Determination of Awareness Levels of Health Services Vocational School Students about X-Ray Radiation

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ABSTRACT

This study was carried out to evaluate the radiation awareness of the students who receive education in various fields in hospitals in the future and to draw attention to this subject. It is very important for the health of the students who will work in the field of radiation to be aware of radiation as it is their profession. At the same time, even if the students of other departments will not be able to work, they will radiation services for diagnosis or treatment at some point in their lives. For this reason, the study was conducted for health care providers and service recipients in the future. It was applied to all associate degree program students at Toros University Health Service Vocational School between November-December 2021. Thus, the difference between the Medical Imaging While there was a significant difference in terms of X-ray knowledge level (t=7,470; p=0.000), awareness (Z=-3.406; p=0.001), awareness of radiation protection (64; p=0.000), there was a statistically significant difference according to age and gender no difference was detected. Techniques for students who receive training on radiation and the students in other programs that are not given information about radiation in the training content have been revealed.

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INTRODUCTION

X-rays were first discovered by the German physicist W. Conrad Roentgen in 1895, and electromagnetic radiation, of which they are a part, has become more and more a part of our lives every year in parallel with technological developments. Electromagnetic radiation has been used mainly in production, agriculture, commerce, and many sectors for diagnosis and treatment in the years after the 1950s, and there has been no research on its harmful effects on living organisms (Bałturkiewicz.,1999). The shortest wavelength in the electromagnetic spectrum, which includes all types of radiation; cosmic rays, γ-gamma, and X-rays, those with larger wavelengths; covers electromagnetic waves ranging from ultraviolet, visible light, infrared, and radio waves at the other end (Mitchel et al.,1999). Radio waves that are in the electromagnetic spectrum and do not cause ionization are visible light, microwaves, infrared light, ultraviolet light. Radiation can be divided into two groups: ionizing radiation and non-ionizing radiation. X and gamma rays are types of ionizing radiation and have harmful effects on human health. Although it has an atom-wide wavelength and causes harmful effects on living tissue, it is frequently used in the diagnosis of many diseases and the treatment of cancerous tissue. It also allowed the development of the radioscopy method by utilizing the fluorescence properties of X-rays and the production of radiography tools known as ranforsators. Ionizing radiation causes biological effects in two ways: stochastic and deterministic effects. These effects depend on the total dose received by the tissues and organs, the dose rate, the width of the area exposed to radiation, the radiation sensitivity, and the type of radiation (Arıkan .,2007, Çelik .,2013).

Low radiation dose in radiology used for diagnostic purposes in medicine causes stochastic effects. Because of the high X-ray energy applied for treatment, deterministic effects may occur. However, the sensitivity of each tissue to radiation is different.

Table 1. Radiation sensitivity classification (Kurtman, 2018)

Radiation Sensitive	Radiation Resistant
Hematological stem cells, Blood-immune cells, Epithelium stem cells, Stem-gamete cells in the reproductive system, Embryo cells Lens Retina	Muscle tissue Nervous tissue Mature bone tissue

The temperature of the organism, the amount of oxygen in the tissues, and the metabolic activities are directly proportional to the sensitivity to radiation. In other words; as the tissue's ability to divide increases, its sensitivity also increases. Accordingly, as given in the table above, the sensitivity of the tissues in the organism changes. At the same time, the amount of dose taken varies according to the type of tests used for diagnostic purposes. As can be seen in the table below, the difference between the dose received in the direct x-ray and the radiation dose in the CT examination is quite high.

Table 2. Dose amounts in some radiological examinations (accessed: March 08, 2022)

Study	**Dose (mSv)**
Whole-body CT	12
Anteroposterior chest X-ray	0,02
Anteroposterior and lateral chest X-ray	0,1
Lung CT	8
Pelvic CT	6
Abdominal CT	14

Although the radiation used is X-ray, the amount of doses received by the person varies due to the different energy produced. Since the first harmful effects of radiation, the frequency of dermatoses, hematological diseases, cataracts, and cancer are remarkably high due to the high dose exposure in radiology workers, the investigation of radiation protection methods has come to the fore (Kraska et al.,2012).

All studies are carried out within the scope of three rules in radiation protection. These;

1.1. Time rule; It is the easiest method to be applied to protect from radiation. The radiation source and the duration of stay in the area where the radioactive materials are located and the amount of dose taken are proportional to each other. The less time you stay near the device and the radioactive source, the lower the dose will be (Algüneş., 2002). The main purpose of radiological imaging; is to obtain the best quality image (ALARA principle) with the last dose. However, in interventional applications, the dose limits allowed in the international arena can be exceeded. Compared to conventional radiography, in studies such as interventional radiography, the radiation dose received by both the patient and the employee increases because the duration of the examination is prolonged (Zuguchi.,2008). In applications that require a long time for the diagnosis stage such as interventional radiology, scopic imaging, linear accelerator, gamma camera applications, patient and employee health pose a serious threat. Thus, the permissible dose amount can be exceeded. Due to the damage of radiation, the patient and the personnel who have to be with the patient during the application should be protected from radiation at the highest level (Eder.,2006, Eder.,2009, Ballsieper.,2006).

1.2. Distance rule; The mean free path of alpha and beta particles in the air is very short due to the loss of energy by ionization. Since neutron and gamma radiations have higher energies, the mean free path they take is much longer than alpha and beta particles. Thus, they travel further, causing more ionization. They slow down by releasing energy with the ionization effect. For this reason, to avoid the ionization effect of radiation, the source should be avoided as much as possible. The amount of radiation exposure will decrease inversely with the square of the distance, depending on the distance.

$I_1 / I_2 = (d_1)^2/(d_2)^2$

In the given expression, it is known as I_1: the initial intensity of the radiation, I_2: the final intensity of the radiation, d_1: the first distance, d_2: the final distance. This equation is called the inverse square law (Phillips et al.,2010, Hallenbeck., 1994)

1.3. Shielding rule; It is the most important component in radiation protection if the distance and time limitations cannot be made. Shielding is the feature of eliminating the effects of radiation or reducing it to a permissible level by placing a protective barrier between the radiation source and the person, which can create an absorption effect. There are different shielding materials and material production methods for different radiations (Yülek.,1992). The absorption property of radiation will increase at the same rate as the thickness of the material increases (Yaramış.,1985).

X-rays are used in many diagnostic procedures performed in hospitals. This makes the principles of radiation protection important. Especially IT applications have been a widely used examination in emergency applications. It is responsible for approximately 50-70% of the radiation received from CT imaging methods, which constitute 5% of all radiological examinations (Başekim.,2007, Başar.,2019). Physicians prefer CT instead of roentgenogram because it is cross-sectional in order not to miss any details. Therefore, its use is quite high. Lung CT was applied to each patient in case the PCR test did not yield clear results during the Covid-19 pandemic process. Thus, many people have been exposed to quite a lot of X-rays.

The largest share of diagnostic radiological procedures using ionizing beams is in computed tomography (Brenner et al.,2007, Tuncel.,2008, González et al.,2007). It is preferred because it gives a cross-sectional image compared to X-ray and is easier to shoot compared to MR.

Every examination performed poses risks to the health of both employees and patients. It is estimated that there are about 23 million workers worldwide, of whom about 10 million are exposed to artificial sources of radiation. Three out of every four workers exposed to artificial sources work in the medical field and receive an annual effective dose of 0.5mSv per worker (UNCLEAR., 2016).

The situation can reach much more serious figures if we take into account the health professionals who receive training as well as the working health practitioners. For this reason, ionizing radiation awareness among health practitioners working or training to work should be created and they should receive training on radiation protection. Physicians and allied health workers will minimize the exposure of both patients and those working with ionizing radiation by avoiding unnecessary examinations by taking into account the principle of ALARA (as low as reasonably achievable), which is accepted by the whole world in radiation protection. The dose rate taken will be greatly reduced when an unnecessary examination is prevented from being performed or repeated. In addition, if the time, distance, and, shielding rules are followed, other steps are carried out to be protected from ionizing radiation. Studies have shown that shielding significantly reduces the radiation level and creates a safe environment for employees (Coşkun.,2015).

MATERIALS AND METHODS

The study is on a 5-point Likert scale. Taken from the thesis prepared by Nermin Turan of Kafkas University Graduate School of Sciences Interdisciplinary Occupational Health and Safety Department.

Statistical analyzes were performed using a package program called SPSS (IBM SPSS Statistics 24). Frequency tables and descriptive statistics were used to interpret the findings.

Parametric methods were used for the measurement values suitable for normal distribution. By parametric methods, the "Independent Sample-t" test (t-table value) was used to compare the measurement values of two independent groups, and the "ANOVA" test (F-table value) method was used to compare the measurement values of three or more independent groups.

Non-parametric methods were used for the measurement values that did not conform to the normal distribution. By non-parametric methods, the "Mann-Whitney U" test (Z-table value) was used to compare the measurement values of two independent groups, and the "Kruskal-Wallis H" test ($\chi 2$-table value) method was used to compare the measurement values of three or more independent groups.

2.1. Apparatus

Table 3. Distribution of research findings

Variable (N=249)	n	%
Status		
Service provider	101	40,6
Service recipient	148	59,4
Age classes [$\overline{X} \pm$ S.S.→21,11±3,70 (yıl)]		
≤18	24	9,6
19-20	128	51,4
21-22	57	22,9
≥23	40	16,1
Gender		
Woman	199	79,9
Man	50	20,1
Education level		
Associate degree	234	94,0
License	12	4,8
Degree	3	1,2
Vocational School Department		
Mouth and dental health	22	8,9
Operating room services	19	7,7
Biomedical devices	2	0,8
Child development	17	6,9
Dialysis	21	8,5
Physiotherapy	11	4,5
First and emergency aid	14	5,7
Optician	22	8,9
Medical imaging techniques	87	35,4
Medical laboratory techniques	31	12,7

In the study, tartrazine content in selected samples was determined at 425 nm using Shimadzu brand UV–VIS spectrophotometry (UV-1800 PC model, Kyoto, Japan). Ultrapure water with a resistivity of 18.2 MΩ cm was obtained by a Milli-Q water purification system (Millipore Corp., USA).

Table 4. Distribution of findings on scales

Scales (N=249)	Average	S.S.	Median	Min.	Max.	Number of items	Cronbach-α coefficient
X-beam information	49,06	11,28	50,0	16,0	75,0	15	0,942
X-beam awareness	6,80	2,30	7,0	3,0	15,0	3	0,763
Total - GIKKFÖ	55,86	11,69	57,0	19,0	90,0	18	0,914

The distribution of the scores obtained from the scales of awareness of individuals about protection from X-rays and their reliability coefficients are given in the table. It was determined that the answers given by the individuals to the scales were at a reliable level.

Table 5. Comparison of scale scores according to the findings

Variable (N=249)	n	*Gama information* $\overline{X} \pm S.S.$	*Gama information* Median [IQR]	*Gama awareness* $\overline{X} \pm S.S.$	*Gama awareness* Median [IQR]	**Total - GIKKFÖ** $\overline{X} \pm S.S.$	**Total - GIKKFÖ** Median [IQR]
Status							
Service provider	101	54,91±10,09	57,0 [11,0]	6,38±2,69	6,0 [4,0]	61,29±10,76	61,0 [12,5]
Servicerecipient	148	45,06±10,29	45,0 [15,8]	7,09±1,95	7,0 [3,0]	52,16±10,86	53,5 [16,8]
Statistical analysis *		t=7,470		Z=-3,406		Z=-6,464	
Possibility		**p=0,000**		**p=0,001**		**p=0,000**	
Age classes							
≤18	24	46,83±11,20	48,0 [23,5]	6,67±2,59	7,0 [4,0]	53,50±11,64	54,5 [24,5]
19-20	128	49,13±10,13	49,5 [12,8]	6,91±2,07	7,0 [4,0]	56,03±10,36	57,0 [12,8]
21-22	57	50,61±12,65	53,0 [20,0]	6,86±2,47	6,0 [3,5]	57,47±13,11	60,0 [20,0]
≥23	40	47,98±12,77	48,0 [17,5]	6,48±2,61	6,0 [3,0]	54,45±13,56	54,5 [17,8]
Statistical analysis		χ^2=2,558		χ^2=2,579		F=0,889	
Possibility		p=0,465		p=0,461		p=0,447	
Gender							
Woman	199	48,36±11,26	49,0 [17,0]	6,79±2,05	7,0 [3,0]	55,14±11,41	56,0 [16,0]
Man	50	51,86±11,03	53,0 [15,0]	6,86±3,12	6,0 [5,0]	58,72±12,45	61,0 [16,3]
Statistical analysis		t=-1,974		Z=-0,720		Z=-1,937	
Possibility		**p=0,049**		p=0,472		p=0,053	
Education level							
Associate degree	234	49,07±11,30	50,0 [16,3]	6,88±2,29	7,0 [4,0]	55,94±11,71	57,0 [16,0]
Bachelor / Master	15	48,93±11,44	49,0 [20,0]	5,80±2,18	6,0 [3,0]	54,73±11,83	56,0 [20,0]
Statistical analysis		Z=-0,200		Z=-1,957		Z=-0,518	
Possibility		p=0,842		p=0,050		p=0,604	

*"Independent Sample-t" test (t-table value) for comparison of measurement values of two independent groups in data with normal distribution; "ANOVA" test (F-table value) statistics were used to compare three or more independent groups. "Mann-Whitney U" test (Z-table value) for comparison of measurement values of two independent groups in data not having normal distribution; "Krusk-Wallis H" test statistics (χ2-table value) were used to compare three or more independent groups.

A statistically significant difference was found in terms of X-ray knowledge scores according to status (t=7,470; p=0,000). X-ray knowledge scores of service providers are significantly higher than service recipients. It can be thought that the reason for its high level is because health students, especially students of medical imaging techniques, take courses related to radiation.

A statistically significant difference was found in terms of X-ray awareness scores according to status (Z=-3.406; p=0.001). X-ray awareness scores of service providers are significantly lower than service recipients.

A statistically significant difference was found in terms of awareness scale scores on protection from X-rays according to status (Z=-6.464; p=0.000). Awareness scale scores of service providers about protection from X-rays are significantly higher than service recipients.

There was no statistically significant difference in terms of X-ray knowledge, X-ray awareness, and awareness of X-ray protection scale scores according to age classes (p>0.05).

A statistically significant difference was found in terms of X-ray knowledge scores according to gender (t=-1.974; p=0.049). X-ray knowledge scores of men are significantly higher than women. It can be thought that the reason for this result is the high participation rate among male students studying in the Medical Imaging Techniques program.

There was no statistically significant difference in terms of X-ray awareness and awareness of X-ray protection scale scores according to gender (p>0.05).

There is no statistically significant difference in terms of X-ray knowledge, X-ray awareness, and awareness of X-ray protection scale scores according to education level (p>0.05).

RESULTSAND DISCUSSION

Arslanoglu et al. In their studies found that most doctors and interns underestimate radiation and do not have knowledge and awareness about protection. As a result of the analysis made by Fisher's exact k-square test, they suggested that the radiation knowledge level of doctoral candidates who had medical education should be increased (Arslanoğlu et al., 2007). According to Guduk et al. As a result of the questionnaire they applied to the patients who were examined and had the necessary diagnostic procedures, they found that 76% of the patients knew that the X-rays in the radiological examinations were harmful, but did not know what type of radiation the examinations applied during the procedure were (Guduk et al., 2018).

According to the results of the study; A statistically significant difference was found in terms of awareness scale scores on protection from X-rays according to status (Z=-6.464; p=0.000). It shows that the necessity of protection from X-rays is aware by the service providers. This result revealed a statistically significant difference in terms of X-ray knowledge scores (t=7,470; p=0,000). The reason why there is no significant difference in the scale of X-ray knowledge, X-ray awareness, and awareness of X-ray protection according to education level is that the majority of the students are at the associate degree level. The close mean age also caused no significant age-related difference. There was a significant difference in the level of knowledge of the students, who will serve the purpose of the study, about X-ray radiation and radiation protection. It is important to raise the awareness of the students who will be radiation workers. Since none of the students who were surveyed had completed the professional practice course, it should be kept in mind that their knowledge was not completed. However, even if there is no education about X-rays, it is necessary to increase the level of awareness, since they can be exposed to a radiological examination at any time. For this purpose, subjects related to radiation and radiation protection can be added to the curriculum.

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Ethical Dimension

Permission for the study was obtained from the relevant institution and the non-interventional ethics committee of a university (Decision Number: 117 and Date: 10.12.2021). For the use of the Applied Scale, Prof. Dr.'s Permission was obtained from Mustafa YÜKSEK via e-mail. Participants were included voluntarily.

REFERENCES

Arıkan, İ.H., The Effects of Environmental Radiation on the Sustainability of Life. Doctoral Thesis, Ankara University, Institute of Social Sciences ,2007.

Arslanoglu, A., Bilgin, S., Kubali, Z., Ceyhan, M. N., İlhan, M. N., & Maral, I. Doctors' and intern doctors' knowledge about patients' ionizing radiation exposure doses during common radiological examinations. *Diagnostic and Interventional Radiology*, *13*(2), 53, 2007.

Algüneş, Ç., Radyasyon Biyofiziği. Trakya Üniversitesi Rektörlüğü Yayınları, No:51. s.134, Edirne, 2002.

Bałturkiewicz Z, Musiałowicz T. 100 lat ochrony przed promieniowaniem jonizującym. Raport CLOR nr 136. Centralne Laboratorium Ochrony Radiologicznej, Warszawa,1999.

Başekim CÇ, Öztürk E. Radyasyon güvenliği açısınan doz kontrolü. BT ve ÇKBT (erişkin ve pediatrik). TURKRAD 2007. Kongres Kurs Kitabı. 27-31 Ekim 2007.

Başar Y, Karaarslan E. Bilgisayarlı tomografide doz hesaplama ve düşük doz uygulamaları. In Gelal F, editor. Radyoloji Fiziği. İstanbul: Nobel Tıp Kitabevleri; 2019.p.92-100.

Brenner DJ, Hall EJ. Computed tomography--an increasing source of radiation exposure. N Engl J Med. 2007;357:2277–84. doi:10.1056/NEJMra072149

Ballsieper B. Radiation protection material based on silicone. The United States Patent Application Publication; No: US 2006/0217477 A1, 2006.

Coşkun, A., & Mavi, B. Investigation of External Radiation Dose Changes in Some X-ray Applications. *Acta Physica Polonica, A.*, 128, 2015.

Çelik, S., Radiation Protection Program and Radiation Protection Optimization. Master Thesis, Ankara University, Institute of Nuclear Sciences,2013.

Eder H. Lead substitute material for radiation protection purposes. United States Patent; No: 7,041,995 B2, 2006.

Eder H. Lightweight radiation protection material for a large energy application range. The United States Patent Application Publication; No: US 2009/0230334 A1, 2009.

Güdük, Ö., KILIÇ, C. H., & Güdük, Ö. Radyasyonun Zararli Etkileri Hakkinda Hastalarin Bilgi Düzeyinin Değerlendirilmesi: Bir Hastane Örneği. *Adıyaman Üniversitesi Sağlık Bilimleri Dergisi*, *4*(2), 874-889, 2018.

González Abd, Mahesh M, Kim K-P, Bhargavan M, Lewis R, Mettler F, Land C. Projected cancer risks from computed tomographic scans performed in the United States in 2007. Arch Intern Med.169:2071–7, 2009.

Hallenbeck, W.H., Radiation Protection. Lewis, 269p, 1994.
https://www.trod.org.tr/app_society_patient?id=14 (accessed March 08, 2022)

Kraska A, Bilski B. Narażenie pracowników ochrony zdrowia na promieniowanie jonizujące a hipoteza Hormezy radiacyjnej. *Medycyna Pracy*;63:371-376, 2012.

Kurtman, C., Radyobiyolojide hücre siklusu, 5r ve hasar. Ankara Sağlık Hizmetleri Dergisi, 17(1), 25-27, 2018.

Mitchel, J.B., Sullivian,F.J., Bernstein, E.F., Salamon.G.D., and Glatstein,E. Biology of Chronic Radiation Effect on issues and Wound Healing. Clinic and Plastic Surgery,20(3),435-453, 1993.

Phillips, L.J., Gibbs, L.M, Goris, M.L, Segall, G.M, Denko, N.C, Arvind, A.M, Freeman, L., and Marsh, M., Radiation Safety Manual, Stanford University, 110p, 2010.

Tuncel E. Klinik Radyoloji. 2nd ed. Bursa: Nobel ve Güneş Tıp Kitabevleri, 2008.

Yülek,G.G., Radyasyon Fiziği. SEK Yayınları No:14, 198s. Ankara, 1992.

Yaramış, B., 1985. Nükleer Fizik. İstanbul Teknik Üniversitesi Fen Edebiyat Fakültesi, 258, İstanbul.

Zuguchi M., Chida K, Taura M, Inaba Y ve ark. The usefulness of non-lead aprons in radiation protection for physicians performing interventional procedures. Radiation Protection Dosimetry;131: 531-534.2008.

UNCLEAR. Radiation effects and sources: What is radiation? What does radiation do to us? Where does radiation come from? [Nairobi, Kenya?]: United Nations Environment Programme; 2016.