

Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students



Suat Çakina¹, Gülsen Gül²

^{1,2}Çanakkale Onsekiz Mart University, Health Service Vocational College, Çanakkale-Turkey

ABSTRACT: For this purpose, this study will examine the level of knowledge about the effects of radiation on pregnant women among the students of Medical Imaging Techniques at the Vocational School of Health Services of Çanakkale Onsekiz Mart University in the province of Çanakkale and compare the level of knowledge about the effects of radiation on pregnant women between the 1st grade students who have just started school and the 2nd grade students who are more experienced both theoretically and practically compared to the 1st grade students.

The knowledge level of the students who do practice/internship/skill training in diagnostic radiology units of hospitals from Çanakkale Onsekiz Mart University Vocational School of Health Services, which provides Medical Imaging and Radiology education in Çanakkale, will be determined by applying a 24-question survey.

When the answers given to the question "Do you know the time period when the fetus is most sensitive to radiation?" were analyzed, it was reported that 67.8% of the 2nd grade students knew it compared to 50.8% of the 1st grade students ($p=0.04$). When the answers to the question "Do you know the threshold radiation doses for pregnancy termination?" were analyzed; 52.5% of the 1st grade students did not know the threshold radiation dose for pregnancy termination, whereas only 40.7% of the 2nd grade students did not ($p=0.02$).

Although 2nd year Medical Imaging Techniques students have more knowledge about the pregnancy-related effects of radiation than 1st year students in terms of both theory and practice, there is still room for improvement.

KEYWORDS: Radiation, Pregnancy, Biological effect

I. INTRODUCTION

The use of radiation in medicine is increasing day by day. Radiation, fast-moving energy that is emitted as particles or waves, is in two forms non-ionizing radiation (NIR) and ionizing radiation (IR). NIR is low frequency radiation that disperses energy through heat and increased molecular movement such as ultraviolet rays (part of it), visible light, infrared rays, and radio waves. IR, which includes alpha and beta particles and some electromagnetic radiations (e.g., gamma and X-rays), can, directly and indirectly, alter the normal structure of a living cell (Bahrami Asl et al., 2023). Ionizing radiation is used in diagnostic devices such as X-rays, computed tomography (CT) and dental X-rays used in Medical Imaging (Amare & Dagne, 2020; Applegate et al., 2021). The choice of the most appropriate imaging modality in pregnant women is a common clinical question and the choice of imaging modality for such patients is a multifaceted issue. Pregnant women are often concerned about the fetus and the various risks or malformations associated with radiation exposure. Radiation exposure, which is strongly related to the stage of pregnancy and the absorbed dose, is a risk factor affecting the entire pregnancy process (Guilbaud et al., 2019; Kappas, 2022). To avoid these harmful effects of radiation and to protect radiation workers and the public from radiation, the risk/benefit concept has been developed by the International Commission on Radiological Protection (ICRP) since 1977, which recommends that radiation exposure should be kept as low as reasonable and possible for all patients. (ALARA principle "As Low as Reasonably Achievable") (Musolino, DeFranco, & Schlueck, 2008). All necessary techniques should be applied to minimize the absorbed dose. Most of the biological responses to radiation occur in the first two weeks of pregnancy, when the mother is unaware that she is pregnant, and these responses can lead to miscarriage (Belaguthi, Prashanth, Dasegowda, Sadaf, & Mirmire, 2022; Guilbaud et al., 2019; Kappas, 2022). Pregnant women should not undergo radiography unless absolutely necessary. Studies have shown that the radiation dose that can be harmful to the fetus is 5 rad (50mGy), and if the fetus is exposed to less than this amount of radiation, it is unlikely to be harmed (Belaguthi et al., 2022; Eskandar, Eckford, & Watkinson, 2010; Kappas, 2022).

Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students

The pregnancy status of all women of childbearing age should be questioned by both the physician and the radiology technician who will perform radiological imaging before the procedures to be performed with ionizing radiation. Unlike other studies, this study will examine the level of knowledge about the effects of radiation on pregnant women among the students of Medical Imaging Techniques at the Vocational School of Health Services of Çanakkale Onsekiz Mart University in the province of Çanakkale and compare the level of knowledge about the effects of radiation on pregnant women between the 1st grade students who have just started school and the 2nd grade students who are more experienced both theoretically and practically compared to the 1st grade students.

II. RESEARCH METHODS

This descriptive study was conducted between May 01, 2023 and August 30, 2023. A questionnaire form created by the researchers in line with the literature review was used to obtain the study data (Mahabob et al., 2021). The questionnaire form was delivered to the participants as an online survey. Prior to the study, approval was obtained from the Republic of Turkey Çanakkale Onsekiz Mart University Rectorate Graduate Education Institute Ethics Committee / Scientific Research Ethics Committee with the decision number 2023-YÖNP-0306, dated 14.04.2023 and E-84026528-050.01.04 document registration number. The questionnaire form consisted of 24 questions aiming to measure the demographic characteristics of the participants (age, gender, department and grade) and their knowledge about the effects of radiation on pregnant women. Previous research suggests that the study population should be at least 5 and at most 20 times the total number of items (Bryant & Yarnold, 2001; Hair, Black, Babin, & Anderson, 2019). The population of the study consisted of Çanakkale Onsekiz Mart University Vocational School of Health Services students (n=120) who went to diagnostic radiology units of hospitals in Çanakkale province for internship/practice/skill training. No sample was selected and the entire study population was included in the study. Participants were asked to answer the questions in the form created by the responsible workers. The questionnaire form was not opened on the screen of those who did not accept online consent.

Statistical analysis: The data obtained from the study were analyzed using SPSS 19.0 software package (SPSS Inc., Chicago, IL, USA). In the analyses, descriptive findings, number and percentage distributions, mean and standard deviations were given; analytical statistics will be evaluated with Independent Groups t Test, Chi-Square Tests. $p < 0.05$ will be considered statistically significant and the data were evaluated at 95% confidence interval.

III. RESULTS

In this cross-sectional study, 61 (50.8%) of the students included in the study were 1st year students and 59 (49.2%) were 2nd year students of Çanakkale Onsekiz Mart University Vocational School of Health Services, Medical Imaging Techniques. The mean age of the participants was 20.34 ± 1.57 years. It was observed that 30.0% of the participants were male and 70.0% were female.

When evaluating the knowledge about the effects of radiation on pregnant women among the students, 100% of the 1st grade students reported that X-rays were harmful for pregnant women, while only 98.3% of the 2nd grade students reported that X-rays were harmful for pregnant women and the difference was not significant ($p=0.49$) (Table 1). When the answers to the question "Do you know the time period when the fetus is most sensitive to radiation?" were analyzed, it was reported that 67.8% of the 2nd grade students knew, compared to 50.8% of the 1st grade students ($p=0.04$). Another interesting observation was seen in the responses to the question "Do you know the threshold radiation doses for pregnancy termination?"; 52.5% of the 1st grade students did not know the threshold radiation dose for pregnancy termination, whereas only 40.7% of the 2nd grade students did not ($p=0.02$). The responses to other questions related to the level of knowledge are shown in Table 1.

Question	Answer	1st Grade (n,%)	2nd Grade (n,%)	p value
Are X-rays harmful for pregnant women?	Yes	61 (%100)	58 (%98.3)	0.49
	No	0 (%0)	1 (%1.7)	
Do radiographs have deterministic and stochastic effects on pregnancy?	Yes	61 (%100)	58 (%98.3)	0.49
	No	0 (%0)	1 (%1.7)	
Does radiation cause preterm labor and low birth weight in the fetus?	Yes	59 (%96.7)	57 (%96.6)	0.68
	No	2 (%3.3)	2 (%3.4)	
Do you know the safe radiation dose?	Yes	53 (%86.9)	55 (%90.0)	0.20

Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students

I have knowledge about X-rays.	No	8 (%13.1)	4 (%10.0)	0.26
	Yes	59 (%96.7)	59 (%100.0)	
Do you know the ALARA-protection principle?	No	2 (%3.3)	0 (%0.0)	0.62
	Yes	57 (%93.4)	55 (%93.3)	
Are you aware of safety methods such as lead aprons, digital radiography?	No	4 (%6.6)	4 (%6.7)	0.51
	Yes	59 (%96.7)	58 (%98.7)	
Do you know when the fetus is most sensitive to radiation?	No	30 (%49.2)	19 (%32.2)	0.04*
	Yes	31 (%50.8)	40 (%67.8)	
Do you know the threshold radiation doses for pregnancy termination?	No	38 (%52.5)	24 (%40.7)	0.02*
	Yes	23 (%37.7)	35 (%59.3)	

When the attitude towards the effects of radiation on pregnant women was examined (Table 2.), 79.7% of 2nd year students agreed with the question "Do you think that dental and medical clinics using radiography should be compulsorily accredited and monitored by regulatory bodies?" (p=0.04). Both 42.6% of 1st grade students and 66.1% of 2nd grade students "strongly disagreed" with the statement "Radiation-related examinations can be performed during certain periods of pregnancy" (p=0.04).

Table 2. Attitudes among students regarding the effects of radiation on pregnant women (* statistically significant)

Answer	Grade	Strongly Agree (n,%)	Agree (n,%)	Neither agree nor disagree (n,%)	Disagree (n,%)	Strongly Disagree (n,%)	p value
Do you think X-rays should be taken during pregnancy?	1	1 (%1.6)	3 (%4.9)	5 (%8.2)	19 (%31.1)	33 (%54.1)	0.35
	2	0 (%0.0)	0 (%0.0)	7 (11.9)	21 (%35.6)	31 (%52.5)	
X-rays should only be taken with appropriate protection techniques if absolutely necessary.	1	23 (%37.7)	32 (%52.5)	2 (%3.3)	3 (%4.9)	1 (%1.6)	0.66
	2	18 (%30.5)	32 (%54.2)	4 (%6.8)	2 (%3.4)	3 (%5.1)	
Education and training programs should be conducted to raise awareness among radiology students about the effects of radiation in pregnant women.	1	27 (%44.3)	26 (%42.6)	3 (%4.9)	2 (%3.3)	3 (%4.9)	0.24
	2	27 (%45.8)	30 (%50.8)	2 (%3.4)	0 (%0.0)	0 (%0.0)	
Do you think there should be mandatory accreditation and monitoring of dental and medical clinics using radiography by regulatory bodies?	1	20 (%32.8)	33 (%54.1)	6 (%9.8)	1 (%1.6)	1 (%1.6)	0.04*
	2	8 (%13.6)	47 (%79.7)	4 (%6.8)	0 (%0.0)	0 (%0.0)	
Pregnant women are allowed to enter radiation fields.	1	1 (%1.6)	2 (%3.3)	1 (%1.6)	8 (%13.1)	49 (%80.3)	0.50
	2	0 (%0.0)	1 (%1.7)	1 (%1.7)	14 (%23.7)	43 (%72.9)	
Radiation-related examinations can be performed during certain periods of pregnancy.	1	3 (%5.1)	7 (%11.5)	14 (%23.0)	26 (%42.6)	12 (%19.7)	0.01*
	2	0 (%0.0)	12 (%20.3)	3 (%5.1)	39 (%66.1)	5 (%8.5)	

IV. DISCUSSION

Cancerous conditions, miscarriage, mutagenic changes in the fetus, cataracts, etc. are strongly associated with radiation exposure. The radiation effect can be stochastic, leading to the emergence of biological hazards. Therefore, radiation protection protocol should be followed and healthcare personnel should limit radiation exposure with the concept of the ALARA principle

Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students

keeping it "As Low As Reasonably Achievable" (Kappas, 2022; Shaw, Duncan, Vouyouka, & Ozsvath, 2011). Therefore, a rigorous knowledge of the biological hazards of X-rays is required, and with this in mind, this study assessed the knowledge of medical imaging techniques students of the vocational school of health services regarding the impact of radiation among pregnant women. Existing studies have revealed that the majority of medical and medical imaging techniques students think that X-rays are harmful. This percentage is particularly higher for medical imaging techniques students compared to dental students and this may be due to a strong course on radiology with special emphasis on biological hazards and different methods of protection. In this study, 96.7% of 1st year medical imaging techniques students and 96.6% of 2nd year medical imaging techniques students knew that X-rays cause preterm labor and low birth weight. The results do not support the study by Mortazavi SMJ et al. which found no statistically significant difference between the mean weights of newborn babies whose mothers were and were not exposed to some common sources of ionizing and non-ionizing radiation (Mortazavi, Shirazi, & Mortazavi, 2013). In the present study, 86.9% of 1st year medical imaging techniques students and 90.0% of 2nd year medical imaging techniques students were aware of the safe radiation dose. This means that approximately 10% of medical imaging technics students are unaware of the biological hazards of radiation. Even existing studies show that the first period is mainly the vulnerable period during pregnancy and exposure can lead to certain defects (Guilbaud et al., 2019; Kappas, 2022). In this study, both medical imaging techniques 1st year students and medical imaging techniques 2nd year students stated that radiographic procedures should not be performed on pregnant women unless there is an absolute necessity, and if the procedure is necessary, all necessary precautions should be taken to minimize the radiation dose and its effects. It was also observed that the majority of 2nd year medical imaging techniques students had a positive attitude towards mandatory accreditation and monitoring of dental and medical clinics using radiography by regulatory bodies. Although students have moderate knowledge and positive attitudes towards radiation protection measures, there is still room for improvement. Awareness training programs should be planned to increase their knowledge about the safety of radiographic procedures and the use of protective techniques in pregnant women.

V. CONCLUSION

Although 2nd year Medical Imaging Techniques students are more knowledgeable about the pregnancy-related effects of radiation than 1st year students, both theoretically and practically, there is still room for improvement. In fact, continuous education and training programs should be conducted at intervals to strictly follow the protocols of different radiographic protection regulations for pregnant women.

REFERENCES

- 1) Amare, D. E., & Dagne, H. (2020). Knowledge and Associated Factors of Medical Students Regarding Radiation Exposure from Common Diagnostic Imaging Procedures at the University of Gondar, Ethiopia. *Ethiop J Health Sci*, 30(4), 589-598. doi:10.4314/ejhs.v30i4.14
- 2) Applegate, K. E., Findlay, Ú., Fraser, L., Kinsella, Y., Ainsbury, L., & Bouffler, S. (2021). Radiation exposures in pregnancy, health effects and risks to the embryo/foetus-information to inform the medical management of the pregnant patient. *J Radiol Prot*, 41(4). doi:10.1088/1361-6498/ac1c95
- 3) Bahrami Asl, F., Islami-Seginsara, M., Ebrahimi Kalan, M., Hemmatjo, R., Hesam, M., & Shafiei-Irannejad, V. (2023). Exposure to ionizing radiations and changes in blood cells and interleukin-6 in radiation workers. *Environ Sci Pollut Res Int*, 30(13), 35757-35768. doi:10.1007/s11356-022-24652-8
- 4) Belaguthi, P. P. K., Prashanth, S., Dasegowda, G., Sadaf, S., & Mirmire, S. (2022). Radiation exposure in pregnancy: need for awareness. *International Journal Of Community Medicine And Public Health*, 9(7), 2987-2991. doi:10.18203/2394-6040.ijcmph20221771
- 5) Bryant, F., & Yarnold, P. (2001). Principal-component analysis and exploratory and confirmatory factor analysis.
- 6) Eskandar, O., Eckford, S., & Watkinson, T. (2010). Safety of diagnostic imaging in pregnancy. Part 1: X-ray, nuclear medicine investigations, computed tomography and contrast media. *The Obstetrician & Gynaecologist*, 12(2), 71-78. doi:https://doi.org/10.1576/toag.12.2.71.27571
- 7) Guilbaud, L., Beghin, D., Dhombres, F., Blondiaux, E., Friszer, S., Ducou Le Pointe, H., . . . Jouannic, J.-M. (2019). Pregnancy outcome after first trimester exposure to ionizing radiations. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, 232, 18-21. doi:https://doi.org/10.1016/j.ejogrb.2018.11.001
- 8) Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate Data Analysis*: Cengage.

Level of Knowledge about the Effects of Radiation on Pregnant Women among Medical Imaging Techniques Program Students

- 9) Kappas, C. (2022). Pregnancy and medical radiation. *Radiation Physics and Chemistry*, 201, 110478. doi:<https://doi.org/10.1016/j.radphyschem.2022.110478>
- 10) Mahabob, M. N., Alabdulsalam, M., Alabduladhem, A., Alfayz, S., Alzurriq, A., & Almomin, A. M. (2021). Knowledge, Attitude and Practice about radiation safety among the undergraduates in Eastern province dental college. *J Pharm Bioallied Sci*, 13(Suppl 2), S1442-s1447. doi:10.4103/jpbs.jpbs_248_21
- 11) Mortazavi, S. M., Shirazi, K. R., & Mortazavi, G. (2013). The study of the effects of ionizing and non-ionizing radiations on birth weight of newborns to exposed mothers. *J Nat Sci Biol Med*, 4(1), 213-217. doi:10.4103/0976-9668.107293
- 12) Musolino, S. V., DeFranco, J., & Schlueck, R. (2008). The ALARA principle in the context of a radiological or nuclear emergency. *Health Phys*, 94(2), 109-111. doi:10.1097/01.HP.0000285801.87304.3f
- 13) Shaw, P., Duncan, A., Vouyouka, A., & Ozsvath, K. (2011). Radiation exposure and pregnancy. *Journal of Vascular Surgery*, 53(1, Supplement), 28S-34S. doi:<https://doi.org/10.1016/j.jvs.2010.05.140>



There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.