

RESEARCH

Open Access



Investigation of the role of radiation protection knowledge of health workers on radiation attitude

Ali Göde^{1*} , Hatice Erdem¹ , Abdullah Dadak¹ and Güneş Açıkgöz¹

Abstract

Purpose The aim of this study was to examine the relationship between radiation protection knowledge of health workers and their attitudes towards radiation. In this context, it was investigated how much knowledge health workers have about radiation safety and how this knowledge is associated with their attitudes towards radiation.

Methods A quantitative research design was used in this study. Using convenience sampling method, 309 health workers were included in this study. “Personal Information Form”, “Radiation Protection Knowledge Scale” and “Radiation Attitude Scale” were used in the study. The data were analyzed with the Statistical Package for the Social Sciences (SPSS) program.

Results A statistically significant difference was found between the radiation protection knowledge levels of the health workers participating in the study according to their occupational groups. It was observed that the support staff of health workers had a lower level of radiation protection knowledge than doctors and nurses. A positive relationship was observed between radiation protection and radiation attitude of health workers. In addition, a positive association between radiation protection knowledge and radiation attitude was also observed.

Conclusions According to the results of the study, an increase in health workers’ knowledge of radiation protection is positively associated with their attitudes and behaviors regarding radiation safety.

Clinical trial number Not applicable.

Keywords Health workers, Radiation, Radiation protection, Radiation attitude

Introduction

Technological advances in healthcare have introduced many innovations to improve diagnosis and treatment processes [1]. In this context, the use of radiation in medical applications has become an essential component of both diagnosis and treatment. However, improper or

unconscious use of radiation can pose potential risks to healthcare professionals and patients [1–3].

According to the International Atomic Energy Agency (IAEA), radiation involves the propagation and transportation of energy in space or in a material medium [4, 5]. Radiation can come from natural sources such as cosmic rays, radiation from the earth and radon gas, as well as man-made sources such as medical applications, industrial activities and nuclear power generation. Types of radiation containing charged particles such as alpha (α), beta (β) and protons have the potential to interact with biological systems and are of great clinical importance.

*Correspondence:

Ali Göde

alig.sy31@gmail.com

¹Hatay Mustafa Kemal University Vocational School of Health Services, Hatay, Turkey



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Understanding the types and sources of radiation is a fundamental requirement for understanding the effects of radiation on human health [6, 7]. Medical uses of ionizing radiation are among the oldest and most common applications of radiation. The number of annual diagnostic and interventional radiological procedures worldwide is estimated to be over 3 billion and radiotherapy treatments over 5 million [5].

Medical uses of radiation offer significant public health benefits. In order to take advantage of the benefits of ionizing radiation for medical purposes, a systematic approach should be adopted to minimize its risks to patients, health workers and the general public. According to data from epidemiological studies, ionizing radiation is known to have harmful effects. These damages are classified as stochastic and deterministic. Stochastic effects such as genetic abnormalities and cancer occur randomly and have no specific threshold value. Deterministic effects occur when a certain exposure threshold is exceeded and lead to consequences such as skin changes [5, 7, 8]. It is also known that ionizing radiation can have harmful effects on biological tissues. Considering the potential hazards of radiation, it is of great importance for health workers to have knowledge on protection against these hazards.

The World Health Organization (WHO) is actively leading a global initiative on radiation safety in the health sector to promote the safe and effective use of radiation. In order to maintain clinical efficacy, it is necessary to prevent increased radiation exposure of patients and to take all necessary protective measures to minimize this exposure [9]. Various protection methods are available to minimize radiation exposure and reduce health risks. Radiation protection is provided by control and precautions in accordance with the established dose limits [10, 11]. These methods include the use of personal protective equipment, radiation shielding, distance and time management, safe use of radiation, education and awareness, and measurement and monitoring of radiation. These practices aim to reduce health risks by minimizing radiation exposure. Health education programs should provide students with a comprehensive education on radiation protection. These trainings should include basic principles of radiation, dose control strategies, use of personal protective equipment and safe working protocols [12, 13]. Radiation safety includes measures and procedures taken to minimize the harmful effects of ionizing radiation. In this context, knowledge about the biological effects of radiation, dose limits, protection methods and legal regulations is essential for establishing an effective radiation safety culture. Health workers' knowledge and attitudes towards radiation protection is a critical factor that directly affects their professional competence and safety awareness.

Health workers are frequently exposed to radiation sources due to their profession. Therefore, having adequate knowledge on radiation safety and protection methods plays a critical role in ensuring both their own health and the safety of their patients. Reducing the risks of radiation exposure is possible through effective education and awareness-raising programs. Research on how health workers' level of knowledge about radiation protection affects their attitudes and behaviors related to radiation aims to fill an important gap in this field.

The aim of this study is to examine the role of radiation protection knowledge of health workers on their attitudes towards radiation. In this context, it was investigated how much knowledge health workers have about radiation safety and how this knowledge shapes their attitudes towards radiation. In addition, this study aimed to compare the knowledge and attitude levels of health workers with different demographic characteristics. It is thought that the results of this study will contribute to the development of radiation safety trainings in the health sector and to the adoption of a more conscious and safer attitude towards radiation by health workers. Thus, it is aimed to increase the quality and safety standards in health services.

Materials and methods

Purpose and importance of the research

This study aimed to examine the effect of radiation protection knowledge on radiation attitude of health workers. As health workers' interactions with radiation increase, the importance of protection knowledge and attitude becomes more evident. The results of the study may contribute to the development of radiation safety trainings in health services and the identification of more effective strategies to reduce risks. This study constitutes an important step towards ensuring safe working environments for health workers and managing radiation-related risks.

The universe and sample of the study

The population of the research includes health workers working in Hatay Mustafa Kemal University Hospital. It was learned that after the February 6 earthquake, the hospital continued its activities with approximately 600 health workers. The scale questions were applied face-to-face to healthcare professionals between 15.04.2024–30.05.2024, on the basis of volunteerism and convenience sampling method. Assuming that the population size is 600 people, the sample calculation in the 95% confidence interval shows that 284 people represent the universe [14]. 309 health workers were reached between the given dates. It was concluded that this number was sufficient as a sample.

The study was conducted in a single Hatay university hospital in Turkey using convenience sampling. The findings therefore cannot be generalized to other healthcare providers in other regions, other categories of hospitals (private, public, specialized centers) or other countries with different training programs. In addition, due to the extraordinary situation following the February 6, 2023 earthquake, the hospital was operating with approximately 600 staff, which is lower than the pre-earthquake figure. This extraordinary circumstance could have influenced the workload of the personnel, stress and training availability, which may have affected their knowledge and attitude towards radiation.

Data collection tools

“Personal Information Form”, “Radiation Protection Knowledge Scale” and “Radiation Attitude Scale” were used to collect data in the study. The questionnaires used in this study are previously published and validated scales. No new instrument was developed specifically for this research.

Personal Information Form; consists of statements to determine the age, gender, marital status, educational status, occupation and the number of years in the profession of health workers.

The Radiation Protection Knowledge Scale used in this study measures self-reported perceived knowledge rather than objectively tested knowledge. While this approach allows for a rapid assessment of participants' confidence levels and perceived awareness, it may not fully reflect actual knowledge or skills. This limitation is acknowledged in the Discussion section. Radiation Protection Knowledge Scale of Health Workers was adapted into Turkish by Ay [15]. The Radiation Protection Knowledge Scale consists of 33 items across three subdimensions (radiation physics/biology and principles of radiation use; radiation protection; guide for safe use of ionizing radiation). It is a 10-point Likert-type scale scored as “1-I have no knowledge to 10-I have full knowledge”. There are no reverse items in the scale. The calculation of the scale score is based on the average total score of the items in the total scale and sub-dimensions. Scores between 1 and 10 are obtained from the scale. The cut-off point of the scale is set as 5. The 5 cut-off was selected based on the Ay [15] adaptation study, which determined this cut-off to distinguish between lower and higher levels of Turkish healthcare workers' self-reported knowledge. Despite this cut-off following from earlier research, it may be determined to be arbitrary and must be interpreted cautiously.

The initial scale of Radiation Protection Knowledge was initially built by Schroderus-Salo [16]. Ay [15] adapted the Turkish one according to cross-cultural adaptation processes recommended internationally. Forward-backward translation, expert panel, and pilot test were

utilized to measure linguistic and cultural equivalence. In the adaptation of the scale, the Cronbach Alpha reliability value was observed to be 0.98 [15]. When the reliability of the radiation protection knowledge scale was examined, the overall scale Cronbach Alpha reliability value was 0.974. This reliability value shows that the data obtained from the radiation protection knowledge scale in the study are highly reliable [17, 18].

Radiation Attitude Scale of Health Workers was developed by Yalçın et al. [19]. The Radiation Attitude Scale consists of 18 items across four subdimensions (practitioner's radiation knowledge; radiation sensitivity of the practitioner; practitioner responsiveness to the patient; practitioner informing the patient). It is a 5-point Likert-type scale scored as “1 - Strongly Disagree to 5 - Strongly Agree”. There are no reverse items in the scale. The calculation of the scale score is based on the average total score of the items in the total scale and sub-dimensions. It consists of practitioner's radiation knowledge, practitioner's radiation sensitivity, practitioner's sensitivity to the patient and practitioner's informing the patient sub-dimensions.

As a result of the development of the scale, it was observed that the Cronbach Alpha reliability value was 0.918 [19]. When the reliability of the radiation protection knowledge scale was examined, the general scale Cronbach Alpha reliability value was 0.922. This reliability value shows that the data obtained from the radiation protection knowledge scale in the study are highly reliable [17, 18].

Data collection and analysis

The data were obtained from volunteers using a face-to-face questionnaire method, and the scale questions on radiation protection knowledge and attitudes were analyzed. The data obtained were analyzed using SPSS (IBM SPSS Statistics 26) program. The socio-demographic characteristics of the participants (age, gender, marital status, educational status, occupation and years in the profession) were determined by frequency and percentage calculations. Furthermore, mean scores were calculated for radiation protection knowledge level and radiation attitude level.

For the purpose of determine whether there was a significant difference between the radiation protection knowledge levels and radiation attitudes of the health workers participating in the study in terms of age, gender, marital status, educational status, occupation, and the number of years in the profession, t-test and ANOVA parametric analyzes were applied in the independent groups after checking that the data were normally distributed and did not deviate. In addition, Pearson correlation and simple regression analyses were performed to examine the relationship and effect between radiation

Table 1 Socio-demographic characteristics of the participants

Socio-demographic characteristics	Variables	Number (n)	Percentage (%)
Gender	Female	170	55.0
	Male	130	45.0
Age	20–29 years old	154	49.8
	30–39 years old	125	40.5
	40 years and over	30	9.7
Marital status	Married	163	52.8
	Single	146	47.2
Education	High school	10	3.2
	Associate Degree	81	26.2
	Undergraduate	180	58.3
Occupation status	Graduate	38	12.3
	Doctor	35	11.3
	Nurse	188	60.8
Years in the profession	Support Staff	86	27.8
	1–5 years	174	56.3
	6–10 years	77	24.9
	Over 10 years	58	18.8
TOTAL		309	100.00

Table 2 Mean scores and normality test analysis data for the explained scale and its dimensions

Scale and dimensions	Min-Max	Mean $\pm$ Sd.	Skewness	Kurtosis
Radiation Protection Knowledge	1–10	6.35 $\pm$ 2.09	-0.278	-0.803
Radiation physics, biology and principles of radiation use	1–10	5.79 $\pm$ 2.34	0.080	1.050
Radiation protection	1–10	6.77 $\pm$ 2.13	-0.553	0.570
Guide for safe use of ionizing radiation	1–10	6.51 $\pm$ 2.41	-0.443	-0.809
Radiation Attitude	1–5	4.14 $\pm$ 0.63	-0.960	0.839
Practitioner's radiation knowledge	1–5	4.13 $\pm$ 0.65	-0.772	0.376
Radiation sensitivity of the practitioner	1–5	4.22 $\pm$ 0.79	-1.333	1.490
Practitioner responsiveness to the patient	1–5	4.06 $\pm$ 0.78	-1.052	1.092
Practitioner informing the patient	1–5	4.17 $\pm$ 0.78	-1.029	0.630

protection knowledge level and radiation attitude level in line with the aim of the study. In all analyzes, $p < 0.05$ was considered as statistically significant.

Results

The distribution of the findings regarding the socio-demographic characteristics of the participants is given in Table 1 below. 309 health workers participated in the study. Of the health professionals who agreed to participate, 55% were female and 45% were male. It was stated that 49.8% of the participants were between the ages

of 20–29, 40.5% between the ages of 30–39 and 9.7% between the ages of 40 and above. In addition, 52.8% of the health workers were married and 47.2% were single. In terms of educational status, 3.2% had high school education, 26.2% had associate's degree, 58.3% had bachelor's degree, and 12.3% had postgraduate education. Of the health professionals, 11.3% are doctors, 60.8% are nurses and 27.8% are support staff. In addition, 56.3% of the participants have worked in their profession for 1–5 years, 24.9% for 5–10 years and 18.8% for more than 10 years.

The mean scores and normality test results for the scales and dimensions used in the study are presented in Table 2. Considering the data obtained from the participants in Table 2, it was determined that the Skewness and Kurtosis values of the data were distributed between “-1.5 and + 1.5”, and it was concluded that the data did not deviate from the normal distribution [20]. As a result of this result, it was decided to conduct parametric analyzes in the following analyzes.

On the basis of the data obtained from the health professionals in Table 2, it was determined that the mean score of radiation protection knowledge was 6.35 ± 2.09 and the mean score of radiation attitude was 4.14 ± 0.63 .

In order to determine whether there is a statistically significant difference between the mean scores of radiation protection knowledge and radiation attitude according to the socio-demographic characteristics of the participants, independent groups t test and ANOVA test were analyzed from parametric analysis methods, and the results are presented in Tables 3 and 4.

As can be seen in Table 3, no statistically significant difference was found between the age, gender, marital status, educational status, and the number of years in the profession according to the radiation protection knowledge levels of the health workers participating in the study ($p > 0.05$). However, a statistically significant difference was determined according to the occupational groups of health workers ($p < 0.05$). According to the advanced statistical analysis (Post-Hoc Tukey), when the mean scores were analyzed, it was observed that the support staff of the health workers had a lower level of radiation protection knowledge than the doctors and nurses.

In Table 4, no statistically significant difference was found between age, gender, marital status, educational status, occupation, and the number of years in the profession according to the radiation attitude of the health workers participating in the study ($p > 0.05$).

As a result of the Pearson correlation given in Table 5, it was determined that there was a significant positive relationship between radiation protection knowledge and radiation attitude ($r: 0.469$; $p < 0.001$). It was also found that there was a significant positive relationship between its sub-dimensions ($p < 0.001$).

Table 3 Analysis findings on radiation protection knowledge according to socio-demographic characteristics

Socio-demographic characteristics	Variables	n	Mean	Sd.	t/F değeri	p
Gender	Female ^a	170	6.25	2.08	-0.964	0.336
	Male ^b	130	6.48	2.10		
Age	20–29 years old ^a	154	6.24	2.08	1.261	0.285
	30–39 years old ^b	125	6.36	2.04		
	40 years and over ^c	30	6.90	2.29		
Marital status	Married ^a	163	6.45	2.09	0.845	0.399
	Single ^b	146	6.24	2.08		
Education	High school ^a	10	5.21	2.19	1.838	0.140
	Associate Degree ^b	81	6.08	2.28		
	Undergraduate ^c	180	6.48	1.96		
	Graduate ^d	38	6.58	2.14		
Occupation status	Doctor ^a	35	6.98	2.06	7.989	0.000*
	Nurse ^b	188	6.56	1.94		
	Support Staff ^c	86	5.63	2.24		
Years in the profession	1–5 years ^a	174	6.29	2.04	0.190	0.827
	6–10 years ^b	77	6.46	2.11		
	Over 10 years ^c	58	6.38	2.23		

* $p < 0.05$; Sd: Standard deviation; t/F value: independent groups t test/ANOVA test value

Table 4 Analysis findings on radiation attitude according to Socio-Demographic characteristics

Socio-demographic characteristics	Variables	n	Mean	Sd.	t/F değeri	p
Gender	Female ^a	170	4.15	0.61	0.347	0.729
	Male ^b	130	4.12	0.67		
Age	20–29 years old ^a	154	4.10	0.66	1.787	0.169
	30–39 years old ^b	125	4.14	0.56		
	40 years and over ^c	30	4.34	0.74		
Marital status	Married ^a	163	4.16	0.63	0.724	0.469
	Single ^b	146	4.11	0.64		
Education	High school ^a	10	3.89	1.05	1.083	0.357
	Associate Degree ^b	81	4.15	0.61		
	Undergraduate ^c	180	4.17	0.59		
	Graduate ^d	38	4.02	0.73		
Occupation status	Doctor ^a	35	4.14	0.71	2.350	0.097
	Nurse ^b	188	4.19	0.56		
	Support Staff ^c	86	4.02	0.73		
Years in the profession	1–5 years ^a	174	4.11	0.64	0.527	0.591
	6–10 years ^b	77	4.17	0.54		
	Over 10 years ^c	58	4.20	0.73		

* $p < 0.05$; Sd: Standard deviation; t/F value: independent groups t test/ANOVA test value

In Table 6, simple linear regression analysis was performed to evaluate the effect of radiation protection knowledge on radiation attitude of healthcare professionals. According to the results of the analysis, when the F statistic ($F: 86,499$; $p < 0,001$) indicating that the model created is significant and the t statistic ($t: 9,300$; $p < 0,001$) showing the significance of the regression coefficients are examined, it is observed that the results obtained are statistically significant. With the statistically significant ($R: 0.469$; $p < 0.001$) and positive relationship between the variables, the R^2 value was obtained as 0.220. According to this finding, 22% of the variability in radiation attitude is explained by changes in the radiation protection

knowledge level. According to the results of simple linear regression analysis, radiation protection knowledge had a positive and significant effect on radiation attitude ($\beta: 0.469$ $p < 0.001$).

Discussion

Radiation is of great importance in various fields and carries potential risks. It is a critical requirement to manage radiation safely and accurately, as it has a wide range of uses such as medical imaging, industrial applications and energy generation. Radiation protection involves taking measures to protect people and the environment from the harmful effects of radiation. Adequate knowledge is

Table 5 Correlation analysis findings of radiation protection knowledge and radiation attitude and Sub-Dimensions

Scale and dimensions		1	2	3	4	5	6	7	8	9
1. Radiation Protection Knowledge	r	1	0.896**	0.942**	0.917**	0.469**	0.426**	0.382**	0.348**	0.471**
	p		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2. Radiation physics, biology and principles of radiation use	r		1	0.727**	0.702**	0.326**	0.328**	0.249**	0.209**	0.336**
	p			0.000	0.000	0.000	0.000	0.000	0.000	0.000
3. Radiation protection	r			1	0.875**	0.516**	0.441**	0.443**	0.405**	0.515**
	p				0.000	0.000	0.000	0.000	0.000	0.000
4. Guide for safe use of ionizing radiation	r				1	0.460**	0.414**	0.368**	0.359**	0.457**
	p					0.000	0.000	0.000	0.000	0.000
5. Radiation Attitude	r					1	0.893**	0.862**	0.875**	0.796**
	p						0.000	0.000	0.000	0.000
6. Practitioner's radiation knowledge	r						1	0.638**	0.688**	0.620**
	p							0.000	0.000	0.000
7. Radiation sensitivity of the practitioner	r							1	0.723**	0.638**
	p								0.000	0.000
8. Practitioner responsiveness to the patient	r								1	0.605**
	p									0.000
9. Practitioner informing the patient	r									1
	p									

** $p < 0.001$ **Table 6** Findings on the effect of radiation protection knowledge on radiation attitude

Variable	Unstandardized coefficients		Standardized coefficients	t	p	F	Model (p)
	B	Std. Error	β				
Fixed	3.236	0.103		31.51	0.000**	86.499	0.000**
Radiation Protection Knowledge	0.143	0.015	0.469	9.30	0.000**		

R²: 0.220, R: 0.469, ** $p < 0.001$, Regression Equation of the Model: $Y = 3.236 + (0.469X)$

essential for the effective implementation of these measures. Radiation safety covers the measures and practices taken to ensure the protection of both patients and healthcare professionals. Adequate knowledge and awareness about radiation protection is vital for professionals working in this field to work safely and effectively.

As a result of the data obtained from healthcare professionals, it was determined that the mean score of radiation protection knowledge was 6.35 ± 2.09 , and the mean score of radiation attitude was 4.14 ± 0.63 . Rahimi et al. [21] observed that radiation protection knowledge was 6.03 ± 2.59 in a study conducted on nurses in Malaysia, and Ay [15] observed that radiation protection knowledge was 4.22 ± 2.33 in a study conducted on healthcare professionals. Our mean knowledge score (6.35) was greater than that noted by Ay [15] but slightly greater than Rahimi et al. [21]. Numerous factors may underpin these differences. First, our sample consisted of doctors, nurses and allied staff in post-earthquake environments, while Ay [15] had predominantly health workers of a different region and Rahimi et al. [21] only nurses in Malaysia. Second, institutional training programs, years of experience and local radiation safety regulations can differ from environment to environment. Lastly, the timing of the studies and the exceptional post-earthquake working conditions in our setting can have accelerated

awareness and perceived knowledge of radiation protection. In the study conducted by Karpuz [22], it was observed that the radiation attitude was approximately 1.79 ± 0.61 on associate degree students, and Tanış [23] observed that radiation attitude was 3.96 ± 0.70 in a study conducted on healthcare professionals. In the study conducted by Göksel [24] in Turkey, most of the radiation therapists stated that the training they received contributed greatly to their profession. This evaluation shows that the attitudes of healthcare professionals towards radiation protection and radiation are conscious in line with their education, professional roles and experiences.

No statistically significant difference was observed between the age, gender, marital status, educational status, and years in the profession with regard to the radiation protection knowledge and radiation attitude of the healthcare professionals participating in the study. This indicates that radiation protection knowledge and attitudes are at a similar level regardless of the demographic characteristics of health workers. While a statistically significant difference was observed according to the occupational groups of health workers, no statistically significant difference was seen according to radiation attitude. When the mean scores of radiation protection knowledge were analyzed, it was observed that the support staff among healthcare workers had a lower level

of radiation protection knowledge than doctors and nurses. This finding emphasizes that the knowledge and attitudes of health workers on radiation protection are homogeneously distributed, however there are differences according to occupational groups and the importance of additional training for support staff. Besides formal instruction, informal exchange of knowledge and attitudes between healthcare teams can influence staff attitudes to radiation protection. Informal exchange of experience, norms and practice among peers can shape behavior on radiation safety. Moreover, potential social or professional distance between trained radiation professionals (e.g., physicians, nurses) and auxiliary staff may limit opportunities for informal learning and mentorship. These variables could contribute to the lesser scores on self-reported knowledge as presented by support staff compared to doctors and nurses. The informal exchange of knowledge or social barriers were not measured directly in this study, and additional research must explore these dynamics in order to have a greater understanding of how they contribute to attitudes. The fact that there are no statistically significant differences by demographic categories such as age, sex, education level and years of experience could mean that radiation protection training and policy within institutions are the same for all regardless of these categories. Maybe required institutional training programs and standardized workplace policies have established a fairly level playing field of knowledge and attitude among different demographics. This outcome suggests the efficacy of standardized training and demonstrates the need for targeted intervention in only occupational groups (like support staff) where a deficit has been found.

When the purpose of the study was evaluated, it was determined that there is a significant positive relationship between radiation protection knowledge and radiation attitude of healthcare professionals. It was also found that there is a positive and significant relationship between its sub-dimensions. In addition, it was determined that radiation protection knowledge of healthcare professionals has a positive and significant effect on radiation attitude. In this context, it has been observed that as the radiation protection knowledge of healthcare professionals increases, their attitudes and behaviors towards radiation safety are also positively affected. In the study conducted by Park ve Yang [25] and Yun et al. [26] on nurses, it was concluded that radiation protection knowledge had a positive effect on attitude towards radiation protection. In a study carried out by Karpuz [22] on associate degree students, a low level positive and significant relationship was determined between radiation protection knowledge and radiation attitude. Goula et al. [27] concluded that healthcare workers' lack of basic and specialized knowledge on radiation protection safety has a negative

impact on the delivery of health services. Continuous training of staff was seen as the only solution to reverse this trend. The study conducted by Yoshida et al. [28] in Japan emphasized that nursing students received inadequate training on radiation and therefore had low levels of knowledge, and that better training should be provided to reduce x-ray fear and risk perception. These findings emphasize that increasing the radiation protection knowledge of health workers will improve their safety attitudes and behaviors and emphasize the importance of continuous education.

This study employed simple linear regression with a single predictor variable to examine the relationship between knowledge of radiation protection and attitudes. Though this allowed us to identify a statistically significant relationship, it did not control for potential confounding factors such as occupation, education or experience in years. Future studies need to employ multivariate models of regression to distinguish more clearly the independent contribution of knowledge to attitudes.

Limitations

In interpreting the findings, there needs to be consideration of the limitations of the study. The single-center nature of the study, the use of the perceived knowledge scale rather than objective testing, and the cross-sectional nature of the study all restrict generalizability and capacity to infer causation. Despite this, the findings provide a valuable snapshot of healthcare staff perceived knowledge and attitudes in poor conditions.

There are some important limitations of this study that should be kept in mind when interpreting its findings. First, it was conducted in a single university hospital in Hatay, Turkey, on the basis of convenience sampling. This limits the external validity of the results, as the findings may not be transferable to healthcare workers who work in other areas, hospital types (e.g., private, public, or specialized oncology hospitals), or countries with different training processes and institutional cultures. Second, the study took place under extraordinary circumstances in the post-February 6, 2023 earthquake situation. The hospital was operating with approximately 600 staff, which was lower than pre-earthquake. The increased workload, heightened stress level, and potential disruption of training activities during the period may have influenced the participants' reported knowledge and attitudes. Third, this study's Radiation Protection Knowledge Scale measures self-reported perceived knowledge and not objective knowledge. Therefore, it may not be fully representative of participants' actual knowledge or abilities. Although the scale has very good internal consistency, subjective knowledge might differ from objectively measured knowledge. Fourth, we applied a cut-off point of 5 for the Radiation Protection Knowledge Scale following

the adaptation study by Ay [15]. This threshold, while consistent with previous work, remains somewhat arbitrary and may not reflect universally accepted standards. Fifth, the study employed single predictor variable simple linear regression analysis. Multiple regression analysis, with demographic variables controlled for, could have been in a position to provide a better insight into the unique contribution of knowledge to attitudes. Finally, because of the cross-sectional design, the study was only able to demonstrate associations and could not provide causal connections between radiation protection knowledge and attitudes towards radiation. Longitudinal or experimental research would be needed to ascertain causality. Despite these limitations, this research adds to an understanding of the relationship between radiation protection knowledge and attitudes among healthcare professionals working under challenging circumstances. This research did not quantify informal knowledge exchange or potential social boundaries between staff categories, which might also impact radiation protection attitudes.

Conclusion and recommendations

The aim of this study was to examine the role of radiation protection knowledge of health workers on their attitudes towards radiation. In this context, it was investigated how much knowledge health workers have about radiation safety and how this knowledge shapes their attitudes towards radiation. The findings show that there is a positive and significant relationship and effect between radiation protection knowledge and radiation attitudes of health workers. This situation reveals that the increase in the level of knowledge of health workers on radiation protection positively affects their attitudes and behaviors towards radiation safety.

In the study, it was determined that demographic characteristics such as age, gender, marital status, educational status, and years of experience in the profession did not create a significant difference on radiation protection knowledge and attitude. However, significant differences were observed between the occupational groups, and the doctors and nurses were found to have a higher level of knowledge than support staff. The low level of knowledge of support staff reveals the need for additional training and awareness-raising programs in this group.

In conclusion, increasing the radiation protection knowledge of health workers is critical for improving attitudes and behaviors regarding radiation safety. Training programs should be kept continuous and up-to-date, and more comprehensive training should be provided especially for support staff and students. Such training will improve the quality of healthcare services and minimize the risks of radiation exposure.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12913-025-13565-0>.

Supplementary Material 1

Supplementary Material 2

Acknowledgements

Not applicable.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by AG, GA, HE and AD. The first draft of the manuscript was written by AG and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This research was conducted in full compliance with the principles of scientific research and publication ethics. Within the scope of the study, ethics committee approval was obtained from Hatay Mustafa Kemal University Social and Human Sciences Scientific Research and Publication Ethics Committee with the decision dated 07.03.2024 and numbered 03. Informed consent was obtained from the participants prior to participation in the survey through the consent text at the beginning of the questionnaire form. Ethical principles were observed throughout the research process and the study was conducted in accordance with the provisions of the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 18 August 2025 / Accepted: 24 September 2025

Published online: 22 October 2025

References

1. Jain S. Radiation in medical practice & health effects of radiation: Rationale, risks, and rewards. *J Fam Med Prim Care*. 2021;10:1520–4.
2. Donya M, Radford M, ElGuindy A, Firmin D, Yacoub MH. Radiation in medicine: Origins, risks and aspirations. *Glob Cardiol Sci Pract*. 2014;2014:57.
3. Stewart FA, Akleyev AV, Hauer-Jensen M, Hendry JH, Kleiman NJ, MacVittie TJ, et al. ICRP PUBLICATION 118: ICRP statement on tissue reactions and early and late effects of radiation in normal tissues and Organs — Threshold doses for tissue reactions in a radiation protection context. *Ann ICRP*. 2012;41:1–322.
4. IAEA. Joint position statement and call for action for strengthening radiation protection of patients undergoing recurrent radiological imaging procedures. 2021.
5. Guide SS. Radiation protection and safety in medical uses of ionizing radiation. IAEA Saf Stand Ser No SSG-46. 2018.
6. Sathiya K, Ramachandran K. Impacts of radiation on human health: A narrative review. *J Radiol Med Imaging*. 2024;7:1–4.
7. Choudhary S. Deterministic and stochastic effects of radiation. *Cancer Ther Oncol Int J*. 2018;12:31–2.

8. Janet VAS, Radhakrishnana N, Sivan A, Ps NB, Ali M. An investigative study on radiation awareness and safety measures among medical radiation students in Bengaluru and Chennai. Available from: SSRN 4724208. 2024.
9. Videira S, Rodrigues MA, Silva MV. da. Worker's exposure to radiation in fluoroscopy, assessing and instruments: a systematic literature review. *Prev Med (Baltim)*. 2024;182:1–24.
10. Tsapaki V, Balter S, Cousins C, Holmberg O, Miller DL, Miranda P, et al. The international atomic energy agency action plan on radiation protection of patients and staff in interventional procedures: achieving change in practice. *Phys Med*. 2018;52:56–64.
11. Göde A, Yorulmaz M, Aydoğdu A. The importance of internet of things (IoT) based Applications in Improving quality of healthcare services. In: Şinasi, Akdemir, editors. Sustainable development and management research. Volume 1. London: Lambert Academic Publishing; 2022. pp. 45–65.
12. Protection International Commission on Radiological. Preface, executive summary and glossary. *Ann ICRP*. 2007;37:9–34.
13. Srinivasan D, Than KD, Wang AC, La Marca F, Wang PI, Schermerhorn TC, et al. Radiation safety and spine surgery: systematic review of exposure limits and methods to minimize radiation exposure. *World Neurosurg*. 2014;82:1337–43.
14. Yazıcıoğlu F, Erdoğan S. SPSS applied scientific research methods. Ankara: Detay Publishing; 2004.
15. Ay M. Sağlık Çalışanlarının Radyasyondan Korunma bilgisi Ölçeği'nin Türkçe'ye Uyarlanması: Geçerlik ve Güvenirlik Çalışması. Yüksek Lisans Tezi, Necmettin Erbakan Üniversitesi, Sağlık bilimleri Enstitüsü. Hemşirelikte Yönetim Anabilim Dalı, Konya; 2021.
16. Schroderus-Salo T, Hirvonen L, Henner A, Ahonen S, Kääriäinen M, Miettunen J, et al. Development and validation of a psychometric scale for assessing healthcare professionals' knowledge in radiation protection. *Radiography*. 2019;25:136–42.
17. Kalaycı Ş. SPSS uygulamalı çok değişkenli İstatistik teknikleri. Ankara: Dinamik Akademi Yayınları; 2017.
18. Munro BH. Statistical methods for healthcare research. Pennsylvania, US: Lippincott Williams & Wilkins; 2005.
19. Yalçın P, Ekinçi M, Altun Yalçın S. Radiation attitudes scale for healthcare staff. *Eur J Phys Educ*. 2020;11:17–37.
20. Tabachnick BG, Fidell LS. Using multivariate Statistics. Sixth ed. Boston: Pearson; 2013.
21. Rahimi AM, Nurdin I, Ismail S, Khalil A. Malaysian nurses' knowledge of radiation protection: A Cross-Sectional study. *Radiol Res Pract*. 2021;2021:1–8.
22. Karpuz N. Radiation attitudes and knowledge evaluation of associate degree students. *Int J Comput Exp Sci Eng*. 2023;9:238–47.
23. Tanış YE. Sağlık Çalışanlarının Radyasyona Yönelik Tutumlarının İncelenmesi. Selçuk Üniversitesi Sağlık bilimleri Enstitüsü. Yüksek Lisans Tezi, Konya; 2023.
24. Göksel EO. Investigation of the contribution of radiotherapy technician education to working life: A National survey study. *Acibadem Univ Saglik Bilim Derg*. 2023;15:114–20.
25. Park S, Yang Y. Factors affecting radiation protection behaviors among emergency room nurses. *Int J Environ Res Public Health*. 2021;18:1–11.
26. Yun S, Oh J, Im M. Knowledge, Attitude, and education needs of radiation protection among nursing students and nurses. *J Korea Contents Assoc*. 2016;16:563–72.
27. Goula A, Chatzis A, Stamouli M-A, Kelesi M, Kaba E, Brilakis E. Assessment of health professionals' attitudes on radiation protection measures. *Int J Environ Res Public Health*. 2021;18:1–16.
28. Yoshida M, Iwamoto S, Okahisa R, Kishida S, Sakama M, Honda E. Knowledge and risk perception of radiation for Japanese nursing students after the Fukushima nuclear power plant disaster. *Nurse Educ Today*. 2020;94:104552.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

© 2025. This work is licensed under
<http://creativecommons.org/licenses/by-nc-nd/4.0/> (the “License”).
Notwithstanding the ProQuest Terms and Conditions, you may use this
content in accordance with the terms of the License.