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Evaluation of knowledge and practices regarding MRI safety among radiology students and technicians

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Abstract
Background: Magnetic Resonance Imaging (MRI) is a non-ionizing diagnostic modality that plays a critical role in medical imaging. However, due to the presence of strong magnetic fields, strict safety protocols are essential to prevent serious hazards. The awareness of these safety practices is especially important among students and technicians who work in or are training to work in MRI environments.
Objective: To assess the level of awareness and understanding regarding MRI safety zones, hazardous objects, emergency procedures, and patient contraindications among students and MRI technicians from two academic institutions.
Methods: A cross-sectional, questionnaire-based survey was conducted among students and technicians from Maharishi Markandeshwar (Deemed to be University) Mullana and MMU Sadopur, Haryana, India. A self-structured Google Form consisting of 18 questions was distributed, covering key areas of MRI safety. A total of 90 valid responses were collected. Descriptive statistical analysis was performed using Microsoft Excel, and results were expressed in terms of percentages and frequencies.
Results: Most participants (90%) correctly identified that MRI safety consists of four zones as per ACR guidelines. A high proportion (88%) recognized the projectile effect caused by ferromagnetic objects as the major safety hazard. Around 95% accurately understood the function of the quench button for emergency magnetic shutdown. However, approximately 15% of respondents showed confusion regarding the non-ionizing nature of MRI. Additionally, while most were aware of pacemakers as contraindications, there were minor gaps in recognizing other safety-sensitive conditions such as tattoos, pregnancy, and implanted devices.
Conclusion: The study demonstrates an overall satisfactory level of MRI safety awareness among the participants. However, certain misconceptions persist, especially concerning radiation type and patient contraindications. These findings emphasize the need for structured, ongoing MRI safety education, including practical training and regular assessments to bridge knowledge gaps and enhance clinical preparedness.

Keywords: MRI safety, awareness, safety zones, hazardous objects, emergency procedures, contraindications, students

Introduction

Magnetic Resonance Imaging (MRI) is widely regarded as a non-invasive and radiation-free diagnostic tool, offering superior soft tissue resolution compared to other imaging modalities. However, the use of strong static magnetic fields, gradient fields, and radiofrequency pulses introduces potential safety risks that are distinct from those in X-ray, CT, or ultrasound imaging environments [1]. These risks include projectile incidents due to ferromagnetic materials, burns from radiofrequency energy, and adverse interactions with implanted medical devices [2].

To mitigate these risks, the American College of Radiology (ACR) has issued standardized safety guidelines that include the division of MRI facilities into four distinct safety zones, each with increasing levels of restricted access [3]. Despite such guidelines, incidents continue to be reported globally, primarily due to lapses in safety protocols, lack of training, or inadequate pre-scan screening [5]. Awareness and education play a critical role in maintaining MRI safety, especially for radiology students, interns, and MRI technicians who are frequently involved in patient handling and equipment operation [4].

Previous studies have emphasized that MRI-related accidents are often preventable through continuous professional education, strict adherence to screening checklists, and simulation-

based learning [6]. However, in many institutions, MRI safety training is not uniformly integrated into academic curricula or technician training programs [7]. This knowledge gap can have serious implications, particularly in high-volume or emergency MRI settings.

This survey-based study was conducted among students, interns, and MRI technicians from Maharishi Markandeshwar (Deemed to be University), Mullana, and technical staff from MM Super Specialty Hospital, Sadopur. The purpose of this study was to assess the level of awareness regarding MRI safety hazards, standard precautions, and the risks associated with different types of exposure during MRI procedures. The findings are intended to provide insight into the current state of MRI safety knowledge and emphasize the need for improved training and policy enforcement in clinical education settings.

Method and Material

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

Study Setting and Population

The survey was conducted among students and MRI technicians of Maharishi Markandeshwar (Deemed to be University), Mullana and MMU Sadopur, both 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 18 multiple-choice questions. The questions focused on essential aspects of MRI safety, including:

ACR-defined MRI safety zones
Potential hazards in MRI environments
Emergency procedures (e.g., quenching)
Pre-scan patient screening
Safe and unsafe objects
Knowledge about radiation type and patient contraindications

Sample Size and Duration

A total of 90 valid responses were received over a data collection period of two weeks in July 2025.

Questionnaire Development

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

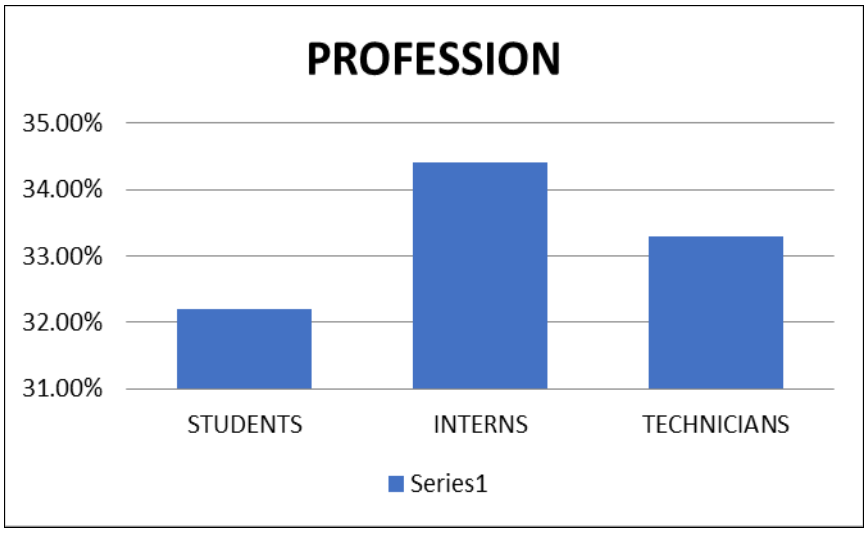
Data Collection and Analysis

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

Result

A total of 90 participants responded to the questionnaire-based survey, including students 33.3%, interns 34.4% and technicians 32.2%. The findings provide insights into the current level of awareness regarding MRI safety practices

A Standard multiple-choice questionnaire was developed to gather data on awareness regarding MRI safety practices. The survey instrument consisted of 18 multiple choice questions.



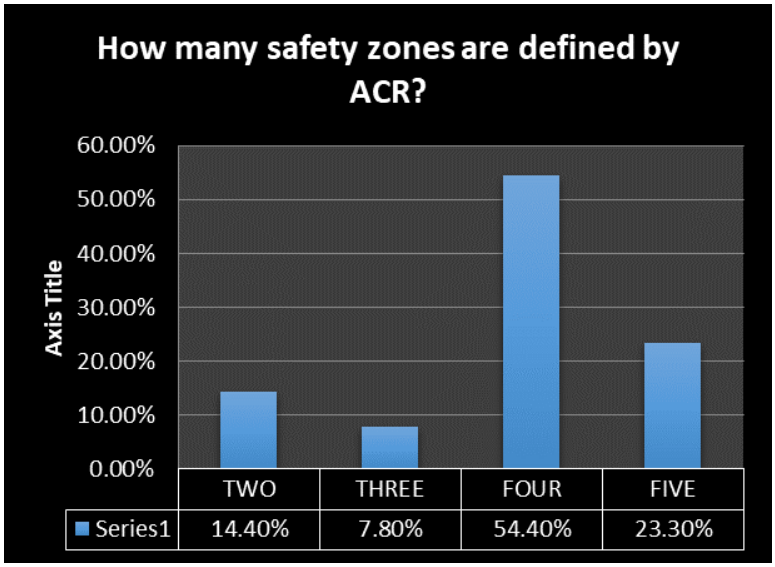
Graph 1: Respondents Profession

Table 1: Respondents Profession

Profession	Percentage
Students	32%
Intern	34.24%
Technicians	33.25%

Knowledge of MRI Safety Zones

Bar graph representing participants' responses regarding the number of MRI safety zones. A total of 54.4% correctly identified four zones, while 7.8% answered three zones, 14.4% selected two zones, and 23.3% incorrectly selected five zones.



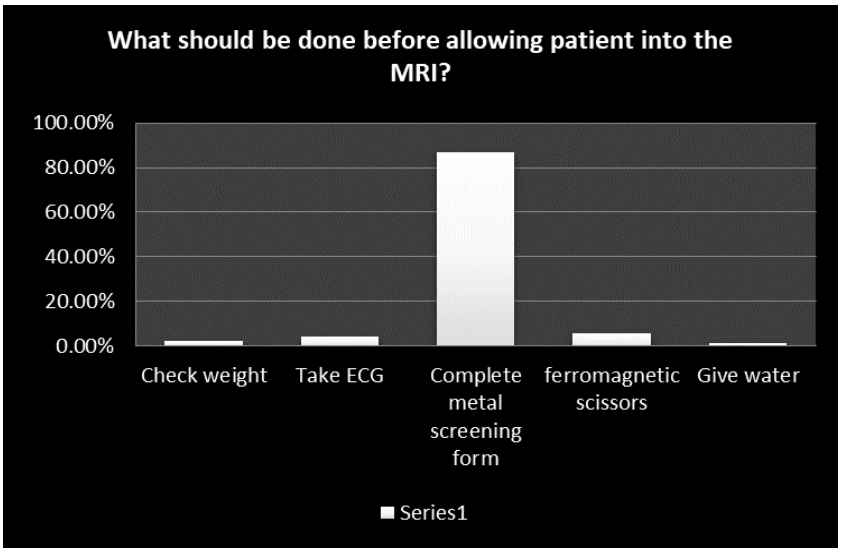
Graph 2: Participants' Knowledge of MRI Safety Zones

Table 2: Participants' Knowledge of MRI Safety Zones

Number of Safety Zones	Percentage
Two	14.40%
Three	7.80%
Four	54.40%
Five	23.30%

Pre-Scan Safety Screening

A high percentage of participants (about 90) selected completing a metal screening form as an essential step before scanning. Other answers indicated minor confusion regarding correct procedures.



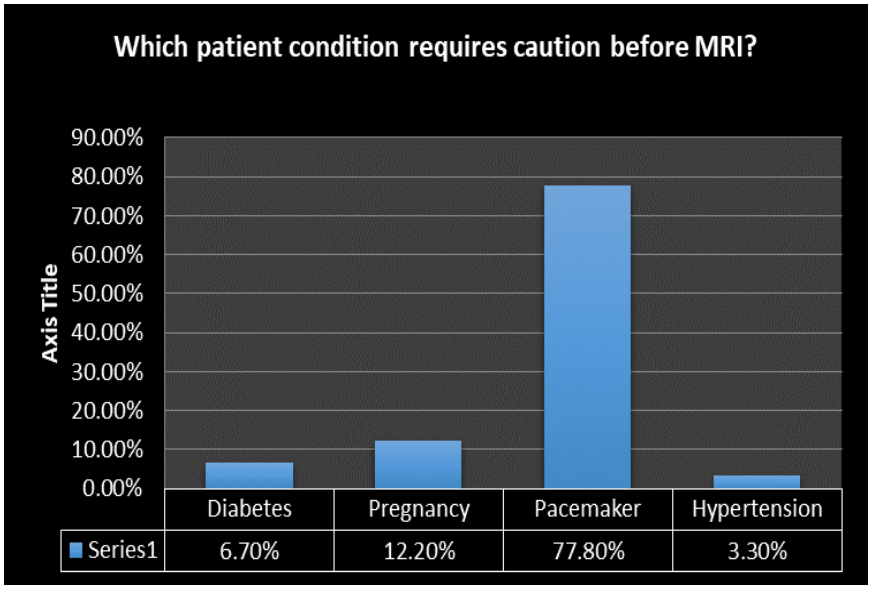
Graph 3: Awareness of Pre-Scan Safety Screening In MRI

Table 3: Awareness of Pre-Scan Safety Screening In MRI

Action	Percentage
Check weight	2.00%
Take ECG	4.00%
Complete Metal Screening Form	88.00%
Ferromagnetic Scissors	4.00%
Give Water	2.00%

High-Risk Patient Condition

Bar graph showing that 77.8% of participants identified pacemakers as a high-risk condition, followed by pregnancy (12.2%), diabetes (6.7%), and hypertension (3.3%).



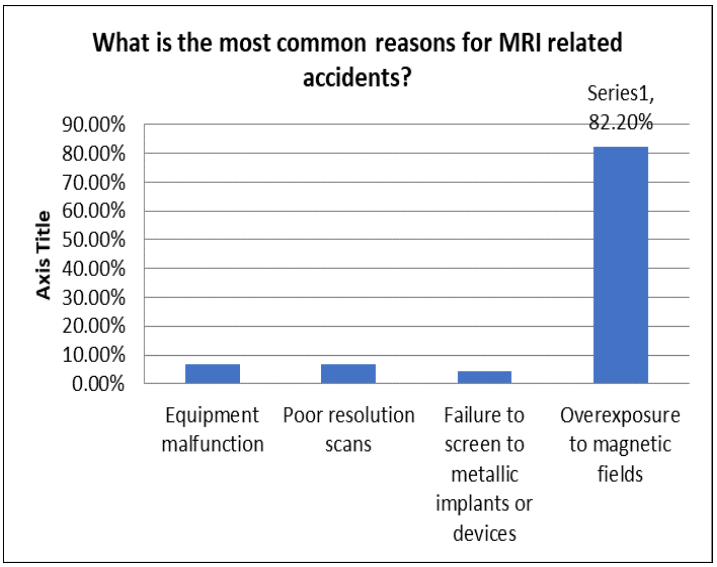
Graph 4: Awareness of High-RiskMRI Patient

Table 4: Awareness of High-RiskMRI Patient

Patient Condition	Percentage
Diabetes	6.70%
Pregnancy	12.20%
Pacemaker	77.80%
Hypertension	3.30%

Common Accident Causes

Bar graph showing that 82.2% of participants identified failure to screen for metallic implants or devices as the leading cause of MRI accidents. Other selected reasons included poor resolution scans (6.7%), equipment malfunction (6.7%), and overexposure to magnetic fields (4.4%).



Graph 5: Reasons for MRI-Related Accidents

Table 5: Reasons for MRI-Related Accidents

Reason for MRI-Related Accidents	Percentage
Equipment Malfunction	6.70%
Poor resolution scans	7.80%
Failure to screen to metallic implants /devices	3.30%
Over exposure to magnetic fields	82.20%

Discussion

This study assessed the level of MRI safety awareness among students and technicians from MMDU Mullana and MMU Sadopur. The findings indicate an overall satisfactory level of knowledge, though important gaps remain in critical safety concepts.

A majority (54.4%) of participants correctly identified the presence of four MRI safety zones, as defined by the American College of Radiology (ACR) [1]. This reflects foundational awareness aligned with national and international guidelines [8], although nearly 46% of participants selected incorrect options, suggesting partial confusion about zone classification and its importance in restricting unauthorized access.

Regarding hazard recognition, 67.8% identified projectile effects from ferromagnetic materials as the most serious threat in the MRI environment—consistent with prior reports highlighting this as the leading cause of serious accidents in MRI suites [2,5]. However, a small proportion misattributed electric shock or radiation as the primary hazard, which reinforces the ongoing challenge of correcting misconceptions, especially among early trainees [4,6].

Encouragingly, a large number of participants (95%) correctly understood the function of the quench button, aligning with safety protocols outlined in ACR safety documents [1,3]. Similarly, the knowledge of pre-scan screening procedures was high, with 92% identifying the use of a metal screening form as mandatory, echoing the emphasis on structured patient evaluation found in global safety recommendations [2,9].

The study also explored understanding of contrast agent safety, where 87.8% correctly identified gadolinium-based contrast as non-ionizing and MRI-compatible. However, a small portion of respondents still believed these agents are radioactive or ionizing, indicating a need for further clarification in training programs [4,9].

Notably, 15% of respondents believed MRI uses ionizing or radioactive radiation, which has been consistently reported as a common misconception even among health professionals [6]. Such gaps in understanding can negatively affect clinical decision-making and patient communication, highlighting the importance of integrated physics education during radiology training [4].

When assessing awareness of high-risk patient conditions, 77.8% selected pacemaker implants as contraindicated, while fewer identified pregnancy or tattoos as risk factors. This suggests a partial understanding of screening protocols and aligns with studies showing that missed or underreported contraindications can lead to avoidable complications [2,7,10].

Furthermore, 82.2% of participants correctly attributed MRI-related accidents to failure in screening for metallic implants, which reflects real-world data from accident analyses [10]. The preferred method of accident prevention cited was strict screening and controlled access (75.6%), which is consistent with ACR guidelines and supports best practices globally [1,8].

These results reinforce prior findings that although basic MRI safety knowledge is present among students and technicians, regular, structured education and practical simulations are crucial for reinforcing correct practices [5,6]. As Calamante emphasized, MRI safety education should be ongoing and adaptive to evolving technology and risks [6].

Conclusion

The present survey highlights the existing disparities in MRI safety awareness among students, interns, and technicians. While technicians displayed relatively higher levels of knowledge, interns and students showed varying degrees of understanding, with students requiring the most improvement. The data also suggest that clinical exposure and recent experience significantly contribute to better safety awareness, as reflected in the performance of those with 3-5 years of experience.

These findings underline the importance of structured training programs, periodic workshops, and continuous professional development to enhance and maintain MRI safety standards across all levels of healthcare professionals. Integrating MRI safety education early in academic curricula and ensuring regular updates for experienced staff can play a crucial role in minimizing risks and promoting a safe imaging environment.

This study not only identifies gaps but also offers direction for future educational strategies aimed at improving MRI safety awareness and implementation in clinical practice.

Limitations and Future Scope

This study, while offering valuable insight into the current level of awareness regarding MRI safety protocols among students and MRI technicians, is subject to several limitations. Firstly, the survey was conducted at two institutions (MMDU Mullana and MMU Sadopur), which may limit the generalizability of the findings to broader populations. The sample size of 90, 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 MRI safety awareness. Furthermore, the study did not correlate the participants' theoretical knowledge with their actual compliance or behavior in clinical MRI 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 educational needs. Finally, integrating simulation-based safety training and assessing its long-term effect on clinical practice may provide a more holistic understanding of MRI safety preparedness.

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Author's Contribution

Not available

Conflict of Interest

Not available

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References

1. Kanal E, Barkovich AJ, Bell C, Borgstede JP, Bradley WG, Froelich JW, *et al*. ACR guidance document on MR safe practices: 2013. AJR Am J Roentgenol. 2013;200(2):1-14.
2. Shellock FG. Reference manual for magnetic resonance safety, implants, and devices: 2015 edition. Los Angeles: Biomedical Research Publishing Group; 2015. p. 1-721.
3. Kanal E, Gilk T. MRI safety and compliance: How to protect your patients and your facility. Radiol Manage. 2008;30(4):29-36.
4. Westbrook C, Roth CK, Talbot J. MRI in practice. 5th ed. Oxford: Wiley-Blackwell; 2018. p. 1-456.
5. Sammet S. Magnetic resonance safety: A practical guide for radiologists. Radiol Clin North Am. 2016;53(3):705-714.
6. Calamante F. MRI safety: Education matters more than ever. J Magn Reson Imaging. 2021;53(1):12-16.
7. Koch KM, King KF, McKinnon GC. MRI safety: Risk management and compliance. Magn Reson Imaging Clin N Am. 2010;18(2):161-172.
8. Kanal E, Borgstede JP, Barkovich AJ, Bell C, Bradley WG, Froelich JW, et al. ACR guidance document for safe MR practices: 2002. AJR Am J Roentgenol. 2002;178(6):1335-1347.
9. Bhargava P. Magnetic resonance imaging: Physical and biological principles. Indian J Radiol Imaging. 2011;21(2):105-113.
10. Hattori Y, Fukatsu H, Ishigaki T. Prevention of accidents in MRI: Analysis of accident reports in Japan. Radiol Phys Technol. 2007;1(1):27-31.

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