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Evaluation of MRI Safety Screening Practices at Asram Medical College

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ABSTRACT

Background

Magnetic Resonance Imaging (MRI) is widely used for diagnosis and does not use ionizing radiation. However, the strong static magnetic field, radiofrequency energy, acoustic noise, and associated equipment may pose safety risks if appropriate precautions are not followed. Adequate MRI safety knowledge is therefore essential for patients, healthcare professionals, students, and other personnel entering the MRI environment.

Aim

To assess the knowledge, awareness, and understanding of MRI hazards and safety practices among medical professionals, technologists, security personnel, ward staff, and medical, allied health science, and nursing students at ASRAM Medical College.

Materials and Methods

A cross-sectional, questionnaire-based study was conducted at ASRAM Medical College, Malkapuram, Eluru District, Andhra Pradesh, among **450 participants**. Participants included Allied Health Science and Nursing students, postgraduate doctors, technicians, nurses, maintenance, housekeeping, and security personnel. A structured self-administered questionnaire assessed basic MRI knowledge, safety precautions, and hazards. Each correct response received one mark, with no negative marking. Data were summarized using frequency, percentage, mean, and standard deviation.

Results

Postgraduate doctors demonstrated the highest overall knowledge score (**92.24%**), followed by Radiology technicians (**86.93%**). Allied Health Science students scored **44.47%**, with B.Sc. Radiology students scoring highest (**57.19%**). Nursing students scored **39.53%**, practicing nurses **53.24%**, and security personnel **38.63%**. Housekeeping and maintenance personnel had the lowest combined score (**33.53%**). Most groups had inadequate knowledge below 60%.

Conclusion

Important gaps in MRI safety knowledge were identified, particularly among students and non-clinical personnel. Regular, structured, role-specific MRI safety education and refresher training are recommended to improve safe

practices and reduce MRI-related risks.

Keywords: MRI Safety, MRI Hazards, Safety Screening, Knowledge, Awareness.

1. Introduction

Magnetic Resonance Imaging (MRI) is a non-invasive medical imaging modality that provides detailed anatomical and functional information about the human body without the use of ionizing radiation. The fundamental principle of MRI is based on Nuclear Magnetic Resonance (NMR), a phenomenon first described in 1946 by Felix Bloch and Edward Purcell. The development of MRI as a clinical imaging technique subsequently involved major contributions from several researchers, including Raymond Damadian, Peter Mansfield, and Paul Lauterbur. The first human MRI examination was performed in the 1970s, and the development of magnetic resonance imaging techniques was recognized with the Nobel Prize in Physiology or Medicine in 2003, awarded to Paul Lauterbur and Peter Mansfield.

MRI operates using a strong static magnetic field, radiofrequency (RF) pulses, and rapidly varying magnetic-field gradients to generate images. The strength of the static magnetic field is expressed in Tesla (T), with 1 Tesla equivalent to 10,000 Gauss (G). Clinical MRI systems commonly operate at field strengths of 1.5 Tesla and 3 Tesla, while lower-field and ultra-high-field systems are also available for specific clinical and research applications. For comparison, the Earth's magnetic field is approximately 0.25–0.65 Gauss, demonstrating the exceptionally strong magnetic environment present within and around an MRI scanner.

MRI systems can be classified according to magnetic-field strength, physical configuration, and clinical application. Low-field systems generally operate at approximately 0.2–0.5 T and may offer advantages in terms of accessibility and patient comfort. Conventional clinical MRI systems commonly operate at 1.5 T, whereas 3 T systems provide higher signal-to-noise ratios and may facilitate improved spatial resolution or shorter acquisition times for selected examinations. Ultra-high-field systems, such as 7 T MRI, are primarily used for specialized clinical and research applications. In terms of scanner configuration, MRI systems may be categorized as closed-bore, wide-bore, or open systems, with differences in patient accessibility, comfort, field strength, and image quality.

MRI has a wide range of clinical applications, including structural brain imaging, diffusion-weighted imaging (DWI), functional MRI (fMRI), cardiac MRI, breast MRI, and magnetic resonance angiography (MRA). Diffusion MRI is particularly important in the early detection of acute ischemic stroke, while MRA can be used to evaluate blood vessels using either contrast-enhanced or non-contrast techniques. MR spectroscopy provides information regarding tissue metabolites and chemical composition and can therefore complement conventional anatomical imaging.

Despite the absence of ionizing radiation, MRI is not completely free from safety hazards. The powerful static magnetic field can attract ferromagnetic objects and convert them into high-velocity projectiles, creating a potentially fatal projectile hazard. In addition, radiofrequency energy can cause tissue heating and burns, particularly when conductive materials, cables, monitoring equipment, or inappropriate patient positioning create conditions for localized heating. The rapidly switching gradient magnetic fields can produce significant acoustic noise and may cause discomfort or temporary auditory effects when adequate hearing protection is not provided. Other safety concerns include risks associated with implants and medical devices, particularly when their MRI compatibility or conditional status is not adequately verified.

MRI safety incidents have been reported in India and internationally, highlighting the importance of systematic screening, staff training, restricted access, appropriate signage, and strict adherence to MRI safety protocols. Serious incidents involving oxygen cylinders and other ferromagnetic objects have demonstrated the potentially catastrophic consequences of inadequate screening and control of the MRI environment. In addition to projectile-related incidents, preventable injuries may occur because of RF-induced burns, inappropriate positioning, failure to identify implants or devices, and inadequate communication between healthcare personnel and patients.

Recent incidents reported in India have further emphasized the importance of MRI safety awareness among not only radiologists and radiographers but also other healthcare workers, patient attendants, security personnel, housekeeping

staff, and patients themselves. The increasing availability of MRI services and the growing number of examinations performed each year make effective safety practices essential. Particular attention is required during patient screening, identification of implants and medical devices, removal of metallic objects, control of access to the MRI suite, and emergency preparedness.

Therefore, assessment of knowledge and awareness regarding MRI safety among healthcare personnel and patients is an important area of research. Identifying gaps in knowledge, training, screening practices, and adherence to established safety procedures can help reduce preventable MRI-related incidents. The present study aims to assess MRI safety awareness and practices and to identify areas where improved education, standardized screening procedures, and appropriate safety measures may contribute to a safer MRI environment.

MRI-Related Accidents Reported in India

Although MRI does not use ionizing radiation, the strong static magnetic field, radiofrequency energy, and gradient fields can produce serious safety hazards when appropriate precautions are not followed. The following are **publicly reported MRI-related incidents in India** that illustrate important categories of MRI safety risks.

MRI Projectile Accident – Mumbai, Maharashtra (2014)

- **Year:** 2014
- **Location:** Advanced Centre for Treatment, Research and Education in Cancer (ACTREC), Tata Memorial Centre, Navi Mumbai, Maharashtra
- **Type of incident:** Ferromagnetic projectile accident
- **What happened:** A ward attendant/ward boy entered the MRI room while carrying a **metal oxygen cylinder**. The powerful magnetic field attracted the cylinder toward the MRI scanner.
- **Persons affected:** A ward boy and MRI technician Swami Ramaiah were involved in the incident.
- **Injury:** The technician became trapped against the MRI system for several hours and sustained serious injuries.
- **Main safety issue:** A ferromagnetic oxygen cylinder was brought into the MRI environment.
- **Safety lesson:** Oxygen cylinders and other ferromagnetic equipment must never be brought into the MRI scanner room unless they are specifically MR Safe or MR Conditional and appropriately verified.
- **Evidence:** Contemporary reports describe the incident as occurring in 2014 and involving an oxygen cylinder entering the MRI room.

Fatal MRI Projectile Accident – Mumbai, Maharashtra (2018)

- **Date:** 27 January 2018
- **Location:** BYL Nair Charitable Hospital, Mumbai, Maharashtra
- **Type of incident:** Fatal projectile accident
- **Victim:** Rajesh Maru, 32 years old
- **What happened:** Maru entered the MRI examination room while carrying a **metal oxygen cylinder**.
- **Incident:** The oxygen cylinder was attracted toward the MRI scanner by the magnetic field, pulling Maru toward the scanner.
- **Outcome:** He sustained fatal injuries and died.
- **Main safety issue:** A ferromagnetic oxygen cylinder was allowed to enter the MRI room.
- **Safety lesson:** Strict access control, screening, and verification of equipment are essential before anyone enters the MRI controlled area.
- **Evidence:** The death and involvement of an oxygen cylinder were reported by multiple news sources at the time.

3. Death During MRI Examination – Eluru, Andhra Pradesh (2025)

- **Date:** 4 February 2025
- **Location:** A private diagnostic centre in Eluru, Andhra Pradesh
- **Patient:** N. Rama Tulasamma, approximately 60–61 years old
- **Type of incident:** Death during MRI examination; reported concern regarding an implanted cardiac device
- **Medical history:** According to reports, the patient had a **pacemaker** and was undergoing dialysis-related treatment.
- **Reason for MRI:** She reportedly underwent MRI for evaluation of dizziness.
- **What was reported:** The patient's husband alleged that the MRI facility staff failed to adequately recognize/check the patient's pacemaker and dialysis-related equipment before the examination.
- **Outcome:** The woman died during the MRI examination.
- **Important caution for research:** The circumstances surrounding the death were **reported as allegations by the family and were subject to investigation**. Therefore, a research paper should **not state as established fact** that the pacemaker heated, malfunctioned, or directly caused her death unless an official medical or investigative report confirms this.
- **Safety lesson:** Patients with implanted cardiac devices must undergo appropriate pre-MRI screening and device-specific safety assessment before scanning.
- **Evidence:** The death and the family's allegations were reported by Indian news sources in February 2025.

2. AIM AND OBJECTIVES OF THE STUDY

Aim of the Study

To assess the level of knowledge, awareness, and understanding of MRI hazards and safety practices among medical professionals, technologists, security personnel, ward staff, and medical, allied health science, and nursing students.

Objectives of the Study Primary Objectives

- To assess the knowledge and awareness of MRI hazards and safety practices among individuals present near or involved in MRI services.
- To educate MRI users and other beneficiaries about MRI hazards and appropriate safety precautions.
- To improve awareness regarding MRI safety warning signs and their importance.

Secondary Objectives

- To educate participants about the basic principles of MRI, potential hazards, and appropriate protective measures.
- To assess the understanding of MRI safety warning signs and metal-detector screening among non-radiology professionals, including physicians, nurses, technicians, ward staff, patients, patient attendants, and housekeeping staff.
- To assess the awareness of MRI safety zones and their markings among individuals who frequently enter or use the MRI environment.
- To assess the basic understanding of magnetic fields and their relevance to MRI safety.

3. MATERIALS AND METHODS

3.1 Study Design

The present study was conducted using a **cross-sectional, questionnaire-based study design** to assess the knowledge and awareness of MRI hazards and safety practices among healthcare professionals, students, and selected non-clinical personnel associated with the MRI environment.

The cross-sectional design was selected because it enabled the assessment of participants' level of MRI safety knowledge and awareness at a defined period of time without intervention or follow-up.

3.2 Study Setting

The study was conducted at **ASRAM Medical College, Malkapuram, Eluru District, Andhra Pradesh, India**.

The institution provides medical, nursing, allied health and diagnostic services and has an MRI facility where different categories of healthcare professionals, students and support personnel may have access to or work in proximity to the MRI environment.

3.3 Study Period

The study was conducted over a period of approximately **six to nine months**, including preparation of the study instrument, participant recruitment, questionnaire administration, data collection and data analysis.

Note: The exact start and end dates should be inserted in the final dissertation so that the study period is reported consistently throughout the manuscript.

3.4 Sample Size

Sample Size : Types of study Cross sectional Study MRI Hazards and Awareness , Knowledge is 50%

$\eta = 4pq / l^2$

this formula can be understood like this:

n = value want to find

p = one given value

q = another given value

l = a given limit/error value l^2 means l×l
$\eta = 4pq / l^2$

n= Value want to Find

4= Constant for 95% confident

p = Expected % of Character =50% (0.5)

q = 1-p , 1-0.5 = 0.05

l = a given limit/error value =4.7% (0.047) $\eta = 4x0.5x0.5 / (0.047)^2$
$\eta = 453 = 450$

Sample Size = 450

Based on the calculated sample size, a target sample of approximately **450 participants** was considered for the study.

3.5 Study Population

The study population consisted of healthcare professionals, students and selected non-clinical personnel who could potentially enter, work in or have contact with the MRI environment. A total of **450 participants** were included in

the study.

The participants comprised:

- ❖ B.Sc. Allied Health Science students
- ❖ B.Sc. Nursing students
- ❖ Postgraduate doctors
- ❖ Technicians
- ❖ Nurses
- ❖ Maintenance staff
- ❖ Housekeeping personnel
- ❖ Security personnel

3.6 Inclusion Criteria

Participants were eligible for inclusion if they:

- ❖ Belonged to one of the selected professional, student or support-staff categories.
- ❖ Were associated with ASRAM Medical College during the study period.
- ❖ Were willing to participate in the study.
- ❖ Provided informed consent.
- ❖ Were able to understand and complete the questionnaire.

3.7 Exclusion Criteria

The following categories were excluded from the study:

- Administrative officers
- Operations and administrative staff
- Billing staff
- Pharmacists
- General laboratory technologists and staff
- Maintenance personnel not included in the designated maintenance category
- AC technicians
- Electrical technicians
- Other personnel who did not meet the predefined eligibility criteria

The final exclusion criteria should be retained consistently with the approved study protocol.

3.8 Study Instrument

Data were collected using a **structured, self-administered questionnaire** developed to assess participants' knowledge and awareness of MRI hazards and safety practices.

The questionnaire was designed to obtain baseline demographic information and assess knowledge of fundamental MRI principles, MRI safety precautions and MRI-related hazards.

3.8.1 Components of the Questionnaire

The questionnaire included the following domains:

Section I: Personal and Demographic Information

The demographic section collected information regarding:

- Age
- Gender
- Professional category/designation
- Educational qualification

Section II: Basic MRI Knowledge

This section assessed fundamental knowledge of MRI, including:

1. What is MRI?
2. Does MRI use X-rays?
3. Does MRI use a strong magnet?

Section III: MRI Safety

This section assessed awareness of common MRI safety precautions, including:

1. Removal of metallic objects before an MRI examination
2. Restrictions on carrying mobile phones into the MRI room
3. Reporting metallic implants to MRI personnel
4. Use of hearing protection during MRI examinations
5. Informing MRI personnel regarding pregnancy

Section IV: MRI Hazards

This section assessed knowledge regarding:

1. Attraction of metallic objects by the MRI magnet
2. Effects of MRI noise on hearing
3. Heating of the body during MRI
4. Potential hazards associated with certain metallic implants
5. Projectile hazards associated with loose metallic objects

3.8.2 Scoring System

Each correct response was awarded **one point** and each incorrect, "don't know," or unanswered response was awarded **zero points**. No negative marking was applied.

The supplied Results were calculated using a **maximum score of 17**.

EVALUATION OF MRI SAFETY SCREENING PRACTICES IN THE ASRAM MEDICAL COLLEGE-STUDY

1. Personal Details – 4 Questions

1. **Age:** _____years
2. **Gender:**

☐ Male ☐Female ☐Other

3. **Profession:**

☐ Student ☐Doctor ☐Technician ☐Other: _____

4. **Qualification:**

☐ School ☐Diploma ☐Degree ☐Postgraduate

2. Basic MRI Knowledge – 3 Questions

5. **What is MRI?**

☐ Magnetic Resonance Imaging

☐ X-ray

☐ Ultrasound

6. **Does MRI use X-rays?**

☐ Yes ☐No ☐Don't know

7. **Does MRI use a strong magnet?**

☐ Yes ☐No ☐Don't know

3. MRI Safety – 5 Questions

8. **Should we remove metal objects before an MRI scan?**

☐ Yes ☐No ☐Don't know

9. **Can we take a mobile phone into the MRI room?**

☐ Yes ☐No ☐Don't know

10. **Should we tell the MRI staff if we have a metal implant?**

☐ Yes ☐No ☐Don't know

11. **Is ear protection needed during an MRI scan?**

☐ Yes ☐No ☐Don't know

12. **Should pregnant patients inform the MRI staff?**

☐ Yes ☐No ☐Don't know

4. MRI Hazards – 5 Questions

13. **Can metal objects be pulled by the MRI magnet?**

☐ Yes ☐No ☐Don't know

14. **Can MRI noise affect hearing?**

☐ Yes ☐No ☐Don't know

15. **Can the body become warm during an MRI scan?**

☐ Yes ☐No ☐Don't know

16. **Can some metal implants be dangerous during MRI?**

☐ Yes ☐No ☐Don't know

17. **Can loose metal objects become dangerous projectiles in an MRI room?**

☐ Yes ☐No ☐Don't know

3.9 Validity and Pretesting of the Instrument

The questionnaire was pretested for clarity, comprehensibility and suitability for the study population.

Content validity was assessed by experts with relevant expertise in **radiology and medical education**. Feedback obtained from the experts was considered in refining the wording and presentation of the questionnaire.

3.10 Study Variables

3.10.1 Independent Variables

- The independent variables considered in the study included:
- Professional category/designation
- Department
- Years of professional experience
- Previous exposure to MRI-related training
- Previous formal safety training
- Other relevant demographic characteristics
- The final list should correspond to variables actually collected in the questionnaire.

3.10.2 Dependent Variables

The primary dependent variable was the participant's **MRI safety knowledge score**.

- The study also assessed awareness related to:
- Basic MRI principles
- MRI safety precautions
- MRI-related hazards
- Safe conduct within MRI-controlled areas

The exact domain scores should correspond to the final validated questionnaire and scoring key.

3.11 Data Collection Procedure

After obtaining the necessary institutional permission and ethical approval, eligible participants were approached during the study period.

The purpose of the study was explained to eligible participants, and informed consent was obtained before questionnaire administration.

Hard-copy questionnaires were distributed to participants and completed in the presence of the investigator. The investigator was available to clarify the meaning of questions when required, without influencing participants' responses.

Completed questionnaires were collected and checked for completeness. Each questionnaire was assigned a study identification number, and the information was entered into a computer-based database for statistical analysis.

3.12 Ethical Considerations

The study was conducted after obtaining the necessary permission from the concerned institutional authorities and ethical committee, as applicable.

Participation was voluntary. Participants were informed about the purpose and nature of the study before participation. Confidentiality and privacy of participants were maintained throughout the study, and the collected information was used only for research purposes.

3.13 Statistical Analysis

The collected data were entered into a computer-based statistical software package and analyzed using appropriate statistical methods.

Descriptive Statistics

Descriptive statistics were used to summarize participant characteristics and questionnaire responses.

The following measures were used:

- Frequency (n)
- Percentage (%)
- Mean
- Standard deviation (SD)
- Minimum score
- Maximum score

Mean knowledge scores were expressed both as raw scores and as percentages wherever applicable.

Inferential Statistics

Appropriate inferential statistical tests were planned to determine differences or associations between relevant variables.

Depending on the number and nature of groups, tests such as the **independent-samples t-test** and **one-way analysis of variance (ANOVA)** may be applied where their assumptions are satisfied.

A **p-value <0.05** was considered statistically significant.

Because respondent-level raw data were not available in the material supplied for preparation of this chapter, exact inferential test values and p-values should be verified against the original dataset before being included as confirmed findings.

3.14 Knowledge Classification

For interpretation of the overall knowledge score, participants were classified according to the percentage score as follows:

Knowledge level	Percentage score
Inadequate	<60%
Adequate	60–79.99%
Excellent	≥80%

This classification was applied to the overall knowledge percentage, subject to confirmation that it matches the

classification specified in the approved study protocol.

3.15 Presentation of Results

The findings were presented using tables and appropriate graphical representations. Results were summarized according to professional category and, where applicable, according to individual professional or educational subgroups.

The analysis focused on identifying differences in MRI safety knowledge and awareness among groups that may have different levels of exposure to the MRI environment.

4. RESULTS

4.1 Overview

The present study assessed knowledge and awareness of MRI hazards and safety practices among different professional, student and support-staff categories at ASRAM Medical College.

A total of **450 participants** were included in the study. The participants comprised B.Sc. Allied Health Science students, B.Sc. Nursing students, postgraduate doctors, technicians, nurses, maintenance staff, housekeeping personnel and security personnel.

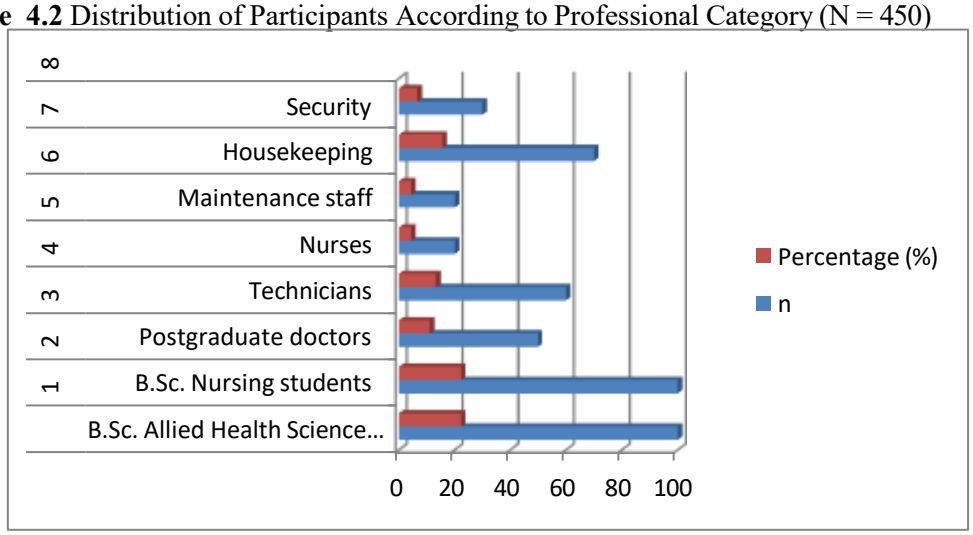
The results are presented in the following sections.

4.2 Distribution of Participants According to Professional Category

Table 4.1 Distribution of Participants According to Professional Category (N = 450)

S. No.	Professional category	n	Percentage (%)
1	B.Sc. Allied Health Science students	100	22.22
2	B.Sc. Nursing students	100	22.22
3	Postgraduate doctors	50	11.11
4	Technicians	60	13.33
5	Nurses	20	4.44
6	Maintenance staff	20	4.44
7	Housekeeping	70	15.56
8	Security	30	6.67
Total		**450**	**100.00**

Figure 4.2 Distribution of Participants According to Professional Category (N = 450)



Interpretation

Table 4.1 shows the distribution of the 450 participants according to professional category. B.Sc. Allied Health Science students and B.Sc. Nursing students constituted the largest groups, with **100 participants each (22.22%)**. This was followed by housekeeping personnel, comprising **70 participants (15.56%)**, and technicians, comprising **60 participants (13.33%)**.

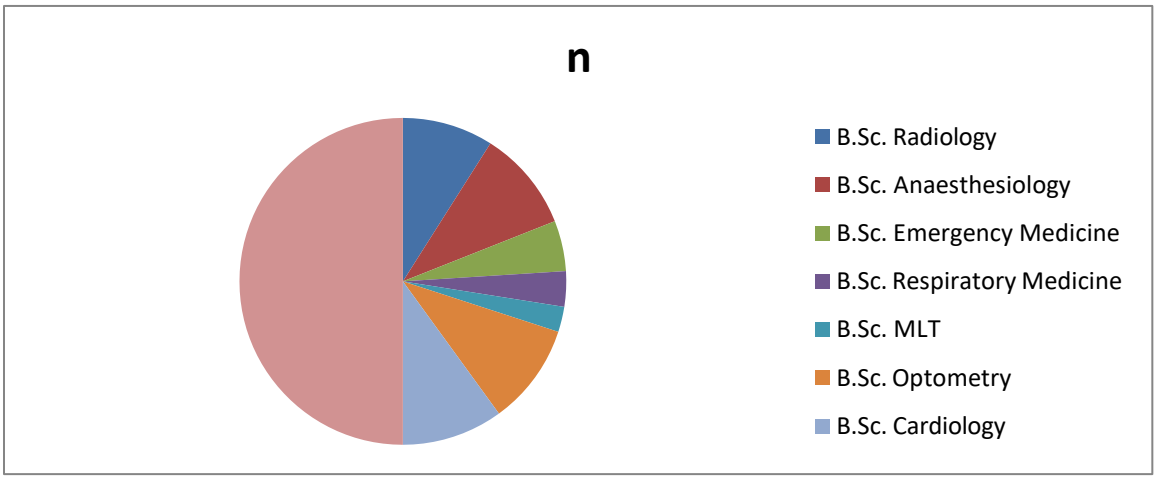
Postgraduate doctors accounted for **50 participants (11.11%)**, while security personnel accounted for **30 participants (6.67%)**. Nurses and maintenance staff each contributed **20 participants (4.44%)**.

Thus, the study included representation from both clinical and non-clinical groups who may potentially access or work in and around the MRI environment.

4.3 Knowledge among B.Sc. Allied Health Science Students

Table 4.3 Profession-wise MRI Safety Knowledge among B.Sc. Allied Health Science Students (N = 100)

Professional group	n	Total score	Mean score ± SD (/17)	Mean knowledge (%)	Highest (%)	Lowest (%)
B.Sc. Radiology	18	175	9.72 ± 2.78	57.19	94.12	35.29
B.Sc. Anaesthesiology	20	140	7.00 ± 2.27	41.18	70.59	23.53
B.Sc. Emergency Medicine	10	77	7.70 ± 1.89	45.29	64.71	29.41
B.Sc. Respiratory Medicine	7	43	6.14 ± 1.68	36.13	52.94	23.53
B.Sc. MLT	5	40	8.00 ± 1.58	47.06	58.82	35.29
B.Sc. Optometry	20	143	7.15 ± 2.06	42.06	64.71	23.53
B.Sc. Cardiology	20	138	6.90 ± 1.59	40.59	52.94	23.53
Overall	**100**	**756**	**7.56**	**44.47**	**94.12**	**23.53**



Interpretation

The overall mean MRI safety knowledge score among B.Sc. Allied Health Science students was **7.56 out of 17**, corresponding to **44.47%**.

B.Sc. Radiology students demonstrated the highest mean knowledge score (**9.72/17; 57.19%**), followed by B.Sc. MLT students (**47.06%**) and B.Sc. Emergency Medicine students (**45.29%**).

The lowest mean knowledge was observed among B.Sc. Respiratory Medicine students (**36.13%**). B.Sc. Cardiology, Anaesthesiology and Optometry students demonstrated mean knowledge levels of **40.59%, 41.18% and 42.06%**, respectively.

Overall, the findings indicate that MRI safety knowledge among Allied Health Science students was below the desirable level, although Radiology students performed comparatively better than students from the other disciplines.

4.4 Demographic Characteristics of B.Sc. Nursing Students

Table 4.4 Distribution of B.Sc. Nursing Students According to Gender (N = 100)

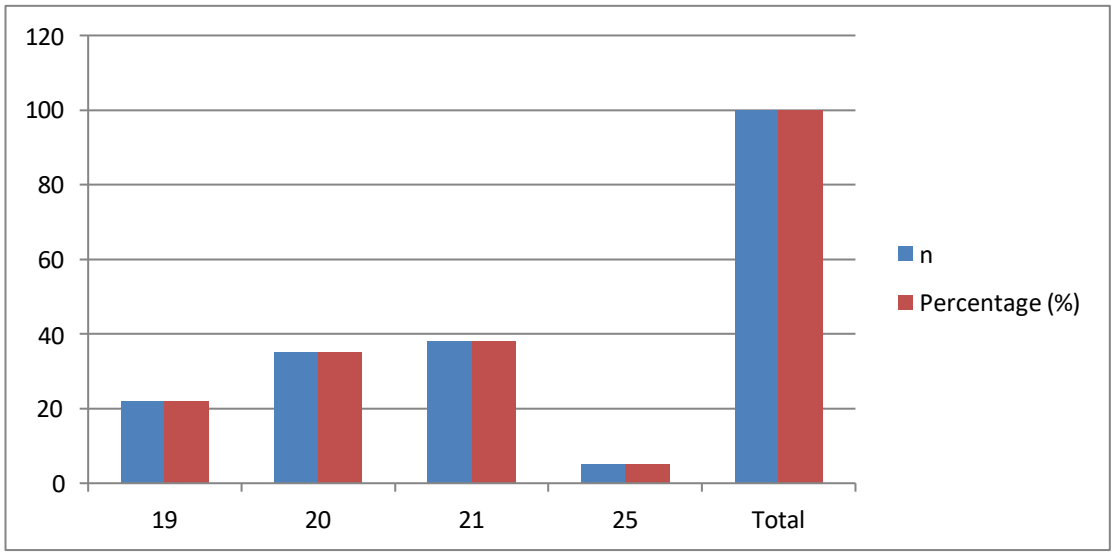
Gender	n	Percentage (%)
Female	90	90.00
Male	10	10.00
Total	**100**	**100.00**

Interpretation

Among the 100 B.Sc. Nursing students, **90 (90.0%) were female** and **10 (10.0%) were male**. **Table 4.4.1** Age Distribution of B.Sc. Nursing Students (N = 100)

Age (years)	n	Percentage (%)
19	22	22.00
20	35	35.00
21	38	38.00
25	5	5.00
Total	**100**	**100.00**

The mean age of the B.Sc. Nursing students was **20.37 ± 1.33 years**. **Figure 4.4.1** Age Distribution of B.Sc. Nursing Students (N = 100)



4.5 MRI Safety Knowledge among B.Sc. Nursing Students

Table 4.5 Overall MRI Safety Knowledge among B.Sc. Nursing Students (N = 100)

Parameter	Value
Total score obtained	672
Maximum possible score	1700
Mean score	6.72/17
Mean knowledge percentage	39.53%
SD	1.36
Highest score	10/17 (58.82%)
Lowest score	5/17 (29.41%)

Interpretation

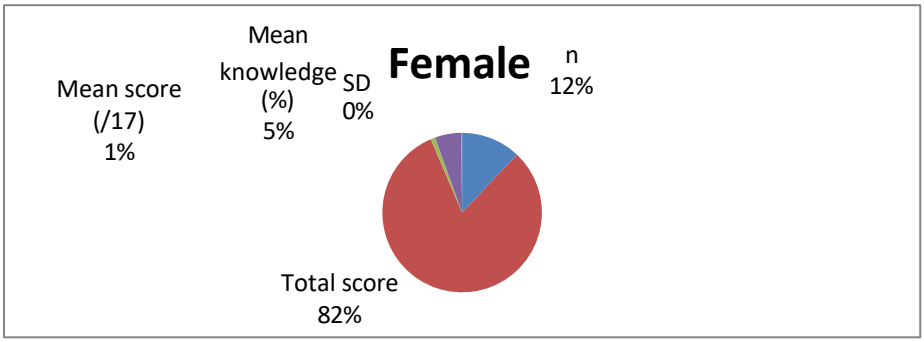
The B.Sc. Nursing students obtained a total score of **672 out of a possible 1700**, giving a mean score of **6.72 out of 17** and an overall mean knowledge percentage of **39.53%**.

The highest individual score was **10/17 (58.82%)**, whereas the lowest was **5/17 (29.41%)**. The findings indicate a generally low level of MRI safety knowledge among the nursing students.

Table 4.5.1 Gender-wise MRI Safety Knowledge among B.Sc. Nursing Students

Gender	n	Total score	Mean score (/17)	Mean knowledge (%)	SD
Female	90	609	6.77	39.80	1.39
Male	10	63	6.30	37.06	0.95
Overall	**100**	**672**	**6.72**	**39.53**	**1.36**

Figure 4.5.1 Gender-wise MRI Safety Knowledge among B.Sc. Nursing Students



Interpretation

Female students had a slightly higher descriptive mean knowledge score (**6.77/17; 39.80%**) compared with male students (**6.30/17; 37.06%**). However, this descriptive difference should not be interpreted as statistically significant without verification using an appropriate inferential test on the respondent-level data.

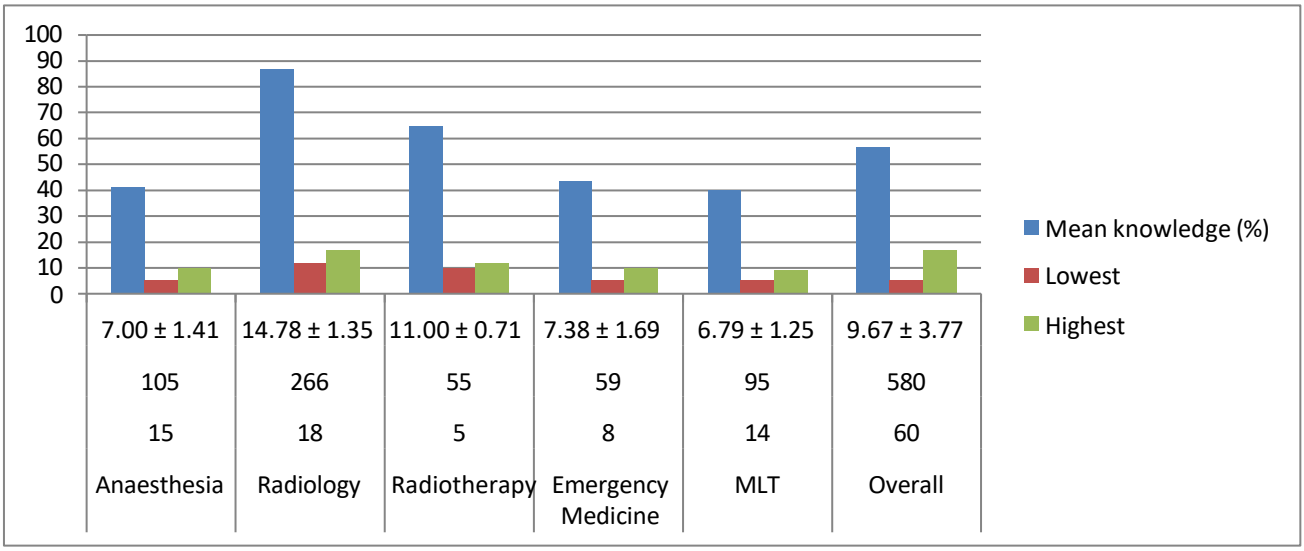
4.6 MRI Safety Knowledge among Technicians

Table 4.6.1 Profession-wise MRI Safety Knowledge among Technicians (N = 60)

Technician category	n	Total score	Mean ± SD (/17)	Mean knowledge (%)	Lowest	Highest
Anaesthesia	15	105	7.00 ± 1.41	41.18	5	10
Radiology	18	266	14.78 ± 1.35	86.93	12	17
Radiotherapy	5	55	11.00 ± 0.71	64.71	10	12

Emergency Medicine	8	59	7.38 ± 1.69	43.38	5	10
MLT	14	95	6.79 ± 1.25	39.92	5	9
Overall	**60**	**580**	**9.67 ± 3.77**	**56.86**	**5**	**17**

Figure 4.6.1 Profession-wise MRI Safety Knowledge among Technicians (N = 60)



Interpretation

The overall mean knowledge score among technicians was **9.67 ± 3.77 out of 17**, corresponding to **56.86%**.

Radiology technicians demonstrated the highest mean knowledge score (**14.78 ± 1.35; 86.93%**), followed by Radiotherapy technicians (**11.00 ± 0.71; 64.71%**).

The lowest mean knowledge was observed among MLT technicians (**6.79 ± 1.25; 39.92%**), followed by Anaesthesia technicians (**41.18%**) and Emergency Medicine technicians (**43.38%**).

The marked difference between Radiology technicians and technicians from other disciplines suggests that occupational exposure to MRI and imaging procedures may be associated with greater MRI safety awareness.

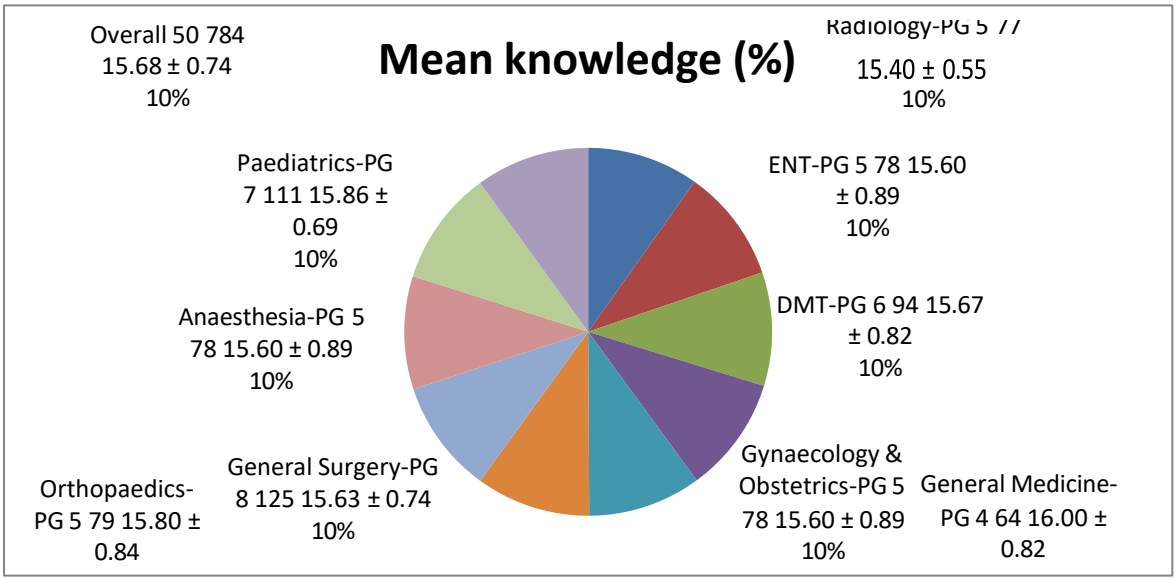
4.7 MRI Safety Knowledge among Postgraduate Doctors

Table 4.7 Specialty-wise MRI Safety Knowledge among Postgraduate Doctors (N = 50)

Specialty	n	Total score	Mean ± SD (/17)	Mean knowledge (%)	Lowest	Highest
Radiology-PG	5	77	15.40 ± 0.55	90.59	15	16
ENT-PG	5	78	15.60 ± 0.89	91.76	15	17
DMT-PG	6	94	15.67 ± 0.82	92.16	15	17
General Medicine-PG	4	64	16.00 ± 0.82	94.12	15	17

Gynaecology & Obstetrics-PG	5	78	15.60 ± 0.89	91.76	15	17
Orthopaedics-PG	5	79	15.80 ± 0.84	92.94	15	17
General Surgery-PG	8	125	15.63 ± 0.74	91.91	15	17
Anaesthesia-PG	5	78	15.60 ± 0.89	91.76	15	17
Paediatrics-PG	7	111	15.86 ± 0.69	93.28	15	17
Overall	**50**	**784**	**15.68 ± 0.74**	**92.24**	**15**	**17**

Figure 4.7 Specialty-wise MRI Safety Knowledge among Postgraduate Doctors (N = 50)



Interpretation

Postgraduate doctors demonstrated the highest overall MRI safety knowledge among the professional groups studied. The overall mean score was **15.68 ± 0.74 out of 17**, corresponding to **92.24%**.

Mean knowledge percentages across the specialties ranged from **90.59% among Radiology-PG participants to 94.12% among General Medicine-PG participants**.

The relatively narrow range of scores indicates consistently high MRI safety knowledge among the postgraduate doctors included in the study.

4.8 MRI Safety Knowledge among Security Personnel

Table 4.8 MRI Safety Knowledge among Security Personnel (N = 30)

Parameter	Value
Number of participants	30
Total score	197
Mean score ± SD	6.57 ± 1.25 /17
Mean knowledge	38.63%
Lowest score	5/17 (29.41%)
Highest score	9/17 (52.94%)

Interpretation

Security personnel demonstrated a mean MRI safety knowledge score of **6.57 ± 1.25 out of 17**, corresponding to **38.63%**.

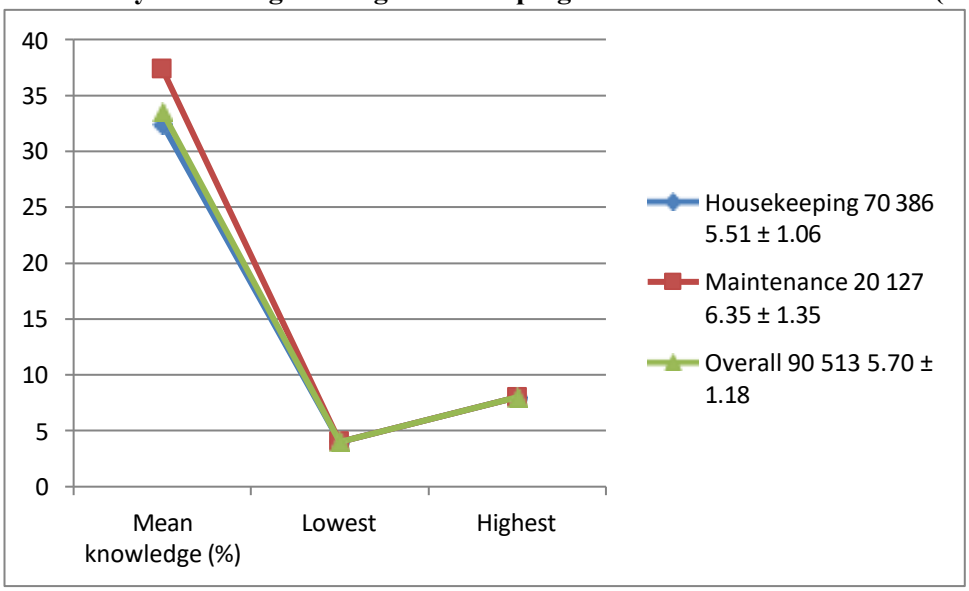
The highest score was **9/17 (52.94%)**, while the lowest was **5/17 (29.41%)**. The findings indicate a relatively low level of MRI safety knowledge among security personnel.

4.9 MRI Safety Knowledge among Housekeeping and Maintenance Personnel Table 4.9 MRI Safety Knowledge among Housekeeping and Maintenance Personnel (N = 90)

Category	n	Total score	Mean ± SD (/17)	Mean knowledge (%)	Lowest	Highest
Housekeeping	70	386	5.51 ± 1.06	32.44	4	8
Maintenance	20	127	6.35 ± 1.35	37.35	4	8
Overall	**90**	**513**	**5.70 ± 1.18**	**33.53**	**4**	**8**

Figure 4.9

MRI Safety Knowledge among Housekeeping and Maintenance Personnel (N = 90)



Interpretation

The combined housekeeping and maintenance group demonstrated an overall mean score of **5.70 ± 1.18 out of 17**, corresponding to **33.53%**.

Housekeeping personnel had a mean knowledge score of **5.51 ± 1.06 (32.44%)**, while maintenance personnel had a mean of **6.35 ± 1.35 (37.35%)**.

The findings demonstrate that MRI safety knowledge was particularly low among housekeeping and maintenance personnel compared with the professional groups directly involved in medical imaging.

4.10 MRI Safety Knowledge among Nurses

Table 4.10 MRI Safety Knowledge among Nurses (N = 20)

Qualification	n	Total score	Mean ± SD (/17)	Mean knowledge (%)	Lowest	Highest
DNM/B.Sc. Nurses	20	181	9.05 ± 1.67	53.24	7	13
Overall	**20**	**181**	**9.05 ± 1.67**	**53.24**	**7**	**13**

Interpretation

The nurses obtained an overall mean MRI safety knowledge score of **9.05 ± 1.67 out of 17**, corresponding to approximately **53.24%**.

The scores ranged from **7 to 13 out of 17**, indicating moderate but incomplete knowledge of MRI safety principles.

4.11 Overall Descriptive Comparison of Professional Groups

Table 4.11 Overall Ranking of Professional Groups According to MRI Safety Knowledge

Rank	Professional group	Knowledge score (%)	Descriptive level*
1	Physicians	92.24	Excellent
2	Technicians	57.25†	Inadequate
3	Nurses	53.23†	Inadequate
4	B.Sc. Allied Health Science students	44.47	Inadequate
5	B.Sc. Nursing students	39.52/39.53†	Inadequate
6	Security	38.81†	Inadequate
7	Housekeeping	33.65†	Inadequate

*Based on the study classification: <60% = Inadequate; 60–79.99% = Adequate; ≥80% = Excellent.

†The aggregate values in this table differ slightly from some profession-specific 17-point calculations presented in Tables 4.2–4.11. The original dataset/scoring method should be checked before final submission.

Interpretation

The overall descriptive comparison showed that **physicians ranked first**, with a knowledge score of **92.24%**, followed by technicians and nurses. Allied Health Science students and Nursing students demonstrated lower overall knowledge, while security and housekeeping personnel showed the lowest levels.

Only the physician group achieved the **excellent** category according to the predefined classification of ≥80%. The remaining professional categories fell below 60% and were therefore classified as **inadequate** using this classification system.

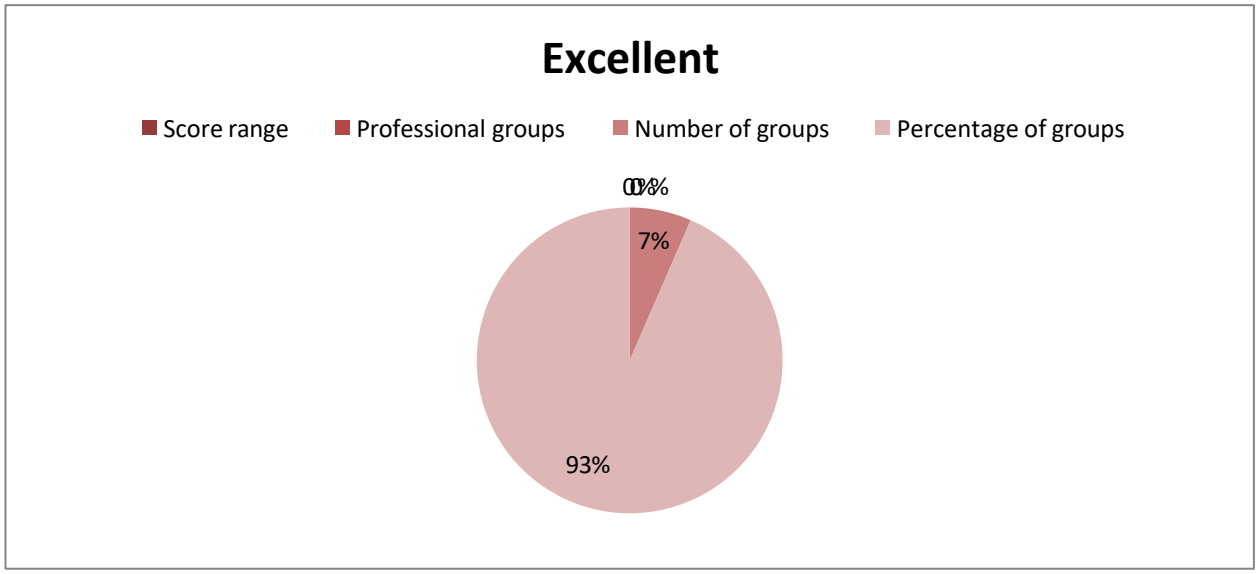
4.12 Overall Performance Classification

Table 4.12 Distribution of Professional Groups According to Overall MRI Safety Knowledge Classification

Knowledge category	Score range	Professional groups	Number groups	ofPercentage of groups
Excellent	≥80%	Physicians	1	14.29
Adequate	60–79.99%	None*	0	0.00
Inadequate	<60%	Technicians, Nurses, AHS students, Nursing students, Security, Housekeeping	6	85.71
Total			**7**	**100.00**

*This classification is based on the aggregate professional comparison supplied. If the detailed technician score of 56.86% is used, technicians also remain in the inadequate category.

Figure 4.12 Distribution of Professional Groups According to Overall MRI Safety Knowledge Classification



Interpretation

According to the predefined classification, **one of the seven professional categories (14.29%) demonstrated excellent knowledge**, while the remaining **six categories (85.71%) demonstrated inadequate knowledge**. No professional category fell within the adequate range of 60–79.99% in the aggregate comparison.

This finding indicates a substantial overall gap in MRI safety knowledge among most of the professional categories included in the study.

4.13 Summary of Major Findings

The major findings of the study were as follows:

1. A total of **450 participants** were included in the study.
2. B.Sc. Allied Health Science students and B.Sc. Nursing students were the largest participant groups, with **22.22% each**.
3. Among Allied Health Science students, **B.Sc. Radiology students** demonstrated the highest mean knowledge score (**57.19%**), whereas **B.Sc. Respiratory Medicine students** demonstrated the lowest (**36.13%**).
4. B.Sc. Nursing students demonstrated an overall mean knowledge score of **39.53%**, indicating inadequate knowledge according to the study classification.
5. Among technicians, **Radiology technicians** demonstrated the highest mean knowledge score (**86.93%**).
6. Postgraduate doctors demonstrated the highest overall knowledge among the professional categories, with a mean score of **92.24%**.
7. Security personnel demonstrated a relatively low mean knowledge score of **38.63%**.
8. Housekeeping and maintenance personnel demonstrated the lowest overall knowledge, with a combined mean of **33.53%**.
9. Nurses demonstrated a mean knowledge score of approximately **53.24%**, indicating an inadequate level according to the predefined <60% threshold.
10. The overall comparison demonstrated substantial variation in MRI safety knowledge across professional categories, with the highest knowledge among physicians and the lowest among housekeeping personnel.
11. The findings indicate a need for **structured, multidisciplinary MRI safety education**, particularly among groups with limited direct exposure to MRI procedures.

4.14 Statistical Interpretation

The descriptive findings demonstrate considerable differences in MRI safety knowledge among the professional groups. However, the exact statistical significance of these differences should be established using the original respondent-level dataset.

Where comparisons between more than two independent professional groups are performed, **one-way ANOVA** may be used when the assumptions of the test are satisfied. For comparisons involving two independent groups, an **independent-samples t-test** may be appropriate.

A **p-value <0.05** should be interpreted as statistically significant.

The exact F-values, t-values, degrees of freedom and p-values should be reported only after verification from the original participant-level dataset. This is particularly important because several summary tables supplied for the study contain slightly different aggregate percentages for the same professional categories.

4.14 Overall Performance Classification of obtained Percentage

Total	Total Marks	AHS Students	Nursing Students	Technicians	Physicians	Security	Housekeeping	Nurses
1	100.00%	52.94%	47.06%	47.06%	88.24%	41.00%	35.29%	47.05%
2	100.00%	41.18%	41.18%	41.18%	94.12%	29.41%	29.41%	52.94%
3	100.00%	47.06%	35.29%	35.29%	88.24%	41.18%	23.53%	47.05%
4	100.00%	35.29%	47.06%	47.06%	88.24%	47.06%	35.29%	41.17%
5	100.00%	41.18%	52.94%	52.94%	94.12%	52.94%	29.41%	58.82%

6	100.00%	52.94%	58.82%	58.82%	100.00%	35.29%	23.53%	52.94%
7	100.00%	58.82%	29.41%	29.41%	88.24%	41.18%	29.41%	41.17%

Total	Total Marks	AHS Students	Nursing Students	Technicians	Physicians	Security	Housekeeping	Nurses
8	100.00%	70.59%	35.29%	35.29%	94.12%	47.06%	29.41%	47.05%
9	100.00%	76.47%	35.29%	35.29%	88.24%	29.41%	29.41%	52.94%
10	100.00%	58.82%	47.06%	47.06%	88.24%	29.41%	35.29%	47.05%
11	100.00%	88.24%	47.06%	47.06%	94.12%	35.29%	35.29%	41.17%
12	100.00%	94.12%	47.06%	47.06%	100.00%	41.18%	29.41%	64.70%
13	100.00%	41.18%	52.94%	52.94%	88.24%	35.29%	29.41%	70.58%
14	100.00%	47.06%	35.29%	35.29%	94.12%	47.06%	23.53%	52.94%
15	100.00%	58.82%	29.41%	29.41%	88.24%	35.29%	23.53%	47.05%
16	100.00%	64.71%	41.18%	70.59%	88.24%	29.41%	29.41%	58.82%
17	100.00%	47.06%	52.94%	76.47%	94.12%	41.18%	29.41%	52.94%
18	100.00%	52.94%	29.41%	82.35%	100.00%	47.06%	23.53%	64.70%
19	100.00%	35.29%	35.29%	88.24%	88.24%	52.94%	29.41%	76.47%
20	100.00%	29.41%	41.18%	94.12%	94.12%	35.29%	35.29%	47.05%
21	100.00%	23.53%	41.18%	88.24%	88.24%	41.18%	35.29%	—
22	100.00%	41.18%	41.18%	88.24%	88.24%	47.06%	35.29%	—
23	100.00%	35.29%	35.29%	76.47%	94.12%	29.41%	29.41%	—
24	100.00%	47.06%	29.41%	76.47%	100.00%	29.41%	29.41%	—
25	100.00%	52.94%	29.41%	82.35%	88.24%	35.29%	29.41%	—
26	100.00%	58.82%	35.29%	94.12%	94.12%	41.18%	29.41%	—
27	100.00%	41.18%	35.29%	88.24%	88.24%	35.29%	23.53%	—
28	100.00%	64.71%	29.41%	94.12%	88.24%	47.06%	23.53%	—
29	100.00%	35.29%	35.29%	94.12%	94.12%	29.41%	35.29%	—
30	100.00%	29.41%	41.18%	100.00%	100.00%	35.29%	35.29%	—
31	100.00%	47.06%	47.06%	88.24%	88.24%	—	41.18%	—
32	100.00%	41.18%	41.18%	94.12%	94.12%	—	41.18%	—
33	100.00%	29.41%	35.29%	88.24%	88.24%	—	35.29%	—
34	100.00%	52.94%	47.06%	58.82%	88.24%	—	35.29%	—
35	100.00%	70.59%	52.94%	64.71%	94.12%	—	47.06%	—
36	100.00%	35.29%	58.82%	64.71%	100.00%	—	29.41%	—
37	100.00%	29.41%	29.41%	64.71%	88.24%	—	23.53%	—
38	100.00%	23.53%	35.29%	70.59%	94.12%	—	35.29%	—
39	100.00%	41.18%	35.29%	47.06%	88.24%	—	23.53%	—
40	100.00%	35.29%	47.06%	41.18%	88.24%	—	41.18%	—
41	100.00%	47.06%	47.06%	35.29%	94.12%	—	35.29%	—
42	100.00%	52.94%	47.06%	47.06%	100.00%	—	29.41%	—
43	100.00%	58.82%	52.94%	52.94%	88.24%	—	35.29%	—

Total	Total Marks	AHS Students	Nursing Students	Technicians	Physicians	Security	Housekeeping	Nurses
44	100.00%	41.18%	35.29%	58.82%	94.12%	—	23.53%	—
45	100.00%	64.71%	29.41%	29.41%	88.24%	—	29.41%	—
46	100.00%	35.29%	41.18%	35.29%	88.24%	—	35.29%	—
47	100.00%	29.41%	52.94%	35.29%	94.12%	—	41.18%	—
48	100.00%	47.06%	29.41%	47.06%	100.00%	—	35.29%	—
49	100.00%	41.18%	35.29%	47.06%	94.12%	—	41.18%	—
50	100.00%	29.41%	41.18%	47.06%	94.12%	—	29.41%	—
51	100.00%	52.94%	41.18%	52.94%	—	—	35.29%	—
52	100.00%	35.29%	41.18%	35.29%	—	—	41.18%	—
53	100.00%	29.41%	35.29%	29.41%	—	—	29.41%	—
54	100.00%	23.53%	29.41%	29.41%	—	—	35.29%	—
55	100.00%	41.18%	29.41%	35.29%	—	—	29.41%	—
56	100.00%	35.29%	35.29%	41.18%	—	—	23.53%	—
57	100.00%	47.06%	35.29%	47.06%	—	—	29.41%	—
58	100.00%	52.94%	29.41%	35.29%	—	—	35.29%	—
59	100.00%	58.82%	35.29%	41.18%	—	—	41.18%	—
60	100.00%	41.18%	41.18%	35.29%	—	—	29.41%	—
61	100.00%	64.71%	47.06%	—	—	—	35.29%	—
62	100.00%	35.29%	41.18%	—	—	—	29.41%	—
63	100.00%	29.41%	35.29%	—	—	—	35.29%	—
64	100.00%	47.06%	47.06%	—	—	—	41.18%	—
65	100.00%	41.18%	52.94%	—	—	—	29.41%	—
66	100.00%	29.41%	58.82%	—	—	—	47.06%	—
67	100.00%	52.94%	29.41%	—	—	—	35.29%	—
68	100.00%	35.29%	35.29%	—	—	—	41.18%	—
69	100.00%	29.41%	35.29%	—	—	—	29.41%	—
70	100.00%	23.53%	47.06%	—	—	—	47.06%	—
71	100.00%	41.18%	47.06%	—	—	—	35.29%	—
72	100.00%	35.29%	47.06%	—	—	—	29.41%	—
73	100.00%	47.06%	52.94%	—	—	—	41.18%	—
74	100.00%	52.94%	35.29%	—	—	—	23.53%	—
75	100.00%	58.82%	29.41%	—	—	—	41.18%	—
76	100.00%	41.18%	41.18%	—	—	—	47.06%	—
77	100.00%	64.71%	52.94%	—	—	—	29.41%	—
78	100.00%	35.29%	29.41%	—	—	—	23.53%	—
79	100.00%	29.41%	35.29%	—	—	—	29.41%	—

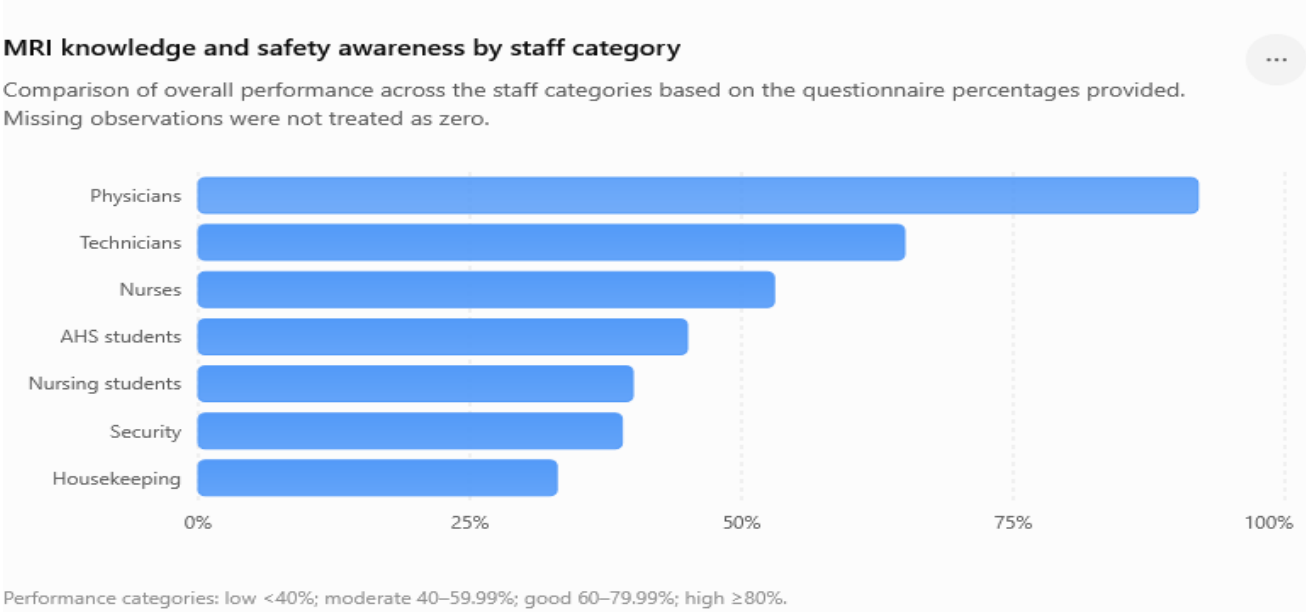
Total	Total Marks	AHS Students	Nursing Students	Technicians	Physicians	Security	Housekeeping	Nurses
80	100.00%	47.06%	41.18%	—	—	—	35.29%	—
81	100.00%	41.18%	41.18%	—	—	—	47.06%	—
82	100.00%	29.41%	41.18%	—	—	—	41.18%	—
83	100.00%	52.94%	35.29%	—	—	—	35.29%	—
84	100.00%	35.29%	29.41%	—	—	—	41.18%	—
85	100.00%	29.41%	29.41%	—	—	—	47.06%	—
86	100.00%	23.53%	35.29%	—	—	—	29.41%	—
87	100.00%	41.18%	35.29%	—	—	—	35.29%	—
88	100.00%	35.29%	29.41%	—	—	—	47.06%	—
89	100.00%	47.06%	35.29%	—	—	—	47.06%	—
90	100.00%	52.94%	41.18%	—	—	—	41.18%	—
91	100.00%	52.94%	29.41%	—	—	—	—	—
92	100.00%	41.18%	35.29%	—	—	—	—	—
93	100.00%	47.06%	35.29%	—	—	—	—	—
94	100.00%	35.29%	41.18%	—	—	—	—	—
95	100.00%	29.41%	41.18%	—	—	—	—	—
96	100.00%	47.06%	35.29%	—	—	—	—	—
97	100.00%	41.18%	47.06%	—	—	—	—	—
98	100.00%	29.41%	35.29%	—	—	—	—	—
99	100.00%	52.94%	41.18%	—	—	—	—	—
100	100.00%	47.06%	29.41%	—	—	—	—	—

Based on the table, I would classify the performance using this practical scale:

- **Poor:** <50%
- **Medium:** 50–74.99%
- **Good:** ≥75%

This is a **training-performance classification**, not an official MRI competency standard.

Score	Interpretation	Training implication
<40%	**Low**	Priority training required
40–59.99%	**Moderate**	Training/refresher required
60–79.99%	**Good**	Targeted reinforcement
≥80%	**High**	Maintain competency/refresher training



5. RESULTS

The assessment revealed substantial variation in MRI-related knowledge and safety awareness among the different staff categories. Performance was classified as low (<40%), moderate (40–59.99%), good (60–79.99%), and high (≥80%). Physicians demonstrated the highest level of performance, with most responses falling within the high-performance category. Their scores were consistently between 88.24% and 100%, indicating a high level of MRI-related knowledge and safety awareness.

Technicians demonstrated the second-highest performance, with several responses falling within the good and high categories. Nurses demonstrated predominantly moderate performance, although some areas reached the good-performance range. AHS students and Nursing students showed low-to-moderate performance, with several responses below 40%, indicating important gaps in MRI-related knowledge and safety awareness.

The lowest performance was observed among Security and Housekeeping personnel. Housekeeping demonstrated particularly low scores, with many responses below 40%, including several values between 23.53% and 35.29%. Security personnel also demonstrated a substantial proportion of responses below the 40% threshold. These findings indicate that non-clinical personnel represent an important area for improvement in MRI safety knowledge.

Accordingly, **Housekeeping personnel should be given the highest priority for structured MRI safety training, followed by Security personnel**. Nursing students and AHS students should receive targeted educational interventions focusing on fundamental MRI safety principles. Nurses should receive targeted refresher training in areas demonstrating lower performance, whereas Technicians and Physicians may benefit primarily from periodic competency assessment and refresher training.

Overall, the findings support a **role-specific MRI safety training program**, with greater emphasis on staff categories demonstrating low performance (<40%). Such an approach may improve MRI safety awareness among all personnel who may enter or work within the MRI environment.

6. DISCUSSION

The present study was conducted at ASRAM Medical College to assess the knowledge and awareness of MRI hazards and safety practices among healthcare professionals, students, and other personnel who may enter or work near the MRI environment. A total of **450 participants** were included in the study.

The study showed that MRI safety knowledge varied considerably between professional groups. **Postgraduate doctors had the highest level of knowledge**, with a mean score of **92.24%**. This may be due to their higher level of medical education, clinical experience and greater awareness of patient safety.

Among technicians, **Radiology technicians had the highest knowledge score (86.93%)**. This may be related to their direct professional exposure to medical imaging and MRI procedures. Technicians from other departments showed lower levels of knowledge, indicating a need for additional MRI safety education.

Among B.Sc. Allied Health Science students, the overall knowledge score was **44.47%**. B.Sc. Radiology students had the highest score (**57.19%**), while B.Sc. Respiratory Medicine students had the lowest score (**36.13%**). This suggests that students with greater exposure to imaging have better awareness of MRI safety, although their overall knowledge was still inadequate.

B.Sc. Nursing students had an overall knowledge score of **39.53%**, indicating inadequate knowledge. Practicing nurses performed better, with a mean score of approximately **53.24%**, but their knowledge was still below the adequate level. This indicates the importance of including MRI safety education in nursing education and clinical training.

Security personnel demonstrated a mean knowledge score of **38.63%**. Since security personnel may control access to restricted MRI areas, they should have basic knowledge of MRI warning signs, restricted zones, metallic objects and MRI-related hazards.

The lowest knowledge was observed among **housekeeping and maintenance personnel**, with an overall score of **33.53%**. This finding is important because these personnel may enter MRI areas during their routine duties. Lack of awareness regarding metallic objects and MRI hazards may increase the risk of unsafe situations. Therefore, specific MRI safety orientation should be provided to these staff members before they enter controlled MRI areas.

Overall, the findings show that personnel who have greater exposure to MRI and medical imaging generally demonstrated better knowledge, while personnel with limited exposure showed lower knowledge. This highlights the need for **regular and role-specific MRI safety training for all hospital personnel**, not only radiology staff.

MRI safety education should include basic MRI principles, MRI zones, warning signs, screening for metallic objects and implants, projectile hazards, acoustic noise, heating, safe use of equipment and emergency procedures.

In conclusion, the study demonstrates that there are important gaps in MRI safety knowledge among several professional and support groups. **Regular training, refresher programmes and competency assessment should be implemented at ASRAM Medical College to improve MRI safety awareness and promote a safe environment for patients, staff and visitors.**

7. CONCLUSION

The present study assessed the knowledge and awareness of MRI hazards and safety practices among 450 participants at ASRAM Medical College.

The study found that the level of MRI safety knowledge varied among different professional groups. **Postgraduate doctors had the highest level of knowledge (92.24%)**, while housekeeping staff, security personnel, and students showed comparatively lower levels of knowledge.

Radiology-related professionals demonstrated better awareness, probably because of their greater exposure to MRI and medical imaging. However, several non-radiology healthcare workers and support staff had inadequate knowledge regarding MRI hazards and safety precautions.

The findings highlight the importance of providing **regular MRI safety education and training to all personnel who may enter or work near the MRI environment**. Training should include MRI screening procedures, warning signs, restricted zones, metallic objects, implants, projectile hazards, noise, heating, and emergency safety procedures.

Therefore, MRI safety should be considered a **multidisciplinary responsibility** involving doctors, nurses, technicians, students, security personnel, housekeeping staff, maintenance personnel, patients and attendants.

Implementing **standardized MRI safety training, regular refresher programmes, proper warning signs, access control and periodic assessment of knowledge** can help improve safety practices and reduce the risk of preventable MRI-related incidents.

In conclusion, the study demonstrates that although some professional groups have good MRI safety knowledge, significant gaps remain among several groups. Improving awareness and providing continuous education can contribute to a safer MRI environment for patients, healthcare workers and visitors.

8. LIMITATIONS OF THE STUDY

1. The study was conducted in a **single medical college**, so the findings may not represent other hospitals or institutions.
2. The study used a **cross-sectional design**, which assessed MRI safety knowledge at only one point in time.
3. The study assessed **knowledge and awareness** through a questionnaire and did not directly assess the actual safety practices of the participants.
4. The number of participants was **different in each professional group**, which may affect comparison between groups.
5. The questionnaire was self-administered, so some responses may have been influenced by **individual understanding or interpretation of the questions**.
6. Previous exposure to MRI safety training or clinical experience may have influenced the knowledge scores.
7. The study did not assess the **availability and implementation of institutional MRI safety policies and training programmes** in detail.
8. The study focused mainly on knowledge and awareness and did not assess participants' practical competency during actual MRI procedures.
9. The questionnaire and scoring system should be checked against the final approved questionnaire before submission, particularly because the reported results use a **17-point score**.

9. REFERENCE

1. **Zhang M, et al. (2026).** Knowledge attitudes and practices regarding MRI safety among healthcare providers and patients/family members in China. **Scientific Reports.**
This is probably the **closest model** for a KAP/questionnaire-based study. It used a cross-sectional questionnaire and assessed knowledge, attitudes and practices related to MRI safety.

2. **Kanbayti IH. (2025).** Exploring MRI Safety Knowledge Among Physicians and Nurses in Saudi Arabia: Highlighting Knowledge Gaps and Key Influencing Factors. **Journal of Medical Radiation Sciences, 72(2), 255–263.**
Very useful if your participants are **doctors, nurses or other healthcare professionals**. It used a structured questionnaire in a cross-sectional study.

3. **Magnetic Resonance Imaging Safety Knowledge, Attitudes and Practices Among Radiology Nurses in Saudi Arabia: A National Multicentre Study.**
This is particularly useful for constructing your **KAP questionnaire, scoring system and statistical analysis**. It used

a structured self-administered questionnaire and assessed knowledge, attitudes and practices.

4. **Validation and benchmarking of Patient-Reported Experience Measures (PREM) tool for the safety of patients undergoing MRI investigations.**
Very relevant to your exact topic because it was conducted in **15 hospitals in India** and developed a **21-item MRI safety questionnaire** after expert discussions, pilot testing and validation.

5. **The European MR safety landscape. (2024).**
This was a large questionnaire survey of healthcare professionals across Europe examining MRI safety training, institutional policies, scanning practices and accidents. It is useful for your **discussion section and comparison of institutional safety practices**.

6. **Ensuring the Safety of MRI Patients With Medical Implants or Devices In Situ: A Snapshot in Time of the Role and Responsibilities of New Zealand and Australian MRI Technologists.** Useful for questions concerning **patient screening, implants/devices, responsibility of MRI personnel and screening procedures**. The study itself used an online questionnaire.

7. **Shellock FG, Kanal E. (1994).** Guidelines and recommendations for MR imaging safety and patient management. III. Questionnaire for screening patients before MR procedures. **Journal of Magnetic Resonance Imaging.**
This is an important **foundational reference for developing the patient MRI safety screening questionnaire**.