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Assessment of radiation knowledge, attitudes, and behaviors among hospital secretaries working near diagnostic imaging units

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ABSTRACT

Aims: This study aimed to assess radiation-related knowledge, attitudes, behaviors, and demand for radiation safety education among hospital secretaries, an occupational group frequently working in proximity to diagnostic imaging environments but rarely targeted by formal radiation safety programs.

Methods: This single-center, cross-sectional study included hospital secretaries working in radiology, emergency, outpatient, and inpatient units. Data were collected using a structured, self-administered questionnaire assessing demographic characteristics, radiation knowledge, attitudes, behaviors, risk perception, and educational preferences. Knowledge, attitude, and behavior scores were calculated, and associations were evaluated using appropriate comparative tests, Spearman correlation analysis, and multivariable logistic regression.

Results: A total of 88 hospital secretaries were included. While awareness of general radiation risks was high (cancer risk: 86.4%; increased sensitivity during pregnancy: 89.8%), correct identification of non-ionizing imaging modalities was limited (magnetic resonance imaging: 48.9%; ultrasonography: 53.4%). None of the participants reported awareness of the ALARA principle. Attitude and behavior scores were consistently high across groups. Attitude score was moderately correlated with behavior score ($\rho=0.53$), whereas knowledge score showed only weak correlations with attitude ($\rho=0.25$) and behavior ($\rho=0.22$). In multivariable logistic regression analysis, no independent predictors of demand for radiation safety education were identified.

Conclusion: Hospital secretaries demonstrate important gaps in modality-specific radiation knowledge despite favorable attitudes and self-reported safety behaviors. These findings highlight the need to extend structured, role-specific radiation safety education to hospital secretaries to strengthen occupational safety and promote a more inclusive radiation protection culture in healthcare settings.

Keywords: Radiation safety, hospital secretaries, occupational exposure, radiation awareness, education needs

INTRODUCTION

The rapid expansion of diagnostic imaging modalities in modern medicine has substantially increased occupational exposure to ionizing radiation within healthcare environments. While radiologists, radiologic technologists, physicians, and nurses are widely recognized as high-risk groups, radiation exposure is not confined to these professions alone. Hospital personnel who work in close proximity to imaging units—often without direct involvement in imaging procedures—may also experience unintended and largely unrecognized exposure.[1-6] Among these groups, hospital secretaries represent a particularly overlooked population.

Hospital secretaries play a critical operational role in healthcare systems, especially in radiology departments, emergency units, outpatient clinics, and inpatient wards. Their duties frequently require physical presence near imaging areas during patient registration, scheduling, documentation, and coordination tasks. Despite this proximity, secretaries are generally not classified as radiation workers, are rarely monitored with personal dosimeters, and often do not receive structured radiation safety training.[7-10] This situation places them at potential risk for cumulative low-dose radiation exposure, a risk that may remain invisible both to the individuals themselves and to institutional occupational health policies.

Existing literature demonstrates that even healthcare professionals who are formally involved in imaging procedures may have significant knowledge gaps regarding ionizing radiation and radiation protection principles.

Several studies conducted over the last decade have reported inadequate awareness of basic concepts such as ionizing versus non-ionizing radiation, radiation dose levels associated with common imaging modalities, and long-term health risks.[11-16] Misconceptions are particularly common regarding magnetic resonance imaging (MRI) and ultrasonography, which are frequently—and incorrectly—perceived as sources of ionizing radiation.[17-19] These findings suggest that radiation awareness cannot be assumed, even among trained healthcare staff.

Education has consistently emerged as a key determinant of radiation awareness. Studies have shown that healthcare workers who receive formal or in-service radiation safety training demonstrate significantly higher knowledge levels, more appropriate attitudes toward radiation risks, and safer behaviors in clinical practice.[20-22] Conversely, lack of training is associated with poor compliance with protective measures such as maintaining distance, minimizing exposure time, and using shielding equipment when appropriate.[23-25] From this perspective, untrained occupational groups working near imaging environments may represent an even more vulnerable population.

Despite growing recognition of radiation safety as a multidisciplinary responsibility, the literature remains heavily focused on physicians, nurses, and radiology technicians. Research specifically addressing non-clinical hospital staff—particularly secretaries—is extremely limited. To date, no comprehensive studies have systematically evaluated hospital secretaries' knowledge, attitudes, behaviors, risk perception, and demand for radiation safety education related to radiation exposure. This represents a critical gap in occupational health research, especially given the increasing volume of diagnostic imaging and the emphasis on safety culture within healthcare institutions.

Addressing this gap is essential for several reasons. First, occupational radiation protection is grounded in the ALARA (As Low as Reasonably Achievable) principle, which applies to all individuals who may be exposed, regardless of job title.[26-29] Second, inadequate awareness among secretaries may indirectly affect patient safety, particularly in high-turnover areas such as emergency departments and radiology units. Third, identifying demand for radiation safety education in this group may inform the development of targeted training programs, contributing to a more inclusive and effective radiation safety culture.[30-32]

Therefore, the aim of the present study is to evaluate the levels of radiation-related knowledge, attitudes, behaviors, and risk perception among hospital secretaries, and to identify their specific demand for radiation safety education. We hypothesize that overall radiation awareness among hospital secretaries will be low, but that individuals working in radiology-related units or those who have previously received radiation education will demonstrate higher knowledge and more appropriate safety-related attitudes and behaviors. By focusing on this often-neglected occupational group, the study seeks to provide original evidence to support more comprehensive radiation safety strategies in healthcare settings.

METHODS

Ethics

This study has been approved by the Non-interventional Clinical Researches Ethics Committee of Gaziantep City Hospital (Date: 17.09.2025, Decision No: 306/2025). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design and Setting

This study was designed as a single-center, cross-sectional survey conducted to assess radiation-related knowledge, attitudes, behaviors, risk perception, and demand for radiation safety education among hospital secretaries. The study was carried out at Gaziantep Medical Point Hospital, a tertiary healthcare institution with active radiology, emergency, outpatient, and inpatient services. Data collection was performed using a structured, self-administered questionnaire.

The target population consisted of hospital secretaries working in different clinical units, including radiology, emergency department, outpatient clinics, and inpatient wards. Inclusion criteria were: (1) age ≥18 years, (2) employment as a hospital secretary, (3) active employment at the institution for at least one month, and (4) voluntary participation with written informed consent. There were no restrictions regarding sex, educational level, or length of professional experience. Exclusion criteria included: (1) non-secretarial administrative or healthcare staff, (2) refusal to participate or failure to provide informed consent, (3) inability to complete the questionnaire due to cognitive or health-related limitations, and (4) employment duration of less than one month at the institution. Participants who left a substantial portion of the questionnaire unanswered or failed attention control items were excluded from the final analysis.

Data Collection Tool: Questionnaire Structure

Data were collected using a structured questionnaire developed by the researchers based on a comprehensive review of the literature on radiation awareness and occupational radiation safety. No previously validated or copyrighted scale was used; therefore, no external permission was required. The questionnaire was pilot-tested for clarity and comprehensibility before full implementation. Prior to the main data collection, the questionnaire was pilot-tested on 10 hospital secretaries who were not included in the final analysis. Based on feedback obtained during the pilot phase, minor wording revisions were made to improve clarity and comprehensibility of several items; however, no items were removed or added, and the overall structure of the questionnaire remained unchanged.

The questionnaire consisted of eight sections:

- Demographic and occupational characteristics (age group, gender, education level, working unit, duration of employment, and frequency of proximity to radiology areas).

- Knowledge assessment regarding ionizing and non-ionizing radiation, health risks, pregnancy-related sensitivity, dosimeter use, ALARA principle, and radiation content of common imaging modalities.

- Dose and radiation protection principles, including time–distance–shielding concepts and portable radiography safety.
- Attitude assessment, evaluated using a 5-point Likert scale ranging from "strongly disagree" to "strongly agree."
- Behavioral practices, assessed on a 5-point frequency scale ranging from "never" to "always."
- Scenario-based questions addressing practical decision-making during portable imaging and special risk situations.
- Risk perception and demand for radiation safety education, including preferred training topics and formats.
- Control questions, including an attention check item and a deliberately incorrect statement to assess response consistency.

Scoring of Knowledge, Attitude, and Behavior Domains

Knowledge questions were coded as correct or incorrect; responses marked as "not sure" were considered incorrect. A total knowledge score was calculated by summing correct responses. Attitude items were scored from 1 to 5, with higher scores indicating more positive attitudes toward radiation safety. Behavioral items were scored from 0 to 4, with higher scores reflecting safer radiation-related practices. Composite scores were calculated separately for knowledge, attitude, and behavior domains.

Sample Size Estimation

Sample size estimation was performed using G*Power version 3.1. Assuming a medium effect size (Cohen's d=0.50), an alpha error probability of 0.05, and a statistical power of 0.80 for two-group comparisons, the minimum required sample size was calculated as 84 participants. Considering potential exclusions and incomplete responses, a target sample size of approximately 100 participants was planned to ensure adequate statistical power.

Statistical Analysis

All data analyses were performed using IBM SPSS Statistics version 30.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as frequencies and percentages for categorical variables, and as mean±standard deviation or median (minimum–maximum) for continuous variables, depending on data distribution. The internal consistency of knowledge items was assessed using the Kuder–Richardson Formula 20 (KR-20). The reliability of attitude and behavior scales was evaluated using Cronbach's alpha coefficient, with values ≥0.70 considered acceptable. Normality of continuous variables was assessed using the Kolmogorov–Smirnov test. For group comparisons, independent samples t-test or Mann–Whitney U test was used for two-group analyses, and one-way ANOVA or Kruskal–Wallis test for comparisons involving three or more groups, as appropriate. Post hoc analyses were performed using Bonferroni correction when significant differences were detected. Associations between categorical variables were evaluated using the chi-square test. Correlations between knowledge, attitude, and behavior scores were analyzed using Spearman's rank correlation coefficient.

To identify independent predictors of educational demand, multivariable logistic regression analysis was conducted, with educational demand (yes/no) as the dependent variable and demographic variables along with knowledge, attitude, and behavior scores as independent variables. Statistical significance was set at $p<0.05$ for all analyses.

RESULTS

Half of the participants were aged 18–25 years (n=44, 50.0%), followed by those aged 26–35 years (n=35, 39.8%), while 9 participants (10.2%) were aged 36–45 years; no participants were aged 46 years or older. The study population was predominantly female (n=80, 90.9%), with males accounting for 9.1% (n=8). Regarding educational status, the majority of participants had an associate degree (n=51, 58.0%). High school graduates constituted 21.6% of the sample (n=19), while 17 participants (19.3%) held a bachelor's degree. Only one participant (1.1%) reported postgraduate education. With respect to working units, nearly half of the participants were employed in outpatient clinics (n=43, 48.9%). This was followed by radiology units (n=23, 26.1%), emergency departments (n=12, 13.6%), and inpatient wards (n=6, 6.8%), while 4 participants (4.6%) worked in other administrative units. Most participants had been working for 1–5 years (n=50, 56.8%), whereas 24 participants (27.3%) had less than one year of work experience. Twelve participants (13.6%) reported 6–10 years of employment, and only 2 participants (2.3%) had more than 10 years of experience. In terms of proximity to radiology areas, 28 participants (31.8%) reported never being near radiology units, while 27 (30.7%) reported rare proximity and 17 (19.3%) reported occasional proximity. Frequent proximity was reported by 3 participants (3.4%), and daily proximity by 13 participants (14.8%) (**Table 1, Figure 1**).

Internal consistency analysis demonstrated acceptable reliability for all questionnaire domains. The knowledge domain showed a Kuder–Richardson Formula 20 (KR-20) coefficient of 0.74. Cronbach's alpha coefficients were 0.81 for the attitude domain and 0.78 for the behavior domain.

Distribution of responses to radiation knowledge items among hospital secretaries were shown in **Table 2**. High correct response rates were observed for general radiation risk awareness. A total of 76 participants (86.4%) correctly identified that radiation exposure may increase long-term cancer risk, and 79 participants (89.8%) correctly reported that sensitivity to radiation increases during pregnancy. Knowledge regarding imaging modalities showed greater variability. Mammography was correctly identified as involving ionizing radiation by 64 participants (72.7%), whereas fluoroscopy/angiography was correctly identified by 54 participants (61.4%). In contrast, correct identification of non-ionizing imaging modalities was lower. Only 43 participants (48.9%) correctly reported that MRI does not involve ionizing radiation, and 47 participants (53.4%) correctly identified ultrasonography as a non-ionizing modality. Knowledge related to occupational radiation monitoring was also limited, as only 53 participants (60.2%) correctly stated that dosimeters were used for personnel dose

Table 1. Baseline demographic and occupational characteristics of hospital secretaries (n=88)

Variable	n (%)
Age group (years)	
18–25	44 (50.0)
26–35	35 (39.8)
36–45	9 (10.2)
Gender	
Female	80 (90.9)
Male	8 (9.1)
Educational level	
High school	19 (21.6)
Associate degree	51 (58.0)
Bachelor's degree	17 (19.3)
Postgraduate	1 (1.1)
Working unit	
Radiology	23 (26.1)
Emergency department	12 (13.6)
Outpatient clinics	43 (48.9)
Inpatient wards	6 (6.8)
Other*	4 (4.6)
Duration of employment	
<1 year	24 (27.3)
1–5 years	50 (56.8)
6–10 years	12 (13.6)
>10 years	2 (2.3)
Frequency of proximity to radiology areas	
Never	28 (31.8)
Rarely	27 (30.7)
Occasionally	17 (19.3)
Frequently	3 (3.4)
Daily	13 (14.8)

*Other units include administrative offices such as hospital management, physician assistance, and institutional billing.

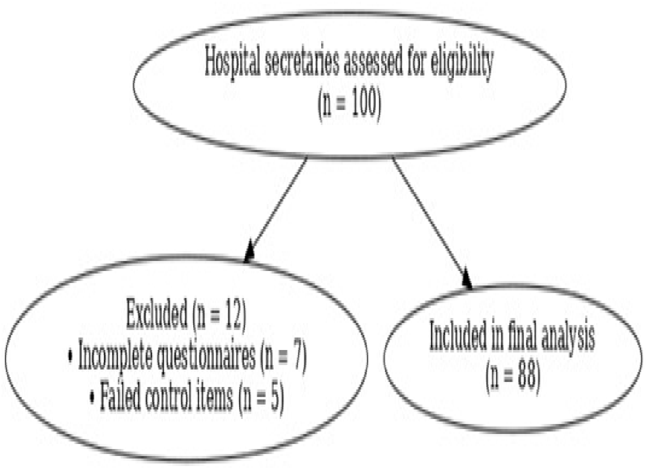

Figure 1. Flow diagram of participant inclusion and exclusion

monitoring. Notably, none of the participants reported prior awareness of the ALARA principle (**Table 2, Figure 2**).

Knowledge, attitude, and behavior scores according to working unit and prior radiation training were shown in **Table 3**. Among participants working in radiology units, those without prior radiation training (n=10) had a mean knowledge score of 5.7±1.3, while those with prior training (n=3) demonstrated a slightly higher mean knowledge score of 6.0±1.0. Mean attitude scores in the radiology unit were 4.83±0.44 in untrained participants and 4.67±0.58 in trained participants, whereas mean behavior scores were 4.85±0.36 and 4.50±0.50, respectively. In the emergency department, untrained participants (n=6) had a mean knowledge score of 3.8±1.5, compared with 5.0±0.47 in the single participant who reported prior training (n=1). Mean attitude scores in the emergency department were 4.33±0.52 among untrained participants and 4.33±0.50 among trained participants, while mean behavior scores were 4.83±0.41 and 5.00±0.41, respectively. Among participants working in outpatient clinics, untrained individuals (n=28) had a mean knowledge score of 5.0±1.4, whereas trained participants (n=13) had a mean knowledge score of 4.23±1.60. Mean attitude scores in outpatient clinics were similar between untrained and trained participants (4.45±0.51 vs. 4.40±0.48), as were mean behavior scores (4.75±0.39 vs. 4.52±0.46). In inpatient wards and other units combined, untrained participants (n=23) demonstrated a mean knowledge score of 4.1±1.8, compared with 3.5±1.9 among trained participants (n=4). Mean attitude scores in this group were 4.39±0.55 in untrained participants and 4.50±0.58 in trained participants, while mean behavior

Table 2. Distribution of responses to radiation knowledge items among hospital secretaries (n=88)

Radiation knowledge item	Correct n (%)	Incorrect n (%)	Not sure n (%)
Fluoroscopy/angiography involves ionizing radiation	54 (61.4)	7 (8.0)	27 (30.7)
Mammography involves ionizing radiation	64 (72.7)	3 (3.4)	21 (23.9)
Magnetic resonance imaging (MRI) does not involve ionizing radiation	43 (48.9)	34 (38.6)	11 (12.5)
Ultrasonography does not involve ionizing radiation	47 (53.4)	27 (30.7)	14 (15.9)
Radiation may increase long-term cancer risk	76 (86.4)	3 (3.4)	9 (10.2)
Sensitivity to radiation increases during pregnancy	79 (89.8)	4 (4.5)	5 (5.7)
A dosimeter is used for personnel dose monitoring	53 (60.2)	3 (3.4)	32 (36.4)
Awareness of the ALARA principle†	0 (0.0)	—	88 (100.0)

ALARA: As Low as Reasonably Achievable. †The ALARA item was assessed as awareness (yes/no) rather than factual correctness; none of the participants reported prior awareness.

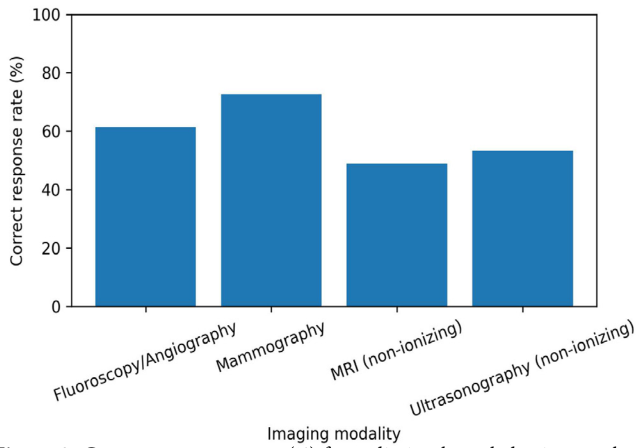

Figure 2. Correct response rates (%) for radiation knowledge items related to common imaging modalities

scores were 4.57±0.49 and 4.75±0.50, respectively. Between-group comparisons did not reveal statistically significant differences in knowledge, attitude, or behavior scores across working units or training status (all p>0.05) (**Table 3, Figure 3**). However, subgroup analyses involving trained participants in certain units were based on small sample sizes and should be interpreted cautiously.

Comparison of knowledge, attitude, and behavior scores by frequency of proximity to radiology areas was shown in **Table 4**. Participants who reported never being near radiology areas (n=28) had a mean knowledge score of 4.18±2.00. Knowledge scores were higher among those reporting rare proximity (n=27; 5.07±1.30) and occasional proximity (n=17; 5.24±1.86). The highest mean knowledge score was observed in participants reporting frequent proximity to radiology areas (n=3; 6.67±0.58), whereas participants with daily proximity showed a lower mean knowledge score with greater variability (n=13; 4.08±2.40). Mean attitude scores were consistently high across all proximity categories, ranging from 4.32±0.87 in the "never" group to 5.00±0.00 in the "frequently" exposed group. Participants reporting rare and occasional proximity demonstrated mean attitude scores of 4.43±0.58 and 4.62±0.57, respectively, while those with daily proximity had a mean attitude score of 4.35±1.09. Behavior scores were also high across groups. Mean behavior scores were 4.57±0.59 among participants who were never near radiology areas, 4.85±0.36 among those with rare proximity, and 4.76±0.50 among those with occasional proximity. Participants reporting frequent proximity demonstrated the highest behavior score (5.00±0.00), whereas those with daily proximity had a mean behavior score of 4.48±1.10. Comparisons across proximity-to-radiology categories did not reach statistical significance for knowledge, attitude, or behavior scores (Kruskal–Wallis test, all p>0.05) (**Table 4**).

Association between radiation knowledge, attitudes, behaviors, and demand for radiation safety education **Table 5**. Participants who expressed a demand for radiation safety education (n=61) had a higher mean knowledge score compared with those who did not request education (4.97±1.63 vs. 4.19±2.30). Similarly, the mean attitude score was higher among participants requesting education than among those without educational demand (4.55±0.55 vs. 4.19±1.08). Behavior scores followed a similar pattern. Participants who reported educational demand demonstrated higher mean behavior scores compared with those who did not request education (4.80±0.45 vs. 4.47±0.86). Differences in knowledge, attitude, and behavior scores between participants with and without educational demand were not statistically significant (all p>0.05) (**Table 5**).

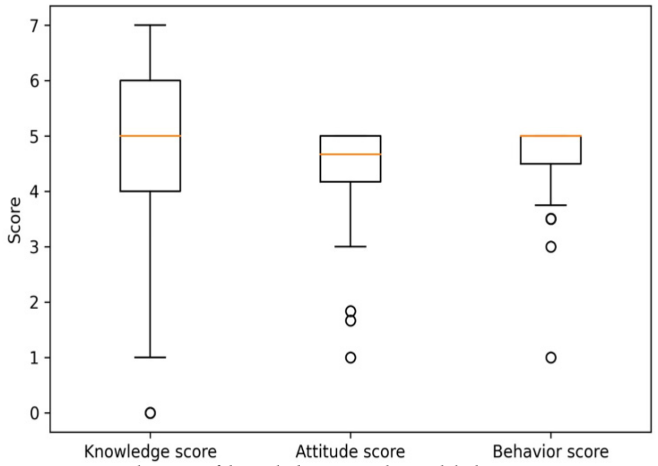

Figure 3. Distribution of knowledge, attitude, and behavior scores among hospital secretaries. Higher scores indicate better radiation-related knowledge, more positive attitudes toward radiation safety, and safer self-reported behaviors

Table 4. Comparison of knowledge, attitude, and behavior scores by frequency of proximity to radiology areas

Frequency of proximity to radiology areas	n	Knowledge score	Attitude score	Behavior score
			Mean±SD	
Never	28	4.18±2.00	4.32±0.87	4.57±0.59
Rarely	27	5.07±1.30	4.43±0.58	4.85±0.36
Occasionally	17	5.24±1.86	4.62±0.57	4.76±0.50
Frequently	3	6.67±0.58	5.00±0.00	5.00±0.00
Daily	13	4.08±2.40	4.35±1.09	4.48±1.10

Small subgroup sizes in certain proximity categories may limit the robustness of inferential comparisons, SD: Standard deviation

Table 5. Association between radiation knowledge, attitudes, behaviors, and demand for radiation safety education

Demand for radiation safety education	n	Knowledge score	Attitude score	Behavior score
			Mean±SD	
No	27	4.19±2.30	4.19±1.08	4.47±0.86
Yes	61	4.97±1.63	4.55±0.55	4.80±0.45

SD: Standard deviation

Table 3. Knowledge, attitude, and behavior scores according to working unit and prior radiation training

Working unit	Prior radiation training	n	Knowledge score	Attitude score	Behavior score
				Mean±SD	
Radiology	Yes	3	6.0±1.0	4.67±0.58	4.50±0.50
	No	10	5.7±1.3	4.83±0.44	4.85±0.36
Emergency department	Yes	1	5.0±0.47	4.33±0.50	5.00±0.41
	No	6	3.8±1.5	4.33±0.52	4.83±0.41
Outpatient clinics	Yes	13	4.2±1.6	4.40±0.48	4.52±0.46
	No	28	5.0±1.4	4.45±0.51	4.75±0.39
Inpatient wards/other units*	Yes	4	3.5±1.9	4.50±0.58	4.75±0.50
	No	23	4.1±1.8	4.39±0.55	4.57±0.49

* Some subgroup analyses are based on small sample sizes; therefore, inferential interpretations should be made with caution, SD Standard deviation

Multivariable logistic regression analysis identifying independent predictors of educational demand regarding radiation safety was shown in **Table 6**. In the adjusted model, knowledge score was not independently associated with educational demand (adjusted OR [aOR]=1.17, 95% CI: 0.90–1.52; p=0.230). Similarly, attitude score did not show a significant association with demand for education (aOR=1.12, 95% CI: 0.47–2.66; p=0.792). Behavior score was also not identified as an independent predictor of educational demand in the multivariable analysis (aOR=1.92, 95% CI: 0.63–5.82; p=0.250). In addition, frequency of proximity to radiology areas, modeled as an ordinal variable, was not significantly associated with demand for radiation safety education (aOR=1.18, 95% CI: 0.81–1.70; p=0.387). Model diagnostics indicated an acceptable goodness-of-fit (Hosmer–Lemeshow test, p>0.05), and no evidence of problematic multicollinearity was observed among the independent variables (variance inflation factors <2.0) (**Table 6**).

Table 6. Multivariable logistic regression analysis identifying independent predictors of educational demand regarding radiation safety

Predictor	Adjusted OR	95% CI	p-value
Knowledge score (per 1-point increase)	1.17	0.90–1.52	0.230
Attitude score (per 1-point increase)	1.12	0.47–2.66	0.792
Behavior score (per 1-point increase)	1.92	0.63–5.82	0.250
Proximity to radiology areas (ordinal)*	1.18	0.81–1.70	0.387

OR: Odds ratio, CI: Confidence interval

Correlation matrix illustrating relationships between knowledge, attitude, and behavior scores were shown in **Figure 4**. Knowledge score showed a weak positive correlation with attitude score (Spearman's ρ=0.25) and with behavior score (ρ=0.22). In contrast, a moderate positive correlation was observed between attitude and behavior scores (ρ=0.53), indicating a stronger association between these two domains. No negative correlations were identified among the evaluated variables (**Figure 4**).

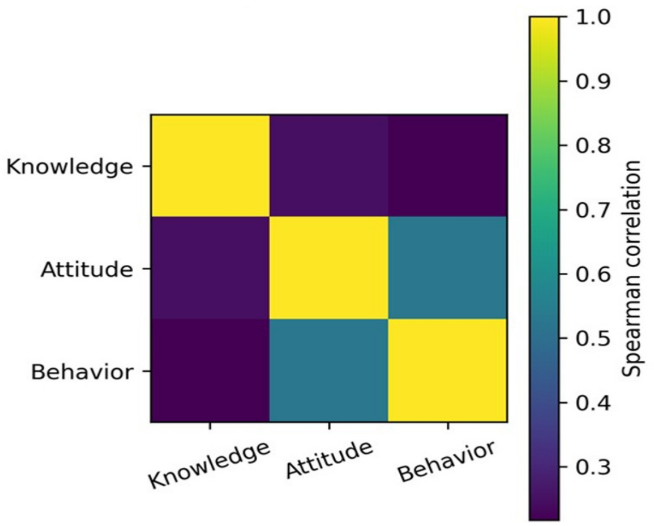

Figure 4. Correlation matrix illustrating relationships between knowledge, attitude, and behavior scores related to radiation safety. Higher scores reflect better knowledge, more favorable attitudes, and safer behaviors

DISCUSSION

This cross-sectional study provides one of the first structured evaluations of radiation-related knowledge, attitudes, behaviors, and demand for radiation safety education among hospital secretaries—an occupational group that routinely operates in imaging-intensive clinical environments but is rarely included in formal radiation safety programs. The findings indicate that, although general awareness of radiation-related health risks such as cancer and increased sensitivity during pregnancy is relatively high, important gaps persist in modality-specific knowledge, particularly regarding MRI and ultrasonography. In addition, awareness of fundamental radiation protection principles, such as the ALARA concept, appears to be absent. Despite these knowledge gaps, self-reported attitudes toward radiation safety and protective behaviors were consistently high, and attitudes were more closely aligned with behaviors than with knowledge levels. Furthermore, when these factors were evaluated simultaneously, none emerged as independent predictors of demand for radiation safety education. Taken together, these findings highlight a dissociation between knowledge and reported practice and underscore the need for structured, role-specific radiation safety education that extends beyond traditionally defined radiation workers.

A striking observation was the reduced correct identification of non-ionizing modalities: only 48.9% correctly stated that MRI does not involve ionizing radiation and 53.4% correctly identified ultrasonography as non-ionizing. This pattern mirrors a broader phenomenon reported in the literature: misconceptions about MRI and ultrasound are common even among healthcare workers and students, suggesting that "radiation awareness" does not reliably diffuse through clinical environments without intentional education. Kanbayti et al.[33] documented significant gaps in MRI safety knowledge among physicians and nurses, reinforcing that MRI-related misunderstandings are widespread and not limited to patients. Similar misconceptions have been repeatedly highlighted in radiation-awareness research as a key educational target, particularly because MRI safety is often conflated with ionizing radiation risk, potentially leading to misplaced fears or inappropriate reassurance. In contrast, participants showed high correct responses for general risk statements—86.4% for cancer risk and 89.8% for increased sensitivity during pregnancy—indicating that "radiation is harmful" messaging is present, but modality-specific understanding is incomplete. This distinction matters: effective protection behaviors depend not only on generic risk awareness, but also on accurate knowledge of which settings and procedures were actually relevant to ionizing exposure.

None of the participants reported awareness of the ALARA principle. This is not merely a vocabulary issue; ALARA is a cornerstone concept that frames practical decisions (time, distance, shielding) and is embedded in institutional radiation-protection programs. International guidance has repeatedly emphasized that radiation protection training should be broadened across professional groups, including those indirectly exposed through workflow proximity.

Vassileva et al.[30] summarized conclusions from an IAEA meeting calling for stronger, more consistent radiation-protection education and training for health professionals across disciplines. Our finding suggests that hospital secretaries may be systematically excluded from this educational ecosystem. At the institutional level, ALARA terminology and principles are not formally incorporated into radiation safety training programs for non-radiation workers, which may partly explain the complete lack of awareness observed in this group.

Only 60.2% correctly identified the purpose of personal dosimeters, and 36.4% responded "not sure." This aligns with the concept of secretaries being an "invisible risk group": they were rarely designated as monitored radiation workers, so dose-tracking tools may not be familiar. Occupational monitoring trends also show that exposure patterns vary by department and job role; Baudin et al.[7] reported trends in occupational exposure among medical staff over 2009–2019, emphasizing the importance of monitoring frameworks tailored to job categories and settings. While secretaries may not routinely exceed dose limits, lack of awareness of monitoring systems can weaken safety behaviors.

Attitude and behavior scores were consistently high across units and proximity categories. This pattern can have at least two interpretations. First, it may reflect genuine safety-mindedness and compliance with visible cues (warning lights/signage), consistent with findings in other hospital settings where staff report high adherence to basic protective measures. For example, Shubayr et al.[34] examined operating-room radiation safety and reported that awareness and compliance can be substantial, though variable across worker groups. Second, the pattern may reflect self-report inflation and a ceiling effect common to safety-behavior questionnaires, where respondents select socially desirable options (particularly in institutional surveys). This is precisely why coupling behavior questions with scenario-based items and control questions, as done in our instrument, is valuable—future work could strengthen this further by adding observational audits or department-level process measures. From a behavioral and occupational safety perspective, the observed association between attitude and behavior scores is consistent with the conceptual view that safety-related attitudes function as proximal determinants of self-reported safety behaviors.

Knowledge scores increased from "never" to "frequently" proximal groups but dropped in the "daily" group with larger variability. This non-linear pattern suggests that proximity alone is not a sufficient proxy for learning—daily exposure does not automatically produce correct understanding. In practice, daily proximity may coincide with routinized administrative flow, time pressure, and normalization of risk signals, which can blunt active learning. This is consistent with broader occupational safety literature, where frequent exposure may desensitize workers unless formal training reinforces correct mental models and self-protective routines.[9]

Participants requesting radiation-safety education had higher mean knowledge, attitude, and behavior scores, yet multivariable logistic regression identified no independent predictors of educational demand. This apparent mismatch is not uncommon in survey-based occupational studies. Several methodological factors can contribute: limited sample size for multivariable modeling, collinearity among KAB domains, restricted variance in attitude/behavior (ceiling effect), and unmeasured determinants (e.g., prior incidents, leadership emphasis, department culture, perceived institutional support). A systematic review by Rodrigues et al.[9] emphasized heterogeneity across studies and settings in radiation-protection knowledge and determinants, underscoring that training effects and predictors often depend strongly on local culture and program structure. In our context, educational demand may be shaped more by perceived institutional safety climate and personal risk perception than by knowledge score alone. Importantly, the absence of independent predictors in the multivariable regression model should not be interpreted as evidence of no effect; rather, it may reflect limited statistical power, restricted variability in knowledge, attitude, and behavior scores, or the influence of unmeasured contextual factors such as institutional culture, managerial support, or informal safety norms.

Our findings were directionally consistent with regional studies reporting knowledge gaps among healthcare staff regarding radiation and protection concepts. In Turkiye, Dönmez et al.[20] assessed healthcare workers' knowledge about protection from ionizing radiation and reported notable deficiencies, supporting the need for structured education. Şenışık et al.[22] evaluated radiation awareness among personnel/students in radiation environments and highlighted gaps that training could address. Although these studies focus primarily on clinical or radiation-area staff, the implication is transferable: if gaps exist among trained groups, they may be more pronounced in groups not systematically targeted—such as secretaries.

From a policy and training perspective, our results support several actionable steps. Integrate secretaries into hospital radiation-safety programs (onboarding+annual refreshers), with a focus on modality-specific knowledge (CT/fluoroscopy vs MRI/US) and "when to step out" protocols during portable imaging. Standardize micro-training modules aligned with department workflow (radiology, ED, clinics), including signage interpretation, safe waiting zones, and escalation routes. Reinforce ALARA in plain language and connect it to day-to-day actions (time–distance–shielding), consistent with international recommendations to strengthen training across health professions.[30] Clarify institutional monitoring practices (dosimeter policies, who is monitored, and why) to reduce uncertainty and promote consistent safety behavior. Multi-center studies are needed to determine whether these patterns generalize across hospitals with different imaging volumes and safety cultures. Intervention studies testing short, targeted training packages (e.g., 15–20-minute modules plus visual reminders) could evaluate improvements in modality-specific knowledge and scenario performance, and examine whether gains persist over time.

Limitations

Limitations include the single-center design, potential self-report and social desirability bias, and smaller subgroup sizes in some unit/training strata. Additionally, our knowledge score emphasized modality identification and selected foundational concepts; future research could expand into dose estimation knowledge, institutional policy knowledge, and objective measures. In addition, the single-center design and the predominantly young and female composition of the study sample, as well as institution-specific organizational characteristics, may limit the generalizability of the findings to other healthcare settings or countries.

CONCLUSION

As a result, this study demonstrates that hospital secretaries, despite their close and routine proximity to imaging-intensive clinical environments, exhibit notable gaps in modality-specific radiation knowledge, particularly regarding non-ionizing imaging techniques, while simultaneously reporting high levels of safety-oriented attitudes and behaviors. The absence of awareness of fundamental radiation protection principles, such as ALARA, further underscores the need to broaden the scope of institutional radiation safety strategies. The lack of independent predictors of educational demand suggests that demand for radiation safety education may not be driven solely by measurable knowledge or behavior levels, but rather by broader factors such as safety culture and perceived occupational risk. These findings highlight the importance of implementing structured, role-specific radiation safety education programs that explicitly include hospital secretaries, thereby strengthening overall occupational safety and promoting a more inclusive radiation protection culture within healthcare institutions.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study has been approved by the Non-interventional Clinical Researches Ethics Committee of Gaziantep City Hospital (Date: 17.09.2025, Decision No: 306/2025).

Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights—including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent form.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The author declare no conflicts of interest related to this study.

Financial Disclosure

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Author Contributions

The author confirms sole responsibility for the study conception, design, data collection, analysis, interpretation, and manuscript preparation. All aspects of the work were carried out by the author.

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