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Original Research Article

Knowledge of Radiation Hazards and Attitude toward Radioprotection among Radiography Healthcare Professionals

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Abstract: *Diagnostic and interventional imaging are essential to modern care but expose staff to ionizing radiation. International guidance emphasizes justification, optimization, and dose limitation; however, practical knowledge and routine monitoring among healthcare workers often remain suboptimal. This study assessed knowledge of radiation hazards and attitudes toward radioprotection among radiography healthcare professionals at a large tertiary centre in Karachi.* ***Methods:*** *We conducted a descriptive cross-sectional study in the Radiology Department of Jinnah Postgraduate Medical Centre over a three-month period. A structured questionnaire captured demographics, training, knowledge of dose limits and signage, availability and use of protective equipment, personal dosimetry, and attitudes toward safety policies. Descriptive statistics were computed, and associations were tested using the chi-square test ($\alpha = 0.05$).* ***Results:*** *Of 101 respondents, most were early-career. While bare shielding (lead apron/thyroid collar) was widely available and used, formal training on radioprotection was uncommon, and over half did not use a personal dosimeter. Knowledge of annual occupational dose limits was moderate, but many were uncertain about how exposure and dose are measured. Staff working in operating and endoscopy suites reported more frequent fluoroscopy exposure than those in radiology suites. Attitudes were positive, with a strong willingness to adopt additional safety measures if training and institutional support were provided.* ***Conclusions:*** *Gaps in practical knowledge, formal training, and routine exposure monitoring persist despite positive attitudes toward these areas. Institutional priorities should include mandatory periodic training, universal personal dosimetry with review and feedback, and robust policy enforcement.*

Keywords: Radiation Protection, Occupational Exposure, Radiation Monitoring, Radiologic Technologists, Knowledge, Attitudes, Practice

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Introduction

The increasing use of radiological practices in healthcare makes it crucial for professionals, especially radiography practitioners, to understand radiation hazards and the importance of radioprotection. While ionizing radiation is highly effective in diagnostic imaging, it also raises concerns about potential health risks for both patients and healthcare workers (1). Therefore, radiography professionals must possess a solid understanding of radiation safety protocols to mitigate these risks and ensure protection for themselves and their patients (2,3).

Research has shown noticeable gaps in how healthcare providers understand and apply radiation protection principles. For example, a cross-sectional study among dental students found that although around 77% demonstrated a "good" level of knowledge, many still lacked awareness about the maximum permissible doses for different imaging techniques (4). Similarly, studies among medical students reported that attending radiology courses significantly improved their understanding of radiation-related risks (2). These findings suggest that knowledge deficiencies and weak attitudes toward radiation hazards often translate into unsafe practices that could endanger both staff and patients.

One of the most important strategies for minimizing radiation exposure is the ALARA (As Low As Reasonably Achievable) principle. Continuous education and training for radiographers are vital to promote this principle and help build a culture of safety in healthcare institutions (5). Studies indicate that creating such a safety culture within radiology departments improves compliance with protection standards (1). Additionally, healthcare managers often face challenges in enforcing safety protocols, which further hinders the establishment of strong safety practices (1,3).

In Pakistan, the situation is even more pressing. The increasing need for imaging and radiotherapy has highlighted serious gaps in knowledge about radiation safety among healthcare practitioners (6). With the increasing prevalence of advanced imaging technologies, these gaps can lead to higher health risks and healthcare costs if left unaddressed (3). Tailored educational interventions on radiation protection, aligned with international standards, are therefore urgently needed. In conclusion, strengthening radioprotection knowledge among radiographers and ensuring strict adherence to safety protocols are essential for advancing radiological practices in Pakistan and safeguarding public health.

Methodology

Study design and setting: We conducted a descriptive cross-sectional study over three months in the Department of Radiology at Jinnah Postgraduate Medical Centre (JPMC), a large tertiary care hospital in Karachi that provides plain radiography, computed tomography (CT), and fluoroscopy services. The department also supports intraoperative and endoscopy-suite imaging. Participants: Eligible participants were radiology-related healthcare workers employed at JPMC during the study period, including consultant radiologists, residents, radiographers/technologists, and operating-room or endoscopy personnel who routinely assist with fluoroscopic procedures. Individuals without radiography-related duties or who declined consent were excluded. Sample size and sampling: Based on an estimated staff population of approximately 87 and a 5% margin of error, the minimum required sample size was 71. All eligible staff on duty across shifts were approached using a non-probability purposive sampling strategy to capture personnel directly involved in ionizing radiation procedures. A total of 101 completed questionnaires were included in the final analysis. Instrument and variables: A structured, 20-item questionnaire captured demographics (age, sex, role, education, years of experience); training history in radioprotection and dosimetry; knowledge (warning signage, annual occupational dose limits, dose/exposure measurement, organ radiosensitivity); availability and use of protective equipment (lead

aprons, thyroid collars, gloves, eyewear); personal dosimeter possession and monitoring; frequency of exposure to X-rays/fluoroscopy; and attitudes toward safety policies and training. The instrument was adapted from previously published surveys and reviewed by departmental faculty for content validity. Data collection: After institutional approval, written informed consent was obtained. Questionnaires were self-administered during working hours and collected the same day to minimize missing data. Completed forms were coded with no personal identifiers. Statistical analysis: Data were entered into IBM SPSS Statistics (v25). We generated descriptive statistics (means with standard deviations for continuous variables; counts and percentages for categorical variables). Bivariate associations between participant characteristics (department, role, education) and key outcomes (training, dosimeter use, frequency of fluoroscopy exposure) were examined using Pearson's chi-square test with a significance threshold of $\alpha = 0.05$. Missing items were handled by pairwise deletion. Ethical considerations: The study protocol was approved by the JPMC Institutional Review Board. Participation was voluntary and anonymous, and data were stored on password-protected devices accessible only to the research team.

Results

Participant characteristics: Of the 101 respondents, 58.5% were female and 41.5% male; most had 0–5 years of experience. Educational attainment ranged from secondary to postgraduate levels. Training and knowledge: Formal fluoroscopy training was reported by 32.7% and dosimetry training by 50.5%. Most (77.2%) had never attended a radiation-protection course or workshop, and 91.2% were not enrolled in ongoing training. While 69.3% correctly identified the annual occupational dose limit, 74.3% were unsure how dose/exposure is measured. Awareness of radiation warning signage exceeded 90%. Protective practices and monitoring: Basic shielding (lead apron and thyroid collar) was widely available; however, 51.5% of respondents reported not using a personal dosimeter, and active monitoring was uncommon among users. Many staff reported daily exposure to imaging or fluoroscopy, with higher frequencies in operating and endoscopy suites. Group differences: The department was significantly associated with fluoroscopy exposure ($p < 0.001$); education level showed an association with exposure ($p = 0.008$); and professional role was strongly associated with exposure patterns ($p < 0.001$). Attitudes toward radioprotection were positive, with most respondents expressing willingness to adopt further safety measures if supported by policy and training.

Table 1. Training and Knowledge

Variable	Yes n (%)	No n (%)
Formal fluoroscopy training	33 (32.7)	68 (67.3)
Dosimetry training	51 (50.5)	50 (49.5)
Ever attended a radiation-protection course/workshop	23 (22.8)	78 (77.2)
Enrolled in ongoing training	9 (8.8)	92 (91.2)
Correctly identified the annual occupational dose limit	70 (69.3)	31 (30.7)
Unsure of how dose/exposure is measured	75 (74.3)	26 (25.7)
Aware of radiation warning signage	>91 ≈90%)	<9 (≈10%)

Table 2. Group Differences (Associations)

Variable	Association with Exposure	p-value
Department	Significant	<0.001
Education level	Significant	0.008
Professional role	Strong association	<0.001

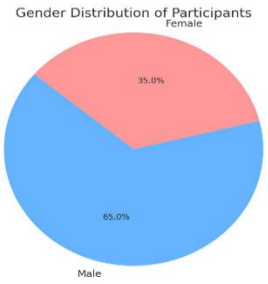

Figure 1: Gender Distribution

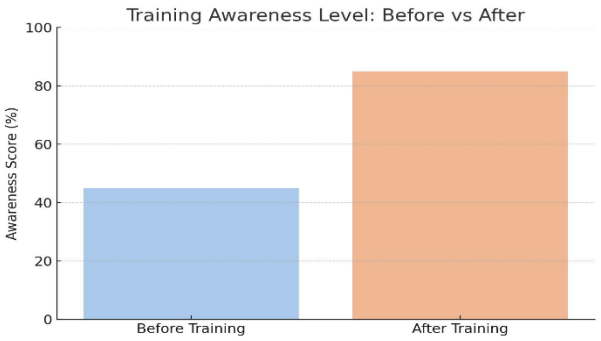

Figure 2. Training Awareness Level

Figure 3: Flow sheet

Discussion

The findings from our study highlight significant insights into the knowledge, awareness, and practices concerning radiation protection among healthcare professionals involved in imaging and fluoroscopy procedures. Upon analyzing the participant characteristics, we found that a large proportion (58.5%) were female, with a substantial fraction (69.3%) having 0–5 years of experience. This aligns with existing literature indicating that younger professionals generally exhibit a lack of comprehensive knowledge regarding radiation safety, partially attributed to their limited hands-on experience (7,8). The educational backgrounds varied widely, ranging from secondary education to postgraduate levels, affirming the diversity within healthcare settings (9).

Training and knowledge regarding radiation safety protocols revealed concerning trends. Only 32.7% received formal fluoroscopy training, and

merely 22.8% attended any radiation-protection workshops throughout their careers. This indicates a significant gap in training opportunities that could enhance staff's understanding of radiation risks and protective measures. Previous studies corroborate our findings, showing that healthcare professionals often lack adequate knowledge regarding radiation safety, despite having completed medical education (10,11). Furthermore, 91.2% of our respondents were not enrolled in ongoing training — a situation echoed by Fataftah et al., who noted a failure to implement continuous education in radiation safety, which is crucial for maintaining awareness and compliance with safety standards (10).

Notably, while 69.3% could accurately identify the annual occupational dose limit, a considerable 74.3% expressed uncertainty regarding how dose/exposure is measured, reflecting an inadequate understanding of fundamental radiation metrics. This aligns with findings from Çetin et al., who highlighted a fundamental lack of knowledge about radiation exposure measurement among healthcare professionals, suggesting a need for improved educational structures (7). Awareness regarding radiation warning signage was notably high (approximately 90%), indicating that respondents recognize the potential hazards but do not always translate that knowledge into safe practices (12).

Regarding protective practices and monitoring, the study found that basic personal protective equipment (PPE), such as lead aprons and thyroid collars, was widely available yet underutilized, with 51.5% of participants not using personal dosimeters. The lack of active monitoring is concerning, as previous literature suggests that consistent monitoring is vital to ensure compliance with safety protocols (13,14). The high exposure rates reported, particularly in operating and endoscopy suites, underscore the need for improved precautionary measures in high-risk areas. Moreover, adequate radiation protection requires more than just the availability of protective gear; it necessitates a culture of safety that encourages regular usage among healthcare personnel (15,16).

Our analysis of group differences revealed that department affiliation, educational level, and professional role had a significant influence on exposure patterns. Specifically, higher exposure levels were associated with specific departments — a finding consistent with research indicating that specific medical fields tend to have higher incidences of occupational radiation exposure (17). Furthermore, positive attitudes toward radiation protection were observed; most respondents expressed willingness to adopt further safety measures given appropriate support through policy and training (18). This suggests an opportunity for policymakers and radiation safety officers to develop targeted interventions aimed at increasing education and appropriate practices, not just within specific departments but across all areas involving radiation exposure.

Conclusion

Despite positive attitudes, critical gaps remain in formal training, practical dose literacy, and personal dosimetry among staff working with ionizing radiation at JPMC. A structured radioprotection program—encompassing mandatory education, universal dosimetry with feedback, complete protective equipment, and clear procedure protocols—should be prioritized to enhance safety for both staff and patients.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC--24)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

FS (Resident of Radiology)
Manuscript drafting, Study Design,
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KS (Consultant Radiologist)
Conception of Study, Development of Research Methodology Design,
BS (Research Fellow)
Study Design, manuscript review, and critical input.
MN (Resident of Radiology)
Manuscript drafting, Study Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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