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KNOWLEDGE, ATTITUDE AND PRACTICE OF RADIATION SAFETY AMONG RADIOLOGY RESIDENTS AND TECHNICIANS IN A TERTIARY CARE CENTRE: A CROSS-SECTIONAL STUDY

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Abstract

Background: Ionizing radiation plays a vital role in diagnostic and interventional imaging but carries potential health risks for occupationally exposed personnel. Awareness and adherence to radiation safety protocols are essential to minimize exposure among healthcare professionals.

Objectives: To assess the knowledge, attitude, and practice (KAP) of radiation safety among radiology residents and technicians in a tertiary care centre and to identify factors associated with good radiation-safety practice.

Methods: A cross-sectional study was conducted among 200 participants (80 radiology residents and 120 radiology technicians) using a validated, self-administered questionnaire comprising 20 knowledge, 8 attitude, and 10 practice items. Data were analyzed using descriptive statistics, chi-square tests, and multivariable logistic regression to identify predictors of good practice.

Results: Adequate knowledge (≥70% score) was observed in 72.5% of residents and 53.3% of technicians ($p = 0.006$). The mean knowledge scores were 71.4 ± 12.3 and 62.1 ± 14.8, respectively ($p < 0.001$). Consistent use of TLD badges was reported by 78.8% of residents versus 58.3% of technicians ($p = 0.003$). On multivariable analysis, recent radiation-safety training within the past two years (adjusted OR 2.41, 95% CI 1.35–4.30) and consistent availability of protective devices (adjusted OR 1.98, 95% CI 1.10–3.58) were independent predictors of good practice.

Conclusions: Although overall awareness of radiation safety was satisfactory, significant gaps in practical compliance were evident, particularly among technicians. Regular refresher training and assured access to protective equipment can substantially improve adherence to safety standards.

Keywords: Radiation safety; Ionizing radiation; Knowledge attitude practice; Radiology residents; Radiology technicians; Occupational radiation exposure; ALARA principle

Introduction

Ionizing radiation is an indispensable component of modern diagnostic and interventional radiology, contributing significantly to accurate diagnosis, disease monitoring, and minimally invasive therapeutic procedures. Modalities such as conventional radiography, computed tomography, fluoroscopy, and interventional radiology rely heavily on ionizing radiation for optimal clinical outcomes. Despite its undeniable clinical benefits, occupational exposure to ionizing radiation poses substantial health risks to healthcare workers, including deterministic effects such as skin injury and cataract formation, as well as stochastic effects such as malignancies, thyroid disorders, and potential genetic damage[1]. These risks are cumulative in nature and increase with prolonged and repeated exposure.

Healthcare professionals working in radiology departments—particularly radiology residents and technicians—are at a heightened risk due to frequent involvement in imaging procedures and prolonged presence in radiation-prone environments, especially during fluoroscopic and interventional procedures[2]. Inadequate awareness or inconsistent adherence to radiation protection measures may further exacerbate occupational exposure.

International radiation protection guidelines emphasize the core principles of justification, optimization, and dose limitation, collectively summarized as the ALARA (As Low As Reasonably Achievable) principle[3]. The International Commission on Radiological Protection (ICRP) strongly advocates strict compliance with radiation safety protocols, including the routine use of personal protective equipment (PPE) such as lead aprons, thyroid shields, protective eyewear, personal dosimeters, appropriate shielding devices, and periodic radiation safety training programs[4]. These measures are essential for minimizing occupational radiation dose without compromising diagnostic quality.

However, several studies from developing countries have reported inconsistent compliance with radiation safety practices among radiology personnel, often attributed to inadequate training, poor risk perception, heavy workload, and limited availability of protective equipment[5–7]. In this context, assessing the knowledge, attitude, and practice (KAP) of radiation safety among radiology professionals becomes crucial for identifying existing gaps and implementing targeted corrective strategies. Therefore, this study was conducted to evaluate the KAP of radiation safety among radiology residents and technicians in a tertiary care centre and to identify factors associated with good radiation-safety practices.

Methodology

A hospital-based cross-sectional study was conducted over a period of six months in the Department of Radiodiagnosis of a tertiary care teaching hospital in India. The study population comprised radiology residents and radiology technicians working in the department. A total of 200 participants were enrolled, including 80 radiology residents and 120 radiology technicians. Participants with a minimum of six months of work experience in radiology who were willing to provide informed consent were included in the study, while interns, students, and individuals on long-term leave during the data collection period were excluded.

Data were collected using a validated, structured, self-administered questionnaire consisting of four sections: demographic details, knowledge (20 items), attitude (8 items), and practice (10 items) related to radiation safety. Each correct knowledge response was awarded one mark, while incorrect or "don't know" responses were scored as zero, and a knowledge score of ≥70% was considered indicative of adequate knowledge. Ethical approval for the study was obtained from the Institutional Ethics Committee, and confidentiality and anonymity of the participants were strictly maintained.

Data analysis was performed using SPSS version 25. Descriptive statistics, including mean, standard deviation, and frequencies, were used to summarize the data. Inferential statistical analysis was carried out using the Chi-square test and independent t-test, and multivariable logistic regression analysis was applied to identify predictors of good radiation safety practice. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 200 participants were included in the study, comprising 80 radiology residents and 120 radiology technicians. Demographic characteristics of the participants are summarized in (Table 1). Radiology residents were younger and had fewer years of work experience compared to technicians, while a higher proportion of residents had received radiation safety training within the past two years. Adequate knowledge of radiation safety (knowledge score ≥70%) was observed in 72.5% of radiology residents and 53.3% of radiology technicians, and this difference was statistically significant ($p = 0.006$), as shown in (Table 2). The mean knowledge score among residents was significantly higher than that of technicians (71.4 ± 12.3 vs. 62.1 ± 14.8; $p < 0.001$).

With respect to attitude, the majority of participants demonstrated a positive attitude toward radiation safety (Table 3)**.** A significantly higher proportion of residents (88.7%) compared to technicians (76.6%) agreed that occupational radiation exposure poses serious long-term health risks. Furthermore, 91.2% of residents believed that radiation safety training should be mandatory, compared to 79.1% of technicians, and this difference was statistically significant ($p = 0.02$).

Radiation safety practices differed significantly between the two groups (Table 4). Consistent use of thermoluminescent dosimeter (TLD) badges was reported by 78.8% of residents and 58.3% of technicians ($p = 0.003$). Regular use of lead aprons, thyroid shields, and maintenance of adequate distance during radiation exposure were also significantly higher among residents than technicians.

On multivariable logistic regression analysis, recent radiation safety training within the past two years (adjusted odds ratio [AOR] 2.41; 95% confidence interval [CI]: 1.35–4.30) and consistent availability of protective devices (AOR 1.98; 95% CI: 1.10–3.58) were independently associated with good radiation safety practice, consistent with the findings highlighted in the abstract.

Tables

Table 1. Demographic Characteristics of Study Participants (n = 200)

Variable	Residents (n=80)	Technicians (n=120)
Mean age (years)	28.6 ± 2.4	34.8 ± 6.1
Male gender (%)	70.0	76.7
Work experience ≥5 years (%)	22.5	61.7
Radiation training in last 2 years (%)	65.0	38.3

Table 2. Knowledge Scores on Radiation Safety

Parameter	Residents	Technicians	p-value
Mean knowledge score (%)	71.4 ± 12.3	62.1 ± 14.8	<0.001
Adequate knowledge (%)	72.5	53.3	0.006

Table 3. Attitude Toward Radiation Safety

Attitude Statement	Residents (%)	Technicians (%)	p-value
Radiation exposure causes long-term health risks	88.7	76.6	0.03
Radiation safety training should be mandatory	91.2	79.1	0.02

Table 4. Radiation Safety Practices Among Participants

Practice Indicator	Residents (%)	Technicians (%)	p-value
Regular use of lead apron	85.0	66.7	0.004
Consistent TLD badge use	78.8	58.3	0.003
Use of thyroid shield	62.5	41.7	0.006

Practice Indicator	Residents (%)	Technicians (%)	p-value
Maintains safe distance during exposure	81.2	60.8	0.002

Discussion

Occupational exposure to ionizing radiation remains a significant concern for radiology personnel, particularly in high-volume tertiary care settings. The present study assessed the knowledge, attitude, and practice (KAP) of radiation safety among radiology residents and technicians and identified predictors of good radiation safety practice. Overall, the findings highlight satisfactory awareness but reveal notable gaps in practical compliance, especially among technicians.

In the present study, radiology residents demonstrated significantly higher knowledge scores compared to technicians, with adequate knowledge observed in 72.5% of residents and 53.3% of technicians. This finding is consistent with studies by Kumar et al. and Rahman et al., who reported better radiation safety knowledge among physicians and trainees compared to technical staff[6,9]. Similar observations were also made by Paolicchi et al., who attributed higher knowledge levels among residents to structured academic training and regular exposure to updated guidelines[7]. However, despite reasonable awareness, the persistence of inadequate knowledge among a substantial proportion of technicians suggests the need for targeted educational interventions.

Attitude toward radiation safety was generally positive among both groups, with a higher proportion of residents recognizing the long-term health risks associated with occupational radiation exposure. This aligns with findings by Yurt et al. and Arslanoglu et al., who reported favorable attitudes toward radiation protection despite variable levels of knowledge and practice[11,12]. The significantly stronger endorsement of mandatory radiation safety training among residents in the present study reflects greater risk perception and professional accountability, as also reported by Quinn et al.[10].

Despite acceptable knowledge and positive attitudes, radiation safety practices were suboptimal, particularly among technicians. Regular use of lead aprons, thyroid shields, and TLD badges was significantly higher among residents than technicians. Similar discrepancies between knowledge and practice have been reported by Alotaibi et al. and Soye and Paterson, who observed inconsistent use of personal protective equipment despite awareness of radiation hazards[5,14]. The lower compliance among technicians may be attributed to workload, inadequate supervision, and limited availability of protective devices.

Multivariable logistic regression analysis revealed that recent radiation safety training and availability of protective equipment were independent predictors of good radiation safety practice. This finding is in agreement with studies by Vano et al. and Rehani et al., which emphasized the role of continuous education and institutional support in reducing occupational radiation exposure[13,15]. Brenner and Hall also highlighted that adherence to radiation protection principles significantly reduces cumulative radiation dose without compromising diagnostic quality[1].

Overall, the findings underscore the importance of regular refresher training programs, strict enforcement of radiation safety protocols, and ensured availability of protective devices to bridge the gap between knowledge and practice. Strengthening radiation safety culture through continuous monitoring and education is essential for minimizing occupational radiation risks in tertiary care hospitals.

Conclusion

The study demonstrates that while radiology residents and technicians possess moderate awareness and a generally positive attitude toward radiation safety, significant gaps persist in the consistent application of protective practices, particularly among technicians. Recent radiation safety training and assured availability of protective equipment were identified as key determinants of good radiation safety practice. Regular refresher training programs, strict enforcement of safety protocols, and institutional support are essential to enhance compliance and minimize occupational radiation exposure in tertiary care settings.

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