluate the data. The statistical significance level was accepted as $p<0,05$, and the results were interpreted within a 95% confidence interval.

3. Findings

A total of 123 students participated in this study; 83 (67,5%) of them were second-year students in the Medical Imaging Techniques program at Istanbul Okan University, School of Health Services, and 40 (32,5%) were second-year students in the Radiotherapy program. The mean general knowledge score of the participants was calculated as 53,24 ± 2,14. 65 students, constituting 52,8% of the participants, obtained a knowledge score above this mean. The mean knowledge score according to the programs was determined as 54,85 ± 7,84 for Medical Imaging Techniques students and 49,21 ± 1,31 for Radiotherapy students (Table 1).

Table 1. *Number of Participants and Average Knowledge Scores*

Participants	Number of Participants	Average Knowledge Scores
Medical Imaging Techniques	83	54,85 ± 7,84
Radiotherapy	40	49,21 ± 1,31
TOTAL	123	53,24 ± 2,14

The average age of the participants was calculated as 21,33 ± 2,11. When gender distribution was examined, 41% of the participants were male and 59% were female. It was determined that there was no significant difference in knowledge levels based on gender (p>0,05). Similarly, no significant difference was found in terms of knowledge levels among the students of the Radiotherapy and Medical Imaging Techniques Program (p>0,05). It was observed that the participants worked in more than one department in the diagnostic radiology units where they performed their internship and skill training. 98,7% of the students participated in direct radiography, 93,8% in Computed Tomography (CT), 54,6% in Magnetic Resonance (MR), 48,2% in Mammography, 31,8% in Other (Scopy/Bone Densitometry), 24,2% in Fluoroscopy and 18,5% in Nuclear Medicine units for practice/internship/skill training (Table 2). Table 3 shows students' knowledge levels on radiation.

A significant relationship was found between the knowledge levels of students who participated in applications in units that involve high levels of radiation, such as fluoroscopy and scopy, and their participation (p=0,012). When we look at the use of dosimeters and lead aprons, 85% of radiotherapy workers correctly know that the dosimeter should be worn over the lead apron during conventional radiologic procedures. This rate is 75,9% among medical imaging workers, but 14,5% do not agree on this issue. This may indicate that medical imaging workers lack knowledge about dosimeter use or that incorrect practices are being implemented.

When we look at the use of lead aprons and protective screens, both groups are aware of the need to stand behind protective screens (radiotherapy: 95%, medical imaging: 98,8%). However, there are different opinions on whether lead aprons are necessary. While 50% of radiotherapy workers think that wearing lead aprons is not necessary, this rate is 53% among medical imaging workers. This situation reveals that some workers have different approaches to the use of protective equipment.

The level of awareness regarding the use of radiation glasses as radiation protection equipment is quite different in both groups. While 65% of radiotherapy workers think that glasses should be worn, this rate is 43,4% among medical imaging workers. This difference may indicate that radiotherapy workers are more aware of the harmful effects of radiation. When radiation doses and time restrictions are examined, awareness of the duration of exposure to ionizing radiation and the amount of dose varies between the two groups. 90% of radiotherapy workers know that the five-year average dose should not exceed 50 mSv. Among medical imaging workers, 56,7% are aware of this rule. Similarly, while 90% of radiotherapy workers have the knowledge that the annual dose of pregnant women should not exceed 1 mSv, this rate is 63,9% among medical imaging workers. This situation indicates the need for additional training in the field of medical imaging, especially for pregnant workers. In cases of students and radiation exposure, awareness of information about radiation exposure is quite low among medical imaging workers (37,3%) for students in the 18-24 age group. This shows that awareness should be increased, especially for students during internships or practical training. Regarding the Radiation Risk in Pregnancy, 67,5% of radiotherapy workers know that the radiation risk during pregnancy is highest in the first trimester and decreases in the following periods. This rate is quite low among medical imaging workers at 19,3%. This result shows that there is a significant knowledge gap regarding the effects of radiation on the fetus. Regarding the ventilation of radiation areas and the use of protective clothing, both groups highly accept that areas where radiation is used should be regularly ventilated (radiotherapy: 100%, medical imaging: 98,8%). Similarly, both groups are quite conscious about the wearing of protective clothing (radiotherapy: 97,5%, medical imaging: 96,4%). However, the awareness rate regarding the process of removing protective clothing in the medical imaging field is slightly lower at 90,4% compared to radiotherapy workers (92,5%).

Table 2. *Distribution of participants according to the diagnostic radiology units where they did their practice/internship/skill training.*

Diagnostic Radiology Units	**Participant Percentages(%)**
Direct Radiography	98,7
CT	93,8
MRI	54,6
Mammography	48,2
Other (Scopy/Bone Densitometry)	31,8
Fluoroscopy	24,2
Nuclear Medicine	18,5

Table 3. *Students' Knowledge Levels on Radiation*

	Radiotherapy (n,%)			**Medical Imaging Techniques (n,%)**		
	Agree	**Disagree**	**No Opinion**	**Agree**	**Disagree**	**No Opinion**
	34	5	1	63	12	8

During conventional radiological procedures, the dosimeter is worn on the lead apron and at chest level	85%	12,50%	(%2,5)	75,90 %	14,50%	9,60%
If you go behind the protective screen while performing conventional radiological procedures, there is no need to wear a lead apron	20	18	2	44	32	7
	50%	45%	5%	53,00 %	38,60%	8,40%
Radiation protective glasses should be worn while performing conventional radiological procedures	26	12	2	36	25	22 (%26,5)
	65%	30%	5%	43,40 %	30,10%	
You should stand behind the protective screen while performing conventional radiological procedures (filming)	38	1	1 (%2,5)	82	0	1
	95%	2,50%		98,80 %	0%	1,20%
The area where ionizing radiation is performed is called the “Supervised Area”	34	4	2	30	2	51 (%61,4)
	85%	10%	5%	36,10 %	2,40%	
For those working with ionizing radiation sources, the average of five consecutive years should not exceed 50mSv as an effective dose	36	3	1 (%2,5)	32	4	47 (%56,7)
	90%	7,50%		38,60 %	4,80%	
If ionizing radiation is performed, the procedure should be performed using the lowest possible dose of radiation.	40	0	0	80	1	2
	100%	0%	0%	96,40 %	1,28%	2,40%
If ionizing radiation is performed, the maximum distance between the person and the radiation source should be provided.	34	6	0	70	4	9 (%10,8)
	85%	15%	0%	84,30 %	4,88%	
In portable radiographs, the radiologist should stay at least 1m away from the camera to reduce the effects of radiation while taking the film.	34	5	1 (%2,5)	64	9	10 (%12,0)
	85%	12,50%		77,10 %	10,80%	
The procedure should be performed as soon as possible when performing a procedure with ionizing radiation.	35	4	1 (%2,5)	78	2	3
	87,50%	10%		94,00 %	2,40%	3,60%
For students between the ages of 16 18, the effective dose that the whole body can be exposed to in 1 year is 5mSv.	31	8	1 (%2,5)	31	7	45 (%54,2)
	77,50%	20%		37,30 %	8,40%	
The tissue most affected by ionizing radiation is the nervous system and muscle tissue.	15	24	1 (%2,5)	28	21	34 (%40,9)
	37,50%	60%		32,50 %	25,30%	
While the risk of radiation in pregnant women is highest in the early fetal period (1st trimester), it gradually decreases in the 2nd and 3rd trimesters.	27	6	7 (%17,5)	16	10	57 (%68,7)
	67,50%	15%		19,30 %	12,00%	
The annual effective dose in pregnant women should not exceed 1 mSv.	36	1	3 (%7,5)	24	6	53 (%63,9)
	90%	2,50%		28,9	7,20%	
Areas where ionizing radiation is used should be continuously and regularly ventilated.	40	0 (%0)	0 (%0)	82	0	1
	100%			98,80 %	0%	1,20%
A long period of time should be allocated for the procedure when performing a procedure with ionizing radiation.	25	15 (%37,5)	0 (%0)	22	35	26 (%31,3)
	62,50%			26,50 %	42,70%	
It is necessary to use paper towels and tissues in cleaning laboratories where radioactive substances are used.	33	8	1 (%2,5)	48	14	21 (%25,3)
	82,50%	20%		57,80 %	16,90%	
Protective clothing such as protective aprons, gloves, and goggles should be worn in laboratories where radioactive substances are used.	39	1	0	80	1	2
	97,50%	2,50%	0%	96,40 %	1,20%	2,40%
It is necessary to remove protective clothing when leaving laboratories where radioactive substances are used.	37	3	0	75	5	3
	92,50%	7,50%	0%	90,40 %	6,00%	3,60%
After working with radioactive materials, it is necessary to throw the waste into the radioactive waste bin.	38	1	1 (%2,5)	81	1	1
	95%	2,50%		97,60 %	1,20%	1,20%

4. Discussion

In radiological studies, the ALARA principle is based on keeping the radiation dose received by both the patient and the radiology staff at the lowest possible level. This principle can be implemented by the physician not requesting unnecessary examinations and by the radiology staff protecting both themselves and the patient by using appropriate protection methods [5-7]. However, in the 10-year period between 1997 and 2007, there was a 50% increase in the number of radiological examinations, including medical and dental radiology, from 2,4 billion to 3,6 billion. According to the 2007 UNSCEAR report, 3,6 billion diagnostic radiographs are taken annually [8]. In addition to technological developments, this increase is also greatly affected by the low perception of the radiation dose to which the patient is exposed by the physicians who request the examinations, as determined by researchers such as Arslanoğlu and Cankorkmaz [9,10]. The results of various studies conducted on the participants' knowledge of radiation protection and the effect of the level of education on the level of knowledge are discussed. In the studies conducted, the knowledge of radiology workers and medical students about radiation protection was found to be quite low. While the average knowledge score was 82,2 in the study conducted by Slechta et al. with radiology technicians, other studies show that the knowledge level of especially medical students and interventional radiology workers is low [11]. Shabani et al. found the knowledge score of interventional radiology workers as 46, and similar results were obtained in Balsak's study [12,13]. In Kada's study, it was observed that the final year medical school students received low scores in MEMD and the organs most affected by radiation [14]. In this study, it was determined that the level of education has a positive effect on the knowledge of radiation protection. The knowledge of radiation and protection of college students was found to be higher than that of secondary school students, and this situation was parallel to the research conducted by Yenal and Ergör on occupational risk factors [15]. One of the most basic protection methods in radiology units is to wear lead aprons and protective glasses. However, in our study, it was determined that 32,1% of the students did not use lead aprons and 92,6% did not wear protective glasses during procedures such as fluoroscopy, scopy or portable radiography. Among the reasons for not using lead aprons; 9% found their use unnecessary, 9,7% said that there were no lead aprons in the department they worked in, 8,1% complained about the weight of the apron, 0,8% believed that the distance provided sufficient protection, and 2,5% stated that other employees did not wear aprons and therefore did not wear them themselves. Similarly, in the study by Balsak (2014), it was seen that the use of lead aprons in radiology units was 51% and the use of protective glasses was 14% [16]. In the study by Slechta et al., it was determined that only 31% of radiology technicians regularly used protective aprons [11]. In the study by Güden et al. (2012), it was stated that 22,5% of radiology technicians wore lead aprons. In a study conducted by Shabani et al. (2018) on interventional radiology workers, it was determined that the attitudes of the workers regarding protective measures (use of lead aprons and protective glasses, etc.) received 65 points out of 100 [13]. In a study conducted by Awosan et al. (2016) on radiology workers, the rate of protective glasses use was found to be only 4,5% [17]. When the reasons for not using protective glasses were examined, 14,3% (n=16) of the participants did not find the use of glasses necessary, 3,6% (n=4) did not believe in their protection, 71,4% (n=80) stated that there were no protective glasses in the unit they worked in, and 10,7% (n=12) did not answer the question. It was determined that the knowledge level of 9 students who found the use of protective glasses unnecessary was above the general average. This situation can be considered as an indicator that knowledge alone does not create a change in behavior. In Helvacı's (2011) study, it was stated that there was no difference between the level of school that radiology workers graduated from and their knowledge and attitudes [18]. In the literature review conducted by Holmström and Ahonen on radiology student education, it was emphasized that students behave like the people they work with and take radiology workers as role models in terms of protection from unsafe practices and finding support in their professional lives [19]. Although vocational school students have a higher level of knowledge, it is striking that they exhibit similar attitudes to secondary school students regarding radiation protection. This supports the fact that receiving professional education does not create a significant difference in personal safety practices, as stated in Tilson's study [20]. Participants did not receive radiation protection knowledge while doing practice, internship or skill training in diagnostic radiology units. Radiation is well studied and reported in the literature [21-33].

5. Conclusions

There are intern students in many departments of hospitals that are classified as dangerous or very dangerous. The knowledge level of the intern students who participated in our research regarding radiation protection and occupational health and safety was found to be quite low. It is seen that it is not enough for students to be protected from the harmful effects of radiation with the "Radiation Protection" courses they take at school. Considering that 100% of the students work in controlled areas, it is recommended that they should be provided with the use of personal dosimeters.

Since it is thought that correct behaviors regarding occupational health and safety can be developed with experience and in-service training in the profession, it is insufficient to leave the protection of intern students regarding radiation safety only to the current laws and school education. Therefore, it is recommended that they undergo health checks like other personnel working in radiology departments before starting their internship/practice/skill training, and that routine checks should be carried out together with the personnel. In addition, it is thought that occupational accident and occupational disease insurance should be made mandatory for all students.

In order to limit the doses to which students working as radiation officers are exposed, it is recommended that their working hours be counted as internship/practice training. It is thought that these measures should also be applied to intern students over the age of 18. In this way, the risk of students experiencing health problems in the future due to the stochastic effects of ionizing radiation will be reduced.

Although the Regulation on Workers with Ionizing Radiation tries to protect intern students between the ages of 16-18 by limiting their annual exposure dose and work areas, it is emphasized that similar regulations should be made for students over the age of 18.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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