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Research Paper

Evaluation of Knowledge and Practice Regarding Ct Safety Among Radiology Student's and Technicians

Rashleen Kour [1], Tanjeet Kour [2], Smriti Salonia [3], Parul [4], Kripanand Yadav [5*]

[1,2,3,4] Master's Imaging Technology, Radiography, Radiology department, Maharishi Markandeshwar Deemed to Be University, Mullana, Ambala, Haryana, India

[5] Assistant Professor in Medical Radiology and Imaging Technology, Radiology Department Maharishi Markandeshwar Deemed to Be University, Mullana, Ambala, Haryana, India

Corresponding Author: *Kripanand Yadav

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ABSTRACT

Background: Computed Tomography is an essential diagnostic imaging tool in modern medicine due to its speed, accuracy, and ability to visualise complex anatomical structures. However, CT imaging delivers significantly higher radiation doses compared to conventional radiography, making radiation safety an important public health concern. Continuous exposure or repeated CT scans can increase the cumulative lifetime risk of radiation-induced effects, particularly in high-risk groups such as children and pregnant women. Ensuring adequate knowledge and proper safety practices among radiology students and CT technicians is crucial for minimising radiation risks and maintaining high standards of patient care. Assessing their competency in CT safety helps identify gaps that may impact clinical practice.

Objective: To assess the knowledge, level of awareness and practice of CT radiation safety, safety practices among radiology students and technicians of an institute using a structured questionnaire.

Methods: A cross-sectional survey was conducted using a Google Form questionnaire consisting of multiple-choice questions on CT radiation, radiosensitive organs, high-risk groups, regulatory bodies, and safety practices related to shielding, pediatric protocols and contrast safety. Participants included students, interns, and CT technicians. The response was analysed using descriptive statistics.

Result: The majority of participants (98%) correctly identified CT using ionising radiation. More than half recognised the gonads as the most radiosensitive organ, while others selected the thyroid or lens. Pregnant women were most commonly identified as the highest risk group (67.3%). Most respondents associated repeated CT exposure with increased cancer risks. Knowledge of India's regulatory authority was strong, with (89.45%) identifying AERB correctly. However, inconsistencies were observed in practical safety measures: some participants reported only "sometimes" or "rarely" using shielding, not always applying pediatric CT protocols, and occasionally neglecting contrast safety assessments.

Conclusion: Although radiology students and technicians demonstrate satisfactory theoretical knowledge of CT radiation safety, their practical application of safety protocols remains inconsistent. Strengthening hands-on training, improving curriculum content, and conducting regular competency assessments are crucial for enhancing radiation protection and ensuring patient safety in CT imaging departments.

Abbreviations: CT: Computed Tomography, AERB: Atomic Energy Regulatory Board, WHO: World Health Organisation, ICRP: International Commission on Radiological Protection, CTDIvol: Computed Tomography Dose Index, DLP: Dose Length Product, LNT Model: Linear No-Threshold Model, DRL: Diagnostic Reference

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KEYWORDS: Computed Tomography (CT), Radiation Safety, Radiology Students, CT Dose Optimisation, Patient Radiation Protection

INTRODUCTION

Computed Tomography (CT) has emerged as one of the most indispensable diagnostic tools in modern medical imaging, offering rapid acquisition, high-resolution cross-sectional images, and superior anatomical detailing compared to conventional radiography. Since its clinical introduction in the 1970s, CT technology has undergone continuous evolution, driven by advancements such as multidetector CT (MDCT), dual-energy CT, faster rotation times, and improved detector efficiency[12]. These innovations have significantly enhanced diagnostic accuracy and expanded the clinical applications of CT in trauma, oncology, neurology, cardiology, and emergency care, resulting in a steady increase in global CT utilization[3].

Despite its undeniable diagnostic value, CT is associated with substantially higher radiation doses than most other imaging modalities. Although CT represents only a fraction of total diagnostic imaging procedures, it contributes disproportionately—nearly 50–70% of the collective radiation dose from medical imaging[4]. The high radiation output of CT is a major public health concern, particularly considering that a single CT scan may deliver a dose equivalent to hundreds of chest radiographs, depending on the protocol and patient size[5]. These concerns are amplified for vulnerable groups such as pediatric patients, pregnant women, and individuals requiring repeated imaging examinations[6].

Ionising radiation has well-documented biological effects, including DNA strand breaks, mutations, and increased stochastic cancer risks. These risks are best explained by the Linear No-Threshold (LNT) model[7], which postulates that there is no safe level of radiation exposure. This has emphasised the need for strict dose management and safety practices. International regulatory and safety organisations—such as the International Commission on Radiological Protection (ICRP), World Health Organisation (WHO), and International Atomic Energy Agency (IAEA)—stress the implementation of the principles of Justification, Optimisation, and Dose Limitation to minimise unnecessary exposure[8].

To ensure patient safety, radiology professionals must understand key radiation dose metrics used in CT, including the Computed Tomography Dose Index (CTDIvol) and Dose-Length Product (DLP)[9]. These indices form the basis for establishing Diagnostic Reference Levels (DRLs), which serve as benchmarks to evaluate whether radiation doses used in specific procedures are within acceptable limits. Effective dose estimation further helps assess potential biological risk and compare exposures across different examinations[10].

Modern CT scanners are equipped with several dose-reduction technologies, such as automatic exposure control (AEC), tube current modulation, organ-based dose shielding, and advanced iterative reconstruction algorithms[11]. When properly applied, these techniques can significantly reduce radiation dose while maintaining or even improving image quality. However, the successful use of these tools depends on the operator's knowledge, protocol selection skills, and adherence to departmental guidelines.

Radiology students and CT technologists play a pivotal role in implementing radiation safety measures, as they are responsible for selecting scan parameters, positioning patients, and applying optimisation techniques. Unfortunately, studies show substantial variations and gaps in CT radiation safety knowledge among radiographers, particularly in areas related to dose indices, DRLs, pediatric dose adjustment, and appropriate scanning practices.

Method and Material

This method was designed as a cross-sectional, questionnaire-based survey aimed at assessing the awareness and understanding of CT safety and related safety protocols among students and technicians. Google based questionnaire was developed.

Study Setting and Population

The survey was conducted among students and CT technicians of Maharishi Markandeshwar (Deemed to be University), Mullana, located in Haryana, India. Participants were selected from departments associated with radiology and medical imaging.

Study design

A structured Google Form-based questionnaire was developed, consisting of 23 multiple-choice questions. The questions focused on essential aspects of CT safety, including:

Knowledge about CT radiation safety.

Practice of CT safety.

Pre-scan patient screening.

Attitude and Perception towards CT Safety.

Type of radiation.

Sample size and Duration

A total of 100 valid responses were received over a data collection period of two weeks in November 2025.

Questionnaire development:

The questionnaire was self-structured, designed based on standard CT safety guidelines (such as ICRP recommendations) and reviewed by radiology faculty for content relevance and clarity. The survey ensured that all questions were mandatory, preventing incomplete responses.

Data Collection and Analysis

The survey link was distributed electronically via institutional groups and emails. Responses were automatically recorded and exported into Microsoft Excel for analysis. Descriptive statistics, including percentages and frequency distribution, were used to interpret results.

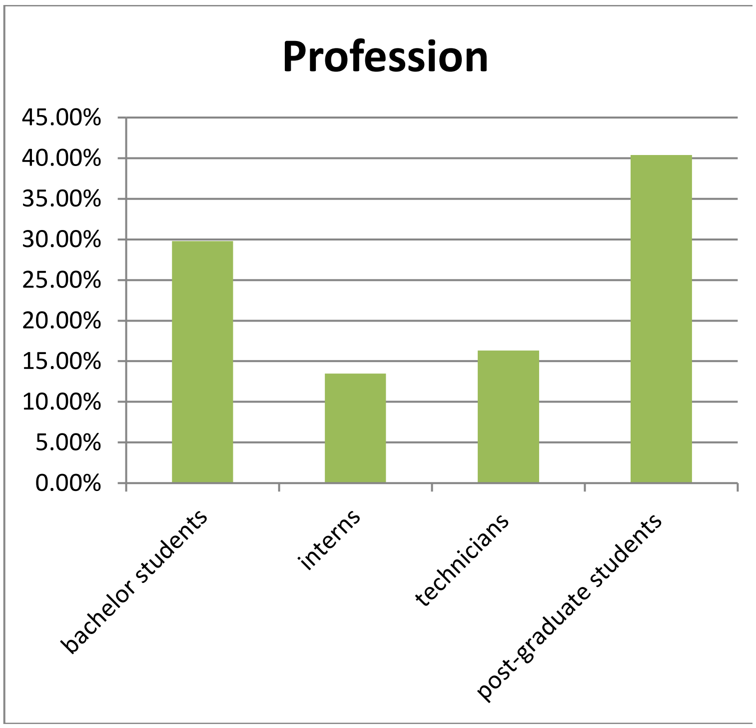
Result

A total of 100 participants responded to the questionnaire-based survey, including bachelor students 29.8%, interns 13.5%, technicians 16.3% and post-graduate students 40.4%. The findings provide insights into the possessed level of knowledge and awareness possessed regarding CT radiation safety, such as ALARA and patient positioning and preparation. A standard multiple-choice questionnaire was developed to gather data on awareness regarding CT safety practices. The survey instrument consisted of 23 multiple-choice questions.

Table 1: Respondents' Profession

Profession	Percentage
Bachelor students	29.8%
Intern	13.5%
Technicians	16.3%
Post-graduate students	40.4%

Graph1: Respondents' profession



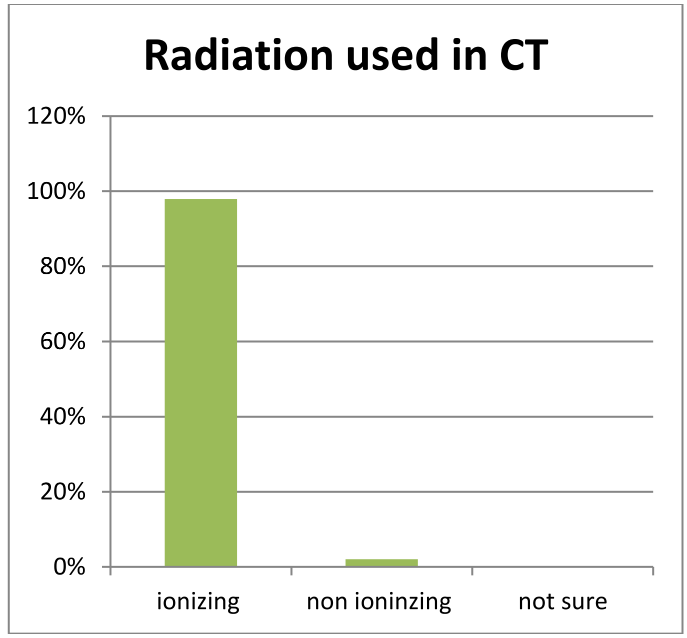
Knowledge of Radiation used in CT

The graph indicates that the majority of participants correctly identified ionising radiation as a type of radiation used in CT, with approximately 98% selecting this option. This aligns with the fact that CT imaging employs ionising radiation. Only a very small proportion of participants selected non-ionising radiation, reflecting a gap in understanding among a minority of participants. Overall, these results suggest that most participants possess accurate knowledge of radiation used in CT.

Table 2: Radiation used in CT

Radiations	Percentage
Ionizing	98%
Non ionizing	2%
Not sure	0%

Graph 2: Knowledge of radiation used in CT



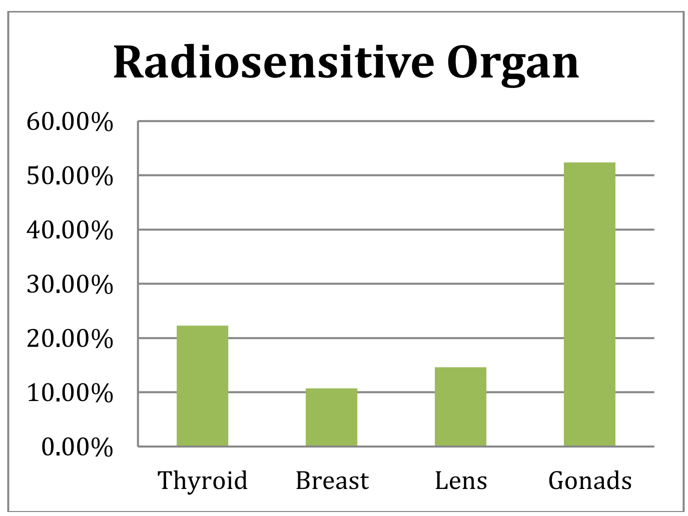
Most Radiosensitive Organ

A high percentage of participants, approximately 52.4%, selected the gonads as the most radiosensitive organ, whereas the thyroid was selected as a radio-sensitive organ by 22.3%, followed by the breast (10.7%) and the lens (14.6%). This shows that participants are aware of the radio-sensitivity of gonads, but there is a need for further education on the radio-sensitivity of different organs.

Organs	Percentage
Thyroid	22.3%
Breast	10.7%
Lens	14.6%
Gonads	52.4%

Table 3: Most radiosensitive organs

Graph 3: Most radiosensitive organ



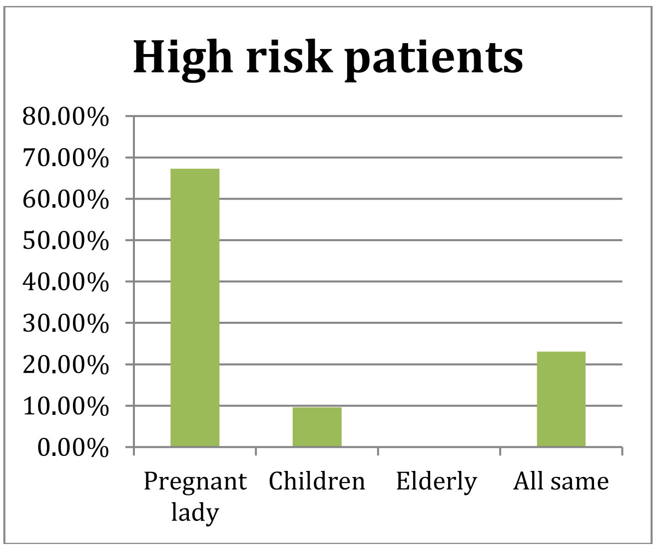
High Risk Patients

A very high percentage of participants (approximately 67.3%) considered the pregnant lady as the highest risk patient from radiation exposure. This corresponds with correct answer, as the fetus is highly radio sensitive and pregnancy is considered a high-risk condition. A small percentage of children selected the elderly or all the same, which does not align with the correct hierarchy of radiation risk. These findings indicate that while most participants accurately recognised pregnant women as the highest risk group, a notable minority demonstrated a misconception regarding radiation vulnerability among different populations.

Table 4: High-risk patients

Groups	Percentage
Pregnant lady	67.3%
Children	9.6%
Elderly	0%
All same	23.1%

Graph 4: High-risk patients



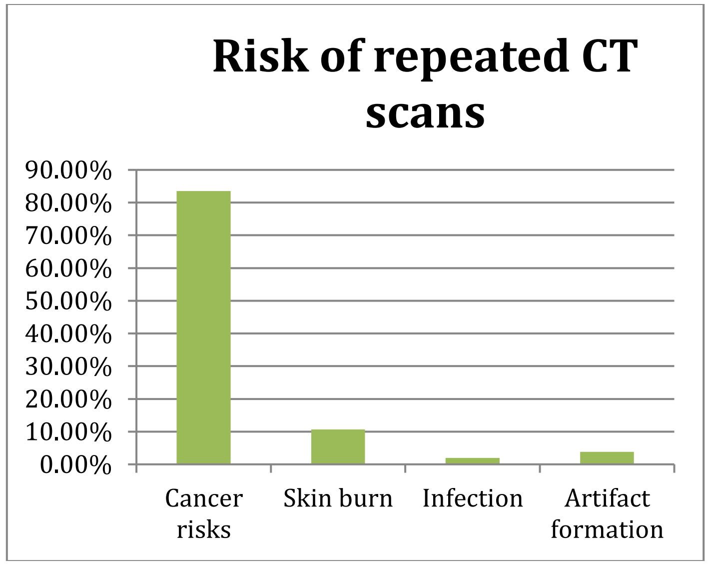
Primary Risk of Repeated CT scans

The response regarding the primary risk of repeated CT scans shows that a large majority of participants (83.5%) selected cancer risk. This aligns with the correct answer, as cumulative exposure to ionising radiation from multiple CT scans increases the lifetime risk of developing radiation-induced cancer. A smaller proportion of respondents chose skin burns (10.7%), infection, or artefact formation, which is incorrect since these are not primary risks associated with repeated CT examinations. Overall, the results indicate that most participants possess accurate knowledge of the long-term radiation risks of CT imaging.

Table 5: Risk of repeated CT scans

Risks	Percentage
Cancer risks	83.5%
Skin burns	10.7%
Infection	2%
Artifact formation	3.8%

Graph 5: Risk of repeated CT scans



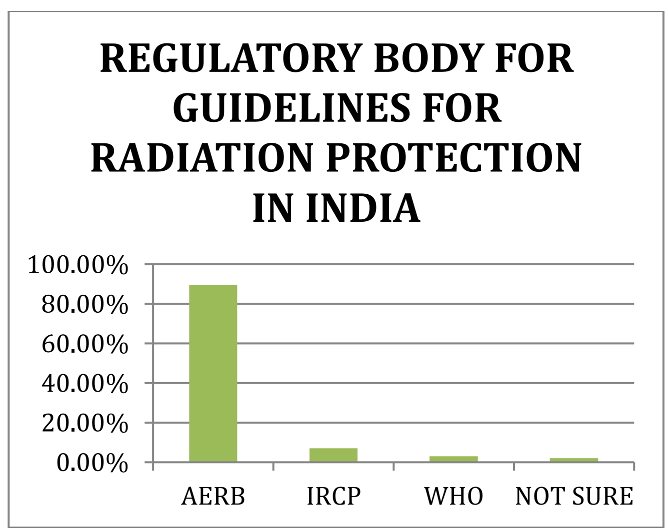
Guideline for Radiation Protection

The response regarding the regulatory body responsible for radiation protection guidelines in India shows that an overwhelming majority of participants (89.4%) correctly identified the AERB (Atomic Energy Regulatory Board) as the authoritative body. A small proportion of participants selected IRCP, WHO, which are incorrect in the context of India's regulatory framework. These findings indicate a strong awareness among participants about the national radiation protection authority.

Table 6: Regulatory bodies for guidelines for radiation protection in

Regulatory bodies	Percentage
AERB	89.4%
ICRP	7%
WHO	3%
NOT SURE	2%

Graph 6: Regulatory body for guidelines for radiation protection in India



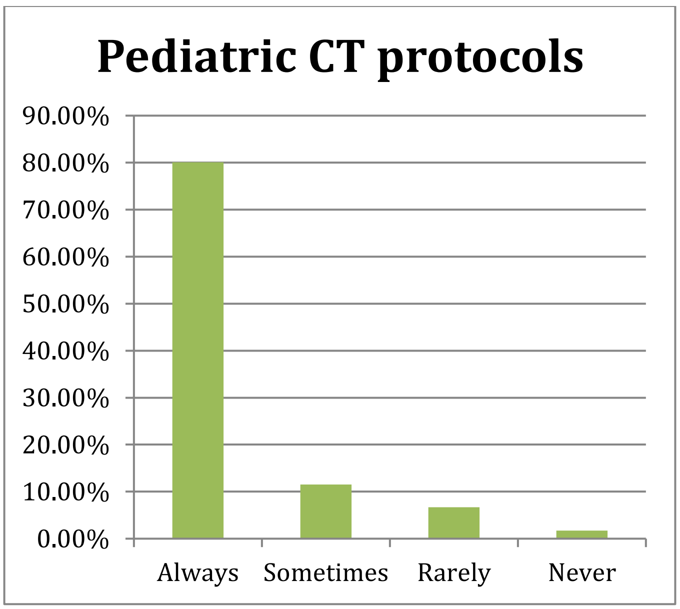
Pediatric CT Protocol

In this study, the majority of participants reported that they "Always" use pediatric CT protocols for children. This aligns well with the recommended best practice, which emphasises that pediatric patient requires tailored, low-dose protocols due to higher radiation sensitivity. However, 11.5% of respondents selected "Sometimes", and 6.7% chose "Rarely", indicating that a proportion of practitioners still do not consistently follow pediatric- specific dose of the optimisation. Overall majority demonstrated correct practice. There is a need for improved awareness and stricter adherence to pediatric Ct protocol.

Table 7: Pediatric CT Protocol

Practice	Percentage
Always	80.08%
Sometimes	11.5%
Rarely	6.7%
Never	1.72%

Graph 7: Pediatric CT Protocols



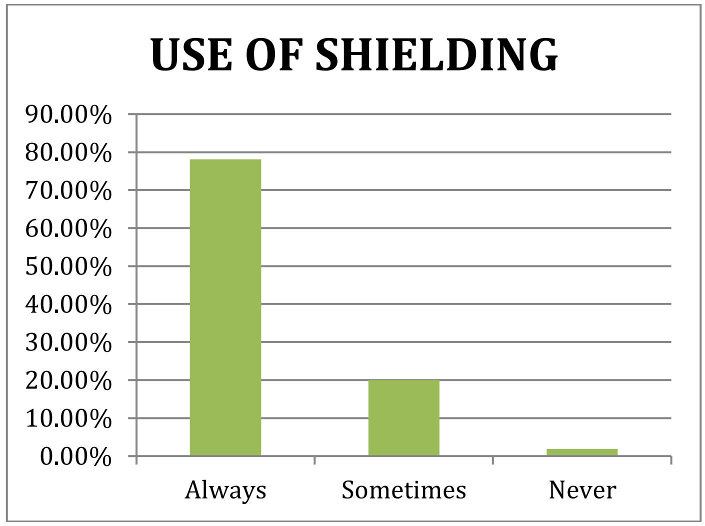
Use of Shielding

The findings show a significant knowledge gap among radiology students regarding shielding practices in CT. While 78.1% believe shielding should always be used, current evidence-based guidelines recommend that shielding be applied selectively, not routinely. Only 20% of participants answered in alignment with modern CT safety recommendations, highlighting the need for improved education on updated radiation protection protocols. This study shows that there is a need for improvement in knowledge to improve the overall practices.

Table 8: Use of shielding

Practice	Percentage
Always	78.10%
Sometimes	20%
Never	1.90%

Graph 8: Use of shielding



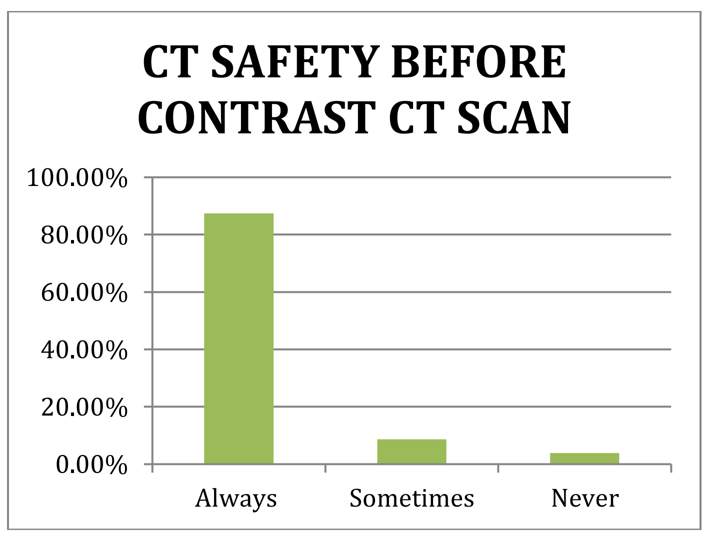
Contrast Media Safety Followed Before Contrast CT

The graph indicates that the majority of the participants, approximately 87.4%, "Always" follow the contrast safety (bun/creatinine test) before the contrast CT. However, a small proportion of participants selected "Sometime" and a very few selected "Never", which shows the gap in knowledge. The present inconsistentpractices indicate that further improvement is necessary to ensure optimal safety in the CT environment.

Table 9: CT safety before contrast CT

Practice	Percentage
Always	87.40%
Sometimes	8.70%
Never	3.90%

Graph 9: CT safety before contrast CT scan



DISCUSSION

The present study aimed to evaluate the knowledge and practice of CT safety among radiology students, interns, and technicians. Overall, the findings demonstrate that although most participants possess a basic awareness of CT radiation and safety guidelines, notable gaps still exist in the practical application of radiation-protective measures and protocol optimization[11].

A major highlight of the study is that the majority of respondents (98%) correctly identified that CT utilizes ionizing radiation. This demonstrates a strong foundational understanding of CT imaging principles. However, despite this awareness, a considerable minority still showed uncertainty or misconceptions regarding the type and effects of radiation, indicating the need for reinforced theoretical education[5].

Participants also demonstrated good recognition of radiosensitive organs, with more than half identifying the gonads as the most radiosensitive, followed by the thyroid and lens. While this reflects acceptable awareness, the variability in responses indicates that knowledge of organ radiosensitivity remains inconsistent. Since an accurate understanding of radiosensitivity directly influences clinical imaging decisions and dose optimisation, continuous education efforts are essential[6].

Regarding patient-related factors, most respondents appropriately identified pregnant women as the group most vulnerable to radiation exposure. However, awareness was markedly lower for children, despite evidence that pediatric patients face increased lifetime radiation-related risks[4]. This suggests a misconception that requires correction and reinforcement, especially because pediatric CT is a critical area requiring tailored dose adjustments.

Responses to related CT scan risks further revealed strong awareness of inherent risks, with most participants recognising cancer as the primary long-term risk. Nonetheless, a portion of respondents selected incorrect options such as “skin burn” or “artefact formation,” indicating areas where conceptual clarity should be improved.

In terms of regulatory knowledge, most participants accurately identified AERB as the responsible body for radiation protection guidelines in India. However, confusion with organisations such as ICRP among a small percentage of respondents underscores the need for clearer instruction about national and international regulatory frameworks[7].

Evaluation of CT safety practices showed variability. While many participants reported adherence to pediatric CT protocols, a significant group only “sometimes” or “rarely” followed these specialised adjustments. This reveals a gap between theoretical awareness and actual practice, especially critical in pediatric imaging, where dose optimisation is essential[10].

Similarly, the data on shielding practices exposed a major inconsistency. Although most participants reported “Always” using shielding, a considerable number selected “Sometimes” or even “Never,” highlighting a divergence from recommended protocols[11]. The inconsistent application of shielding reflects inadequate reinforcement of radiation protection training and possibly limited availability of protective devices in some settings. The assessment of contrast-related safety revealed encouraging results, with most participants reporting that they “always” follow contrast safety procedures. However, the small yet relevant percentage who only “sometimes” or “never” follow these measures suggests a need for stricter supervision in contrast to administration to minimise life-threatening risks[3]. Overall, the findings of this study indicate that while radiology students and technicians exhibit a satisfactory theoretical understanding of CT radiation and safety, significant gaps persist in practical application. These gaps are attributed to inconsistent training exposure, lack of hands-on experience, and limited reinforcement of standardised protocols during routine clinical practice. Addressing these shortcomings through structured educational programs, workshops, regular competency assessments, and supervised clinical training can greatly improve CT safety practices.

CONCLUSION

The results of this study indicate that radiology students, interns, and CT technicians demonstrate a satisfactory level of theoretical knowledge regarding CT radiation, radiosensitive organs, and high-risk patient groups. Most participants correctly identified ionising radiation as the basis of CT imaging and were aware of the regulatory role of the AERB in India. However, the findings also reveal notable gaps in the consistent application of essential CT safety practices. These include irregular use of shielding, incomplete adherence to pediatric dose optimisation, and inconsistent compliance with contrast safety protocols.

Although awareness of radiation risks is adequate, translating this knowledge into everyday clinical practice remains a challenge. Strengthening hands -on training, improving curriculum design, and implementing routine competency assessments are essential for enhancing safe CT practices. Reinforcing these measures will help cultivate a strong safety culture, improve patient protection, and reduce unnecessary radiation exposure in clinical environments.

Limitation and Future Scope

This study, while offering valuable insight into the current level of awareness regarding CT safety protocols among students and CT technicians, is subject to several limitations. Firstly, the survey was conducted at one institution (MMDU Mullana), which may limit the generalizability of the findings to broader populations. The sample size of 100, though adequate for a preliminary analysis, restricts the statistical power needed to draw more comprehensive conclusions across diverse demographic and institutional settings.

Additionally, the study relied on self-reported responses, which may be influenced by social desirability bias or participants’ tendency to guess correct answers. The absence of a pre- and post-intervention design also limits the ability to evaluate the effectiveness of educational strategies or training programs on improving CT safety awareness. Furthermore, the study did not correlate the participants’ theoretical knowledge with their actual compliance or behaviour in clinical CT environments, which could provide more practical insights. Future research should aim to expand the sample size and include participants from multiple geographic regions and varied clinical settings to enhance the external validity of the findings. Incorporating interventional components, such as training workshops followed by post-assessment, would allow a clearer evaluation of educational impact. Comparative studies across different professional groups (e.g., students, interns, radiologists, technologists) could help identify specific educationalneeds. Finally, integrating simulation-based safety training and assessing its long-term effect on clinical practice may provide a more holistic understanding of CT safety preparedness.

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About the corresponding author

Kripanand Yadav is an Assistant Professor in Medical Radiology and Imaging Technology at Maharishi Markandeshwar Deemed to be University, Molana, Ambala, Haryana, India. He specialises in advanced imaging techniques, particularly MRI applications, focusing on anatomical evaluation and diagnostic imaging, contributing to research and education in radiology and medical imaging technology.