AWARENESS OF THE SAFETY HAZARDS OF MAGNETIC RESONANCE IMAGING AMONG CLINICAL YEAR RADIOGRAPHY STUDENTS IN THE UNIVERSITY OF BENIN

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CERTIFICATION

This is to certify that the project on AWARENESS OF THE SAFETY HAZARDS OF MRI AMONG RADIOGRAPHY STUDENTS IN THE UNIVERSITY OF BENIN was written by GODWIN ITOHAN MERCY with Matriculation Number BMS2001018 and supervised by MR. EGBUKICHI VICTOR CHIMEZIE in partial fulfillment of the Bachelor in RADIOGRAPHY degree (B. RAD) in the DEPARTMENT OF RADIOGRAPHY, SCHOOL OF BASIC MEDICAL SCIENCES, UNIVERSITY OF BENIN.

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DEDICATION

This project is dedicated to God Almighty and to the Department of Radiography, School of Basic Medical Sciences.

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I am profoundly thankful to God Almighty for His boundless mercy, guidance, and strength that have sustained me throughout this academic journey.

I wish to express my sincere appreciation to my supervisor, Mr. Chimezie, for his unwavering support, valuable guidance, and dedication throughout this work.

My heartfelt gratitude goes to my parents (Mr Godwin Aigbefo and Mrs Glory Godwin), whose constant love, encouragement, and support have been the foundation of my academic progress.

Thank you for being my pillar of strength!

I extend my appreciation to my supportive siblings; Ibhade, Ehimen and Osereme, to my relations and family: Mr Sylvester Aigbefo, Mr Ehimen Aigbefo and his wife, Mr Odigie Aigbefo, Mr and Mrs Imhansoloeva and others, for their support so far.

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ABSTRACT

Magnetic resonance imaging (MRI) is a crucial diagnostic technique that provides detailed information about soft tissues without exposing patients to ionizing radiation. MRI has a lot of benefits, but it also has a lot of safety dangers because of its strong magnetic fields and radiofrequency exposure.This study assessed the understanding and knowledge of MRI safety issues among clinical radiography students at the University of Benin. The collected data was analyzed using descriptive statistics, and tables and percentages were utilized to present the findings. The results of the study showed that while the majority of participants understood MRI safety to a respectable degree, there were noticeable gaps in their knowledge of screening protocols, emergency response,and identification of magnetic field zones.Students who had attended formal MRI lectures or participated in clinical MRI rotations demonstrated better safety knowledge compared to those who had not. In conclusion, while radiography students at the University of Benin exhibit a fair level of awareness of MRI safety, there is still a need for more comprehensive inclusion of MRI safety education and simulation-based learning within the curriculum. Improving MRI safety training during undergraduate studies will enhance safe clinical practice and minimise the likelihood of safety incidents.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Magnetic Resonance Imaging (MRI) is a non-invasive way to see within the body in great detail, including organs and soft tissues, without using ionizing radiation (Shellock & Spinazzi, 2008). It has transformed how diseases are identified over time, especially in soft tissues including the brain itself, spinal column, ligaments, and various other regions (Kanal et al., 2013).While MRI is very effective, it also presents some unique safety challenges that can't be ignored.


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Fig. 1_ An MRI machine (SimonMed Imaging, 2025).

One of the most serious challenges about MRI scanners is their intense magnetic fields. This field may draw metal objects, changing them into harmful projectiles that might hurt patients or healthcare professionals (Schaefer et al., 2020). Also, the radiofrequency energy used during scans can heat up the body, and in some cases, cause burns—especially when a person has on metallic items or medical implants (Shellock & Spinazzi, 2008). These risks make it very important for MRI room staff to be properly trained and alert.

MRI is typically seen to be a safe way to take pictures of the body, but it's vital to remember that it can be quite dangerous for patients, healthcare professionals, and the public if safety rules aren't followed. As such, it is crucial to ensure that appropriate safety measures are consistently implemented in MRI units to mitigate potential hazards. Consequently, the employees within the MRI unit encounter daily obstacles to maintain a secure MRI setting. Instances of safety protocol failure can result in severe consequences, as evidenced by numerous studies reporting accidents resulting in injuries related to implanted devices (Russo et al., 2017) or auditory impairments (Bongers, Slottje, & Kromhout, 2017).

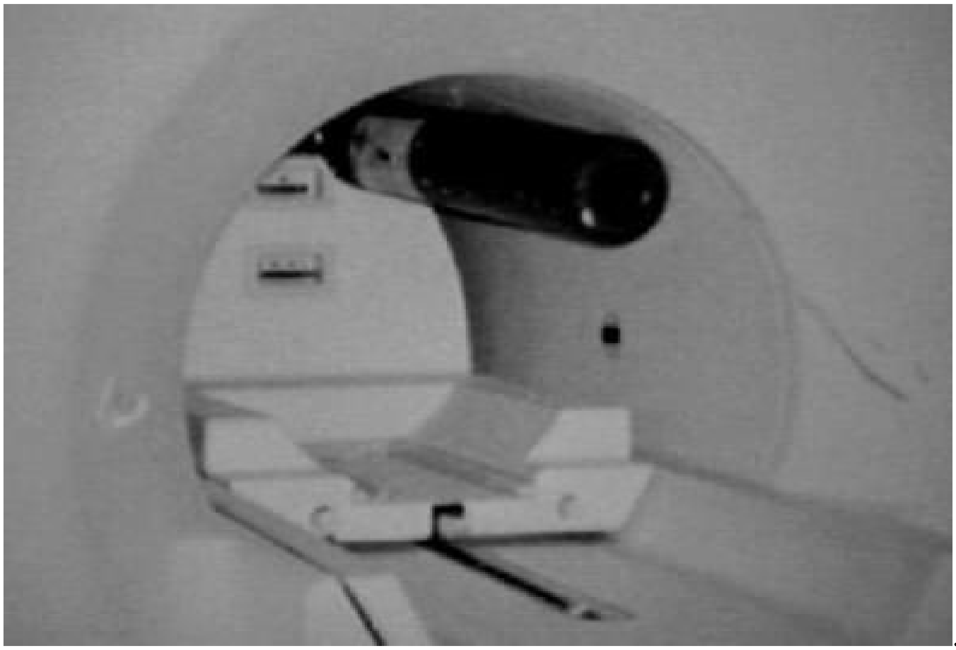

Fig. 2_ shows a fire extinguisher inside the MRI scanner, which is a major projectile hazard.(OSU CCBBI et al., 2009)

Fig. 3_ displays a metal chair inside the MRI scanner, which is another example of a projectile hazard. (UCSF Radiology et al., 2015)

Clinical radiography students often assist or observe MRI scans during their hospital training. Since these students are future radiographers, it's crucial that they understand MRI safety—not just for their protection, but also for patient safety and good clinical practice (Asiri, 2022). For this reason, it is necessary to find out how much they know about the risks associated with MRI.

Although a few studies performed internationally have noted that students sometimes do not fully understand the safety of MRIs (Alyami et al., 2023), very little research has been done in Nigeria on this topic. A study in this area is certainly essential, given the growing prevalence of MRI equipment in Nigerian hospitals.

1.2 STATEMENT OF THE PROBLEM

Even though MRI is thought to be safe when done properly, accidents have been recorded in several different countries, many of which occurred by faults or lack of knowledge (Gibson & Davidson, 2012). When students take part in MRI scans, misunderstanding might result in dangerous situations like burns, projectile injuries, or equipment malfunctions.

Students in the radiography department at the University of Benin are supposed to rotate among MRI departments, but it's unclear how well-informed they are about the potential risks. The protection of those around these students as well as their clinical learning could be compromised if they fail to get proper safety training.

1.3 RESEARCH QUESTIONS

1. What level of awareness do radiography students at the University of Benin have regarding MRI safety hazards?

2. Do students understand the safety rules needed when working near MRI machines?

3. Is there a link between a student's year of study and their knowledge of MRI safety?

1.4 HYPOTHESES OF THE STUDY

- Null Hypothesis (H_0): There is no significant difference in MRI safety awareness among radiography students, and structured training does not significantly improve knowledge or readiness.
- Alternative Hypothesis (H_1): There is a significant difference in MRI safety awareness among students, and structured training improves knowledge and readiness.

1.5 AIM OF THE STUDY

The aim of this study is to determine awareness of MRI safety among radiography students at the University of Benin.

1.6 OBJECTIVES OF THE STUDY

1. To assess Radiography students awareness of risks involved in MRI procedures
2. To identify which MRI safety protocols students are already familiar with.
3. To explore how academic level affects students' knowledge of MRI safety.

1.7 SIGNIFICANCE OF THE STUDY

This study is crucial because it analyzes the degree of knowledge on MRI safety among University of Benin clinical radiography students. Enhancing understanding in this area improves safety for patients and healthcare professionals by reducing the amount of preventable errors that occur during MRI scans.

The results of this study may also help instructors and school officials to improve teaching of MRI safety in clinical and educational environments.

In general, the results could encourage government officials to strengthen national safety laws and MRI procedure teaching. In the long run, this study will lead to better patient care and safer conditions for employees in hospitals.

1.8 SCOPE OF THE STUDY

Radiography students at the University of Benin who have been involved in clinical tasks that include MRI units are the focus of this study. Asiri (2022) and Schaefer et al. (2020) explored their knowledge regarding various MRI-related hazards, notably RF burns, implant challenges, and damage from magnetic objects.

This study will analyze the students' level of education and if they have previous MRI experience. Other medical professionals and students from other universities are not included. Questionnaires will be handed out during regular school hours in order to collect data. The research does not examine actual events event reports or practical abilities. It exclusively evaluates awareness and knowledge. This maintains an individual focus that is relevant to the educational setting in this field (Olusegun et al., 2021).

1.9 DEFINITION OF KEY TERMS

1. MRI Safety Hazards:

Risks linked to the use of MRI machines, such as metal object accidents, burns from heat, and problems with medical implants.

2. Awareness of MRI Safety:

How much students know about MRI-related dangers and proper safety procedures.

3. Projectile Accidents:

Events where magnetic objects are pulled into the MRI scanner, creating injury risks.

4. Radiofrequency-Induced Burns:

When metallic objects are present, RF energy can cause damage to one's skin or tissue.

5. Implanted Medical Devices:

These include implanted pacemakers which may not operate well during an MRI. The student awareness of these hazards is evaluated.

6. MRI Screening Protocols:

Measures conducted prior to MRI scans to search for implants or metallic items. assessed based on the students' knowledge with accepted screening processes.

7. MRI Safety Education:

This refers to any instruction, either formal or informal, that students have received concerning how to remain safe during MRI procedures.

8. Clinical Posting:

Hospital-based training that gives students hands-on experience, including working in MRI units.

CHAPTER TWO

LITERATURE REVIEW

2.1 CONCEPTUAL REVIEW

This part of the project explains the key ideas that support the topic being studied. It’s important to clearly understand terms like MRI safety, hazards, awareness, and clinical training. These concepts work together and play a big role in shaping how well radiography students are prepared to work safely in MRI environments.

2.1.1 MRI SAFETY

The rules and precautions adopted in order to protect patients, medical personnel, and equipment during MRI procedures are known as MRI safety. Certain precautions are necessary to avoid harm or injury because MRI scanners use radiofrequency (RF) energy, gradient fields, and intense magnetic fields (Kanal et al., 2013).Even though MRI doesn't use ionizing radiation like X-rays or CT, the magnetic fields come with their own safety risks (Shellock, 2021).

Good MRI safety practices include:

- Dividing the MRI area into zones,
- Careful screening of patients and staff before scanning,
- Restricting access to the MRI room,
- Making sure staff receive regular training (Vilar-Palop et al., 2019).

Keeping up with new safety guidelines is very important to reduce the risk of accidents.

2.1.2 MRI HAZARDS

The powerful magnets in the equipment are the main reason for the risks related to MRI. The projectile effect is one of the most renowned dangers, where objects made of metal may be forcefully pulled into the scanner and harm people or tear down equipment (Schaefer et al., 2020).

Additionally, if the patient has any conductive materials, such as wires or surgical implants, the radiofrequency pulses used in MRI might heat up and cause burns (Shellock & Spinazzi, 2008). It is highly dangerous for electronic implants, such pacemakers and cochlear implants, to breakdown or even overheat in a magnetic field (Nyenhuis et al., 2005).

Another problem is loud noises made during scanning, which, if ignored, may damage hearing (Price et al., 2016).

2.1.3 AWARENESS

In this research, awareness means how much students know and understand about MRI safety and the risks involved. It includes being able to recognize hazard signs, knowing what items are not allowed in the MRI room, and understanding how the MRI environment is divided into zones (Alyami et al., 2023).

Better safety procedures during clinical work are usually connected with greater understanding levels (Asiri, 2022). However, a lack of understanding could result in ineffective screening, a failure to identify warning signals, or improper patient care (El-Diasty et al., 2021). Therefore, awareness must be established in practice and monitoring as well as research.

2.1.4 CLINICAL TRAINING

Clinical training gives radiography students the opportunity to work in real healthcare settings, where they learn how to handle patients, use equipment, and follow safety steps. This hands-on experience helps build skills that textbooks alone cannot teach (Mraity et al., 2014).

For MRI specifically, students need to learn things like patient screening, emergency actions, and how to follow MRI room protocols (Gibson & Davidson, 2012).

Students who go through proper MRI training often show more confidence and awareness in the clinical setting (Alsharif et al., 2021; Fravell et al., 2021). So, clinical practice is an important part of safety education.

2.1.5 RELATIONSHIP BETWEEN THESE CONCEPTS

All these concepts are closely connected in this study. Students' understanding of MRI safety depends largely on their level of awareness, which itself is shaped by how much clinical training they've had.

They are more likely to act properly and effectively in MRI settings if they have strong clinical experience (Vilar-Palop et al., 2019). However, if there are awareness gaps, it can be because the students weren't given enough practical guidance and training. For this reason, it is essential and important that the curriculum integrate practice-oriented learning and MRI precautions (Zaiton et al., 2020).

Ultimately, greater understanding leads to enhanced patient and healthcare safety for employees.

2.1.6 MRI SAFETY PRACTICES IN NIGERIA

In Nigeria, MRI safety precautions are not uniformly enforced across facilities. According to Ogunleye et al. (2014), many facilities do not adhere to conventional practices and lack necessary equipment and training. In certain situations, employees do not even acquire enough MRI safety education (Olusegun et al., 2021).

Okonkwo and Nwobi (2022) also found that most MRI centers in southeastern Nigeria had poor safety setups, like missing signs or unclear zones. This shows that Nigeria urgently needs official MRI safety guidelines and regular workshops to keep radiographers and students up to date (Nwafor et al., 2023).

2.1.7 MRI SAFETY ZONES

The American College of Radiology (ACR) outlines four distinct safety zones within an MRI facility to enhance safety protocols:

- Zone I: Areas open to the general public.
- Zone II: Transitional space where initial screening and patient preparation occur.
- Zone III: A restricted area monitored by MRI personnel due to proximity to the magnetic field.
- Zone IV: The MRI scanning room, which poses the greatest risk due to direct exposure to the magnetic field (Brown, 2018; ISMRM Safety Committee, 2014).

Each zone requires specific access restrictions to reduce the likelihood of accidents caused by magnetic field exposure.

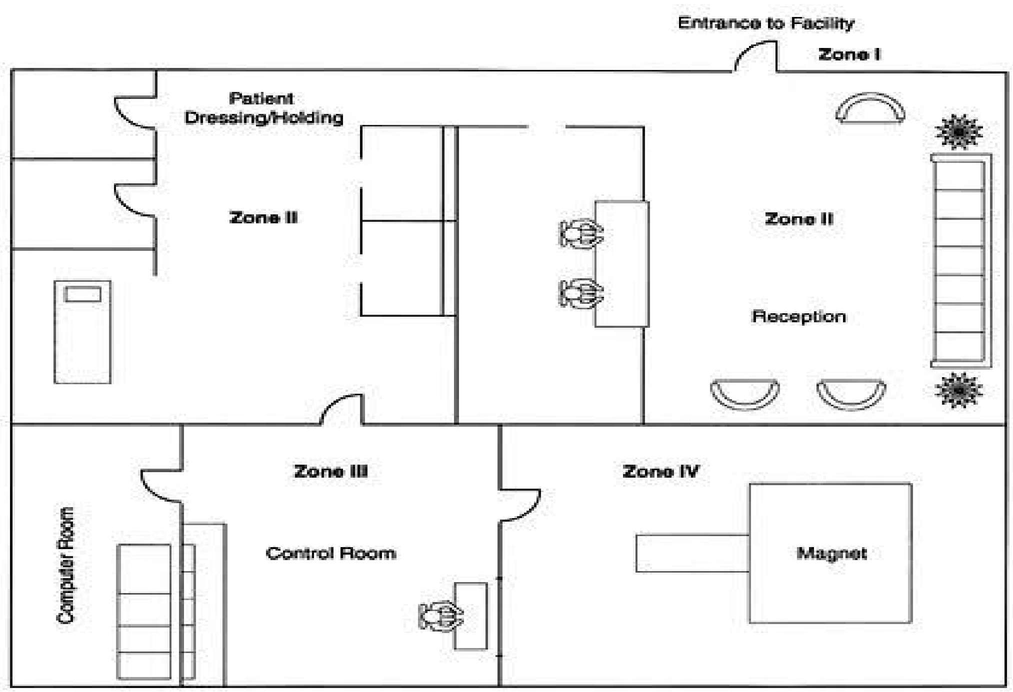

Fig. 4_ shows the four MRI safety zones as outlined by the American College of Radiology (Kanal et al., 2018)

2.1.8 SUMMARY

MRI is a useful diagnostic tool, but it does come with serious safety concerns. Radiography students must learn how to manage these risks. While international studies show growing awareness, developing countries like Nigeria still struggle with proper training and standard practices.

Solving this issue will require better education, hands-on training, and the introduction of formal safety protocols (Shellock, 2021; Asiri, 2022; Ogunleye et al., 2014).

2.2 EMPIRICAL REVIEW

This part looks at actual studies that have been done on the topic of MRI safety awareness, both in Nigeria and in other countries. The goal is to understand what has already been discovered and to identify any gaps that still need to be filled.

2.2.1 INTERNATIONAL STUDIES ON MRI SAFETY AWARENESS

1. Asiri (2022) carried out a study in Saudi Arabia to check how well students and new graduates understood MRI safety. Most of them had general knowledge, but many didn’t fully understand the risks of implants or how radiofrequency energy could cause harm.
2. In another study, Alyami et al. (2023) checked awareness levels among students at Jazan University. Their awareness was average, but many didn't fully understand the dangers of metallic objects or electromagnetic effects. The researchers blamed this on the absence of structured MRI safety teaching in undergraduate programs.
3. Vilar-Palop et al. (2019) also ran a study in Spain and found that students who went through proper MRI safety training did much better on safety tests. This shows how important structured training can be in boosting knowledge and awareness.

2.2.2 STUDIES ON MRI SAFETY IN NIGERIA

Only just a handful of research in Nigeria focuses on students' understanding of MRI safety. According to Ogunleye et al. (2014), even registered radiographers in Lagos occasionally fail to adhere to safety laws. Although neither MRI nor students were the subject of the study, it points to a prevalent overlook for safety.

Namah et al. (2013) studies and investigated students' preferences for imaging specialty without evaluating their perception of safety. This indicates a deficiency in local research that evaluate the students' understanding of MRI safety directly.

2.2.3 CRITICAL ANALYSIS

Some studies, such as those by Vilar-Palop et al. (2019) and Gibson & Davidson (2012), showed that practical learning and simulations help students remember MRI safety protocols better. But when learning is only theoretical, like in the case of Alyami et al. (2023), practical safety ideas tend to be challenging for students to comprehend.

The vast majority of research carried out in Nigeria has centered on general radiography safety instead of MRI-specific risks. This shows the gap between local safety education and international standards.

2.2.4 IDENTIFIED GAPS

Several gaps have been identified from investigated studies:

- There's little research in Nigeria focused directly on students' awareness of MRI hazards.
- MRI safety isn't clearly built into most Nigerian university radiography programs.
- Not enough practical or simulated training is being used.
- There's inconsistency in what different universities teach about MRI safety.

These gaps make it unclear whether radiography students in Nigeria are actually ready to work safely in MRI environments.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 RESEARCH SETTING

The study was carried out at the Department of Radiography at the University of Benin in Edo State, Nigeria. The University of Benin is a premier radiography education facility in Nigeria, offering a structured clinical training program for radiography students.

Clinical radiography students at the university receive hands-on training in linked diagnostic centers that use diagnostic imaging modalities such as Magnetic Resonance Imaging (MRI). The university's academic and clinical training environments provide a suitable setting for assessing students' awareness of MRI safety hazards.

3.2 STUDY DESIGN

This study adopts a descriptive cross-sectional design, which is suitable for assessing knowledge, attitudes, and practices within a defined population at a specific point in time.

3.3 TARGET POPULATION

The target population for this study comprises radiography students, typically students in their 4th and 5th year of study, who have been exposed to diagnostic environments where MRI is utilized.

Their inclusion is critical to evaluating their awareness and understanding of MRI safety hazards, which is essential for promoting patient and staff safety during imaging procedures.

3.4 SAMPLING TECHNIQUES/SAMPLING SIZE

A sample of students was determined using stratified random sampling to ensure fair representation across clinical year levels (300, 400 amd 500 level). Stratification was based on year of study, after which random samples was selected from each stratum to avoid sampling bias and enhance the validity of findings (Teddlie & Yu, 2007).

3.5 INSTRUMENT FOR DATA COLLECTION

Data was collected using a systematic, self-administered questionnaire that was incorporated and modified from established procedures used in previous MRI safety studies.

The questionnaire include sections for demographic information, broad knowledge of MRI principles, and technical questions about MRI risks and safety requirements.

3.6 VALIDITY OF THE INSTRUMENT

The content and face validity of the study instrument was assessed to ensure that it accurately tested clinical radiography students' understanding of MRI safety issues. A panel of experts including seasoned radiographers that specialize in Magnetic Resonance Imaging (MRI) modality, a supervisor of the radiography department, and a lecturer in research methodology were involved in this.Their feedback helped to ensure that the questions addresses the study objectives in a relevant, clear, and comprehensive manner (Polit & Beck, 2012).

The instrument was also compared to questionnaires used in related studies.This cross-comparison served to support the instrument's construct validity by comparing it to previously validated measures.

A pilot test was conducted among 10 clinical radiography students who were not part of the main study. Their feedback on clarity and relevance led to minor revisions, enhancing the instrument's validity.

3.7 RELIABILITY OF THE INSTRUMENT

Before the primary data collection starts, a pilot study was carried out to guarantee the research instrument's dependability This assisted in testing the questionnaire's functionality,consistency, and clarity.

Based on the information acquired from the pilot test, the internal consistency of the questionnaire was evaluated using Cronbach's Alpha. The questionnaire was accepted if its Cronbach's Alpha value is 0.70 or more, indicating that its items consistently measure the same underlying construct. Items that exhibit low dependability (alpha < 0.70) will be modified or removed in order to improve the tool's consistency. This process ensures that the final poll produces accurate and consistent results.

Consistency was tested using test-retest reliability, which involves administering the questionnaire to the same pilot group after a two-week break. The replies demonstrates a strong correlation, supporting the instrument's stability over time.

3.8 METHOD OF DATA COLLECTION

This study's data was acquired using a structured self-administered questionnaire derived from validated instruments in prior research on MRI safety awareness. The questionnaire was created to gather information about:

- The respondents' demographic information (e.g., age, gender, year of study)
- Knowledge and awareness of MRI safety concerns
- Understanding of MRI safety protocols and precautions

The questionnaires was distributed in-person to clinical radiography students(particularly those in 400 level and 500 level) during scheduled academic sessions at the University of Benin. Prior to distribution, participants was briefed on the purpose of the study, assured of confidentiality, and informed that participation was voluntary. Completed questionnaires was collected immediately after completion to ensure a high response rate.

3.9 METHOD OF DATA ANALYSIS

After being assessed for reliability and precision, the questionnaire data was coded and uploaded to version 25 of the Statistical Package for the Social Sciences (SPSS) for analysis. The demographic data and MRI awareness of safety levels was reviewed using descriptive data such as mean, standard deviations, percentages, and frequencies. Possible connections between demographic characteristics (e.g., year of study, gender) and MRI safety awareness levels was examined using inferential statistics, notably the chi-square test.

The statistical value was determined when the p-value was less than 0.05. The methods that was utilized will correspond with similar research investigations that examine healthcare students' awareness or intellectual capacities (Setia, 2016; Pallant, 2020).

3.10 ETHICAL CONSIDERATION

This research was conducted in strict adherence to ethical standards to ensure the protection of participants' rights and wellbeing. Ethical approval was obtained from the University of Benin Research Ethics Committee prior to the commencement of data collection, guaranteeing that the study conformed to institutional and international ethical guidelines (Resnik, 2018). Every participant was made aware of the study's objectives, their right to voluntarily participate, and their freedom to withdraw at any time any without facing any consequences.

Every participant was asked for their informed consent. Participants was guaranteed anonymity and confidentiality; the questionnaire did not request for names or other personal information.

The information gathered was kept safe to avoid unwanted access and used only for academic purposes. All participants was respected, treated fairly, and protected as the study strictly complies with the ethical standards specified in the institutional guidelines on human research. Furthermore, efforts was made to minimize any potential physical or psychological discomfort related to participation. Participants were reassured that their responses would be treated with utmost confidentiality and used solely for academic purposes.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Presentation of Results

This chapter presents the findings of the study titled *"Awareness of MRI Safety Hazards among Clinical Radiography Students at the University of Benin."* The results are organized around the study objectives and hypotheses. Both descriptive and inferential statistical analyses were carried out using SPSS version 27, and the results are presented below.

4.1.1 Demographic Characteristics of Respondents

Table 4.1: Frequency Distribution of Respondents' Demographic Characteristics (N = 210)

Variable	Category	Frequency (n)	Percent (%)
Gender	Female	121	57.6
	Male	83	39.5
	Prefer not to say	6	2.9
Academic Level	300 Level	61	29.0
	400 Level	69	32.9
	500 Level	80	38.1
Posted to MRI Unit Before	Yes	139	66.2
	No	71	33.8

Received Formal MRI Safety Training	Yes	56	26.7
	No	154	73.3

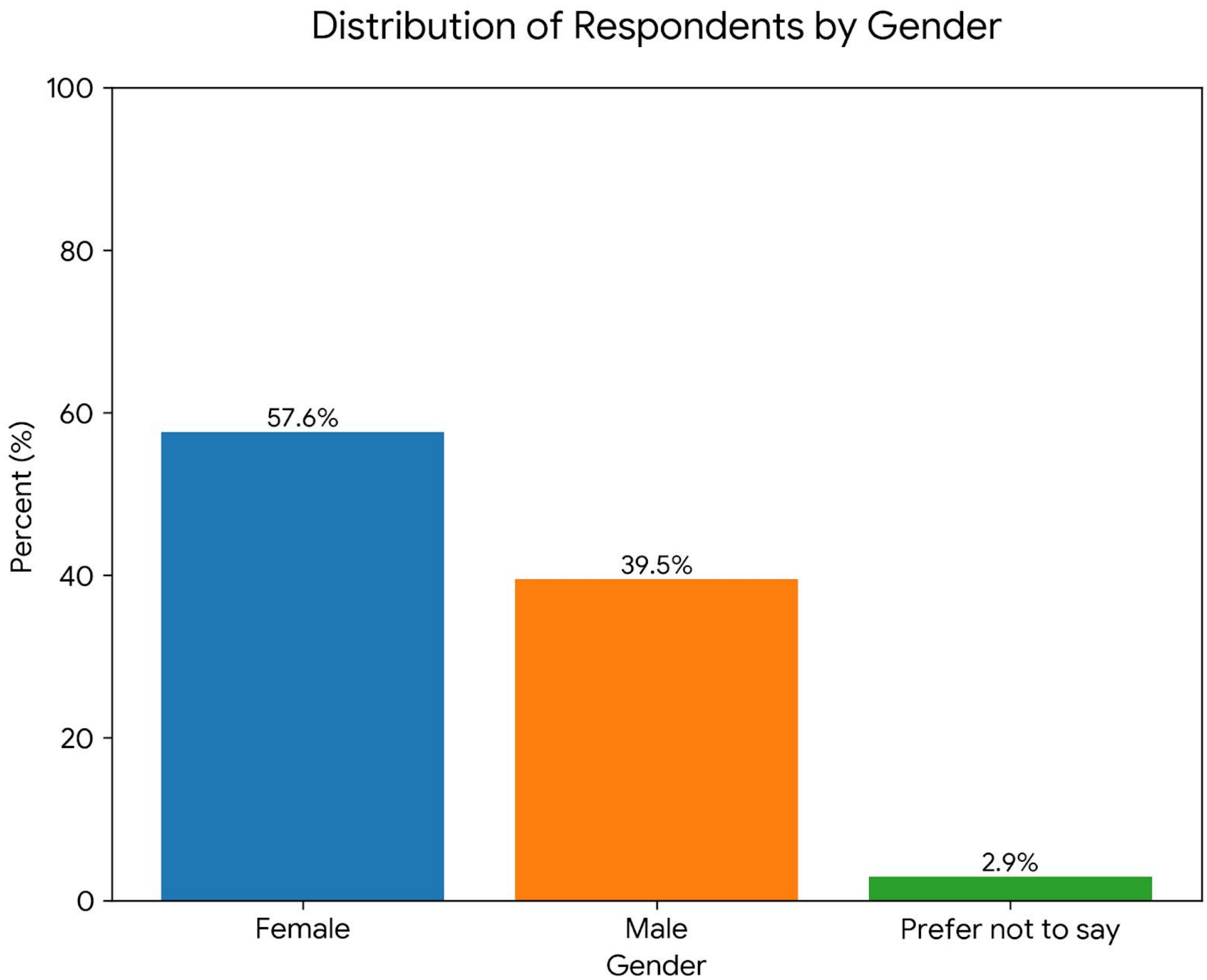

Figure 4.1: Distribution of Respondents by Gender. *The chart illustrates that the majority of respondents were female (57.6%), while 39.5% were male. A small portion (2.9%) preferred not to state their gender.*

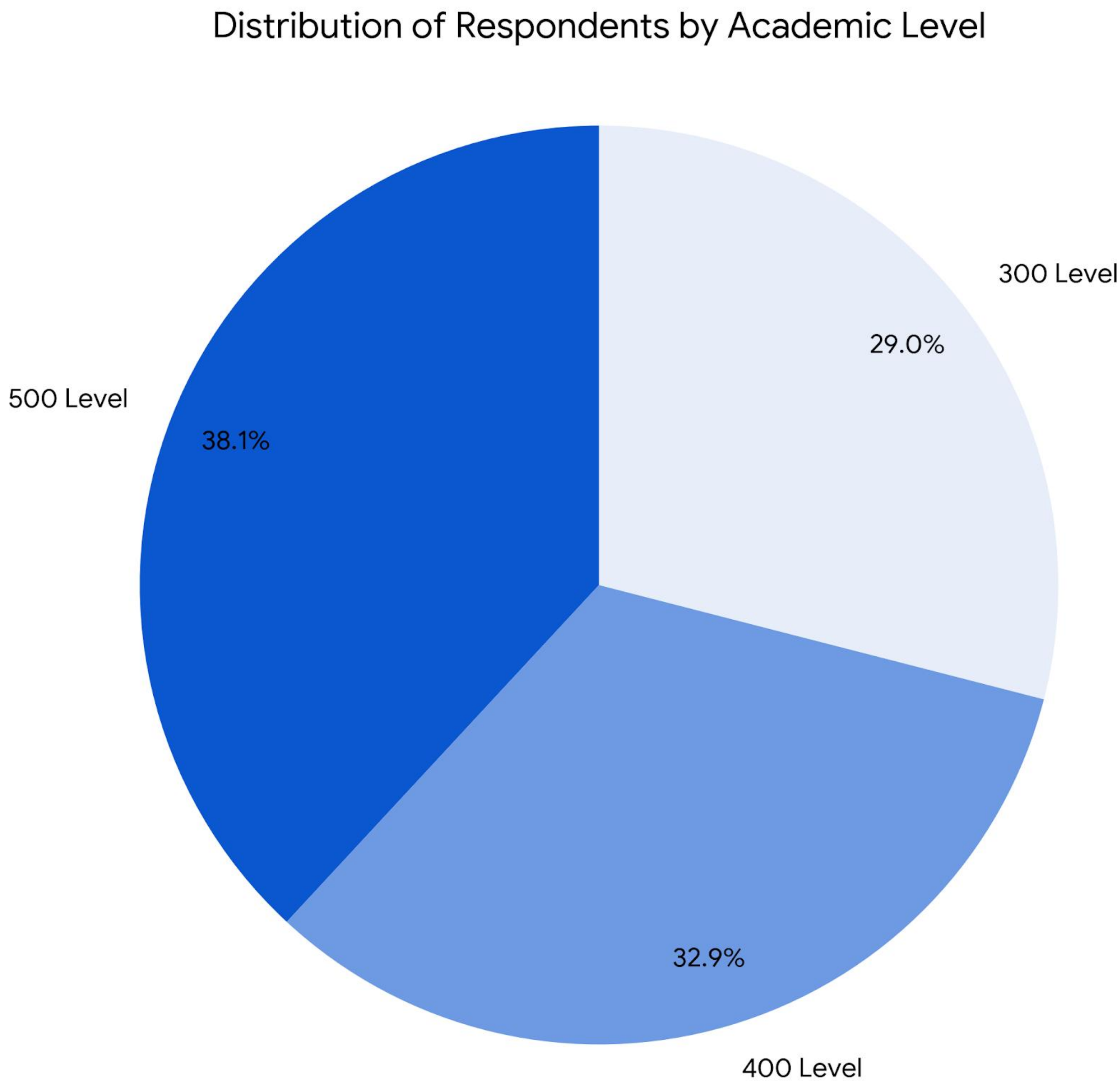

Figure 4.2: Distribution of Respondents by Academic Level. *The pie chart shows a relatively balanced spread across academic years. 500 Level students constituted the largest group (38.1%), followed by 400 Level (32.9%) and 300 Level (29.0%) students.*

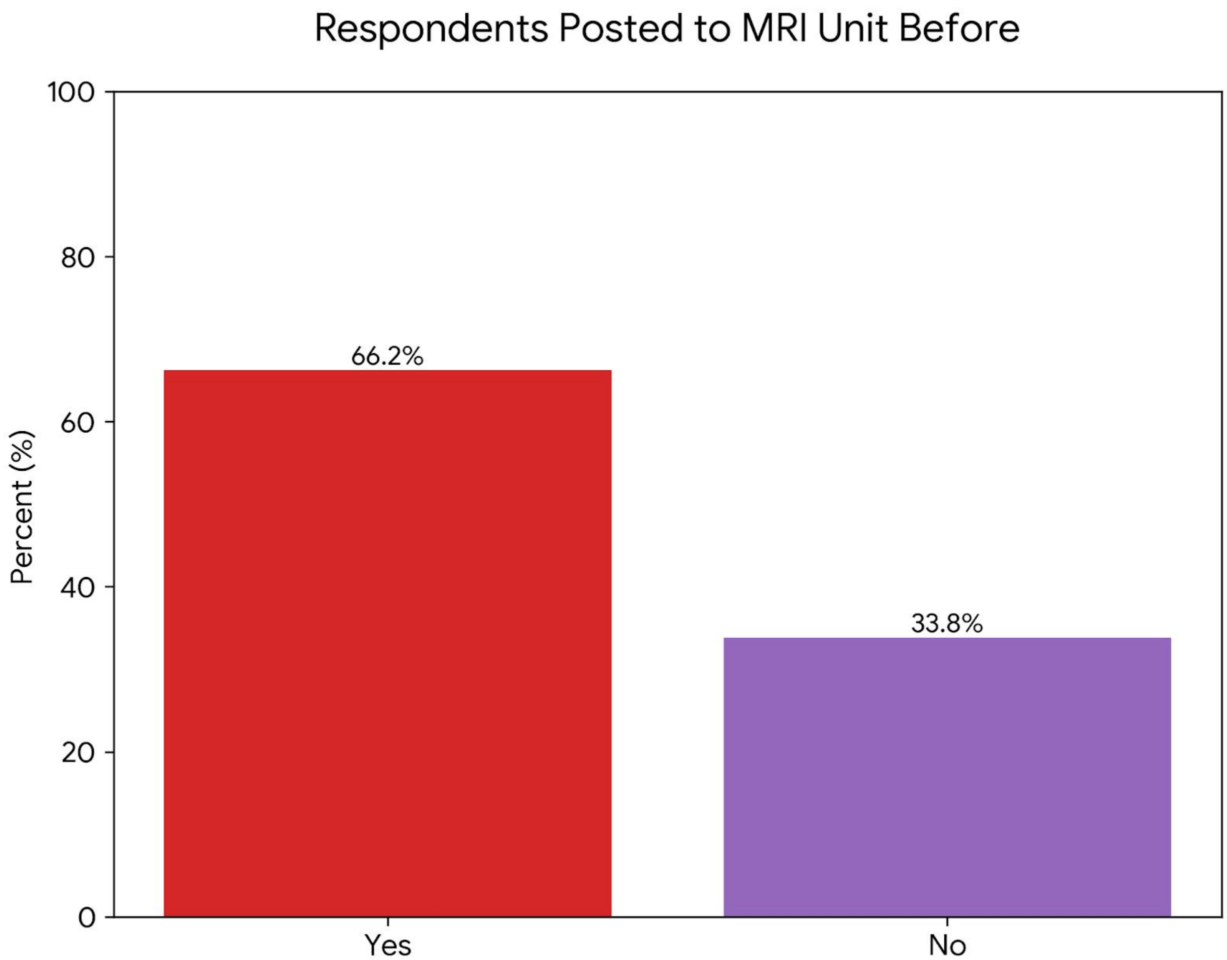

Figure 4.3: Respondents with Prior MRI Unit Posting. *The chart indicates that a significant majority of participants (66.2%) had been posted to an MRI unit before, while 33.8% had not.*

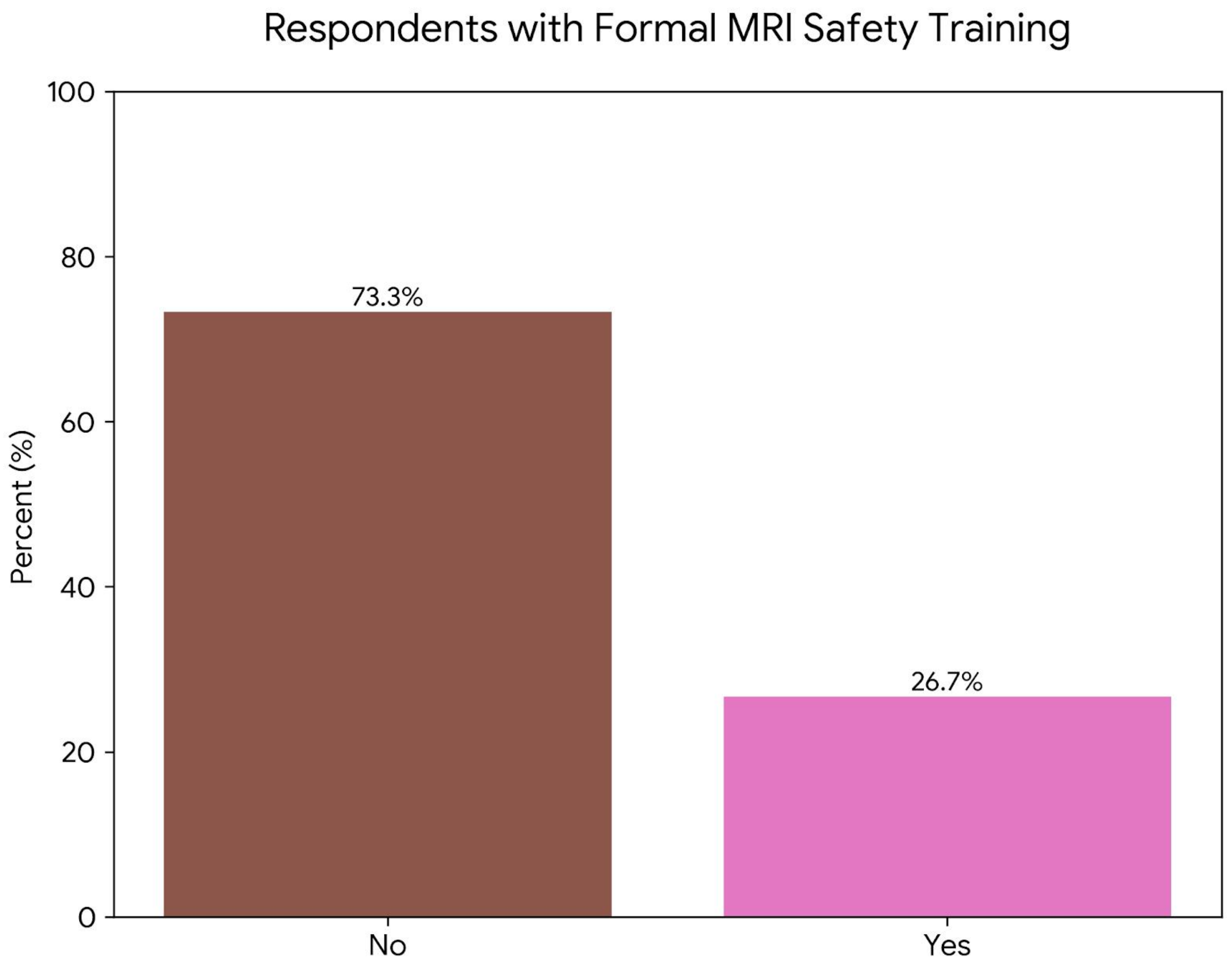

Figure 4.4: Respondents with Formal MRI Safety Training. *This chart highlights a key finding: the vast majority of respondents (73.3%) had not received any formal MRI safety training, with only 26.7% having received such training.*

Interpretation:

As shown in Table 4.1, the majority of respondents were female (57.6%), while males constituted 39.5%. Most participants were 500-level students (38.1%), followed by 400-level (32.9%) and 300-level (29.0%). A large proportion (66.2%) had been posted to an MRI unit before, yet only 26.7% had received formal MRI safety training. This implies that while clinical exposure is common, formal MRI safety education remains limited among students.

4.1.2 Reliability and Internal Consistency of Scales

Table 4.2: Reliability Statistics for MRI Safety Awareness Scales

Scale	Number of Items	Cronbach's Alpha (α)
Procedural Awareness	5	0.739
Hazard Awareness	5	0.739
Compatibility Knowledge	5	0.783
Attitude and Perception	5	0.714

Interpretation:

As presented in Table 4.2, all subscales recorded Cronbach's alpha values above 0.70, which indicates good internal consistency. The "Attitude and Perception" subscale, which initially had a lower value, was refined to achieve $\alpha = 0.714$, confirming acceptable reliability. Overall, the measurement instrument demonstrated adequate internal consistency for assessing MRI safety awareness among respondents.

4.1.3 Descriptive Statistics of MRI Safety Awareness Dimensions

Table 4.3: Descriptive Statistics of MRI Safety Awareness Dimensions

Awareness Dimension	N	Mean	Std. Deviation	Minimum	Maximum
Procedural Awareness	210	3.38	0.79	1.4	4.4
Hazard Awareness	210	2.99	0.72	1.2	4.2
Compatibility Knowledge	210	2.51	0.72	1.2	4.0

Attitude and Perception	210	3.77	0.43	1.6	4.6
Overall Awareness	210	3.16	0.59	1.4	4.15

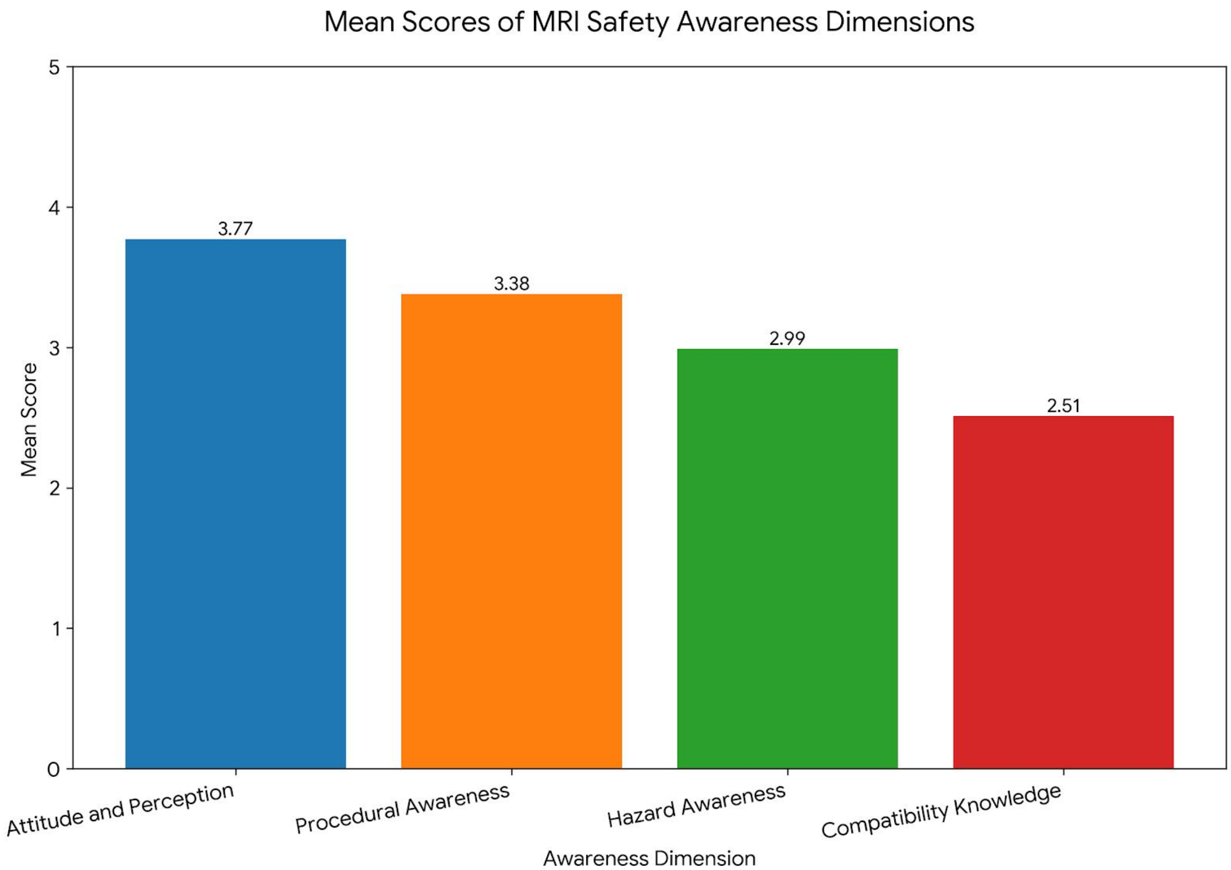

Figure 4.5: Mean Scores of MRI Safety Awareness Dimensions. *The bar chart compares the mean scores for the four dimensions of awareness. 'Attitude and Perception' had the highest mean score (M = 3.77, SD = 0.43), followed by 'Procedural Awareness' (M = 3.38, SD = 0.79). 'Compatibility Knowledge' registered the lowest mean score (M = 2.51, SD = 0.72).*

Interpretation:

Table 4.3 reveals that students demonstrated moderate procedural (M = 3.38) and hazard awareness (M = 2.99), while compatibility knowledge scored the lowest (M = 2.51). Attitude and perception recorded the highest mean score (M = 3.77), suggesting that students value MRI safety practices and are open to learning. The overall mean score of 3.16 indicates that awareness among students is moderate but can be improved, especially regarding technical aspects of MRI safety.

4.1.4 Effect of Formal MRI Safety Training on Awareness Levels

To determine whether formal MRI safety training significantly affected students' awareness, an independent samples *t*-test was conducted. The results are presented below.

Table 4.4(a): Group Statistics

Training Status	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Received Formal Training	56	3.68	0.41	0.05
No Formal Training	154	3.00	0.57	0.05

Table 4.4(b): Independent Samples Test

Levene's Test for Equality of Variances			**t-test for Equality of Means**			
	F	Sig.	t	df	Sig. (2-tailed)	
Equal variances assumed	4.51	.035	6.10	208	.000	

Equal variances not assumed			6.20	145.11	.000

	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
Equal variances assumed	0.68	0.11	0.46	0.90
Equal variances not assumed	0.68	0.11	0.46	0.90

Interpretation:

Levene's test for equality of variances was significant (F = 4.51, $p = .035$), so the row for *equal variances not assumed* was used. Students who received formal MRI safety training recorded a significantly higher awareness mean score (M = 3.68, SD = 0.41) than those who did not (M = 3.00, SD = 0.57). The difference was statistically significant, $t(145.11) = 6.20$, $p < .001$, with a mean difference of 0.68 and a 95% confidence interval between 0.46 and 0.90.

This confirms that formal training significantly improves students' awareness of MRI safety, leading to the rejection of the null hypothesis that structured training has no effect on MRI safety awareness.

4.1.5 Effect of Academic Level on MRI Safety Awareness

A one-way Analysis of Variance (ANOVA) was conducted to determine whether MRI safety awareness differs significantly across academic levels.

Table 4.5(a): Descriptive Statistics

Academic Level	N	Mean	Std. Deviation	Std. Error
300 Level	61	2.85	0.48	0.06
400 Level	69	3.32	0.44	0.05
500 Level	80	3.55	0.41	0.05
Total	210	3.16	0.59	0.04

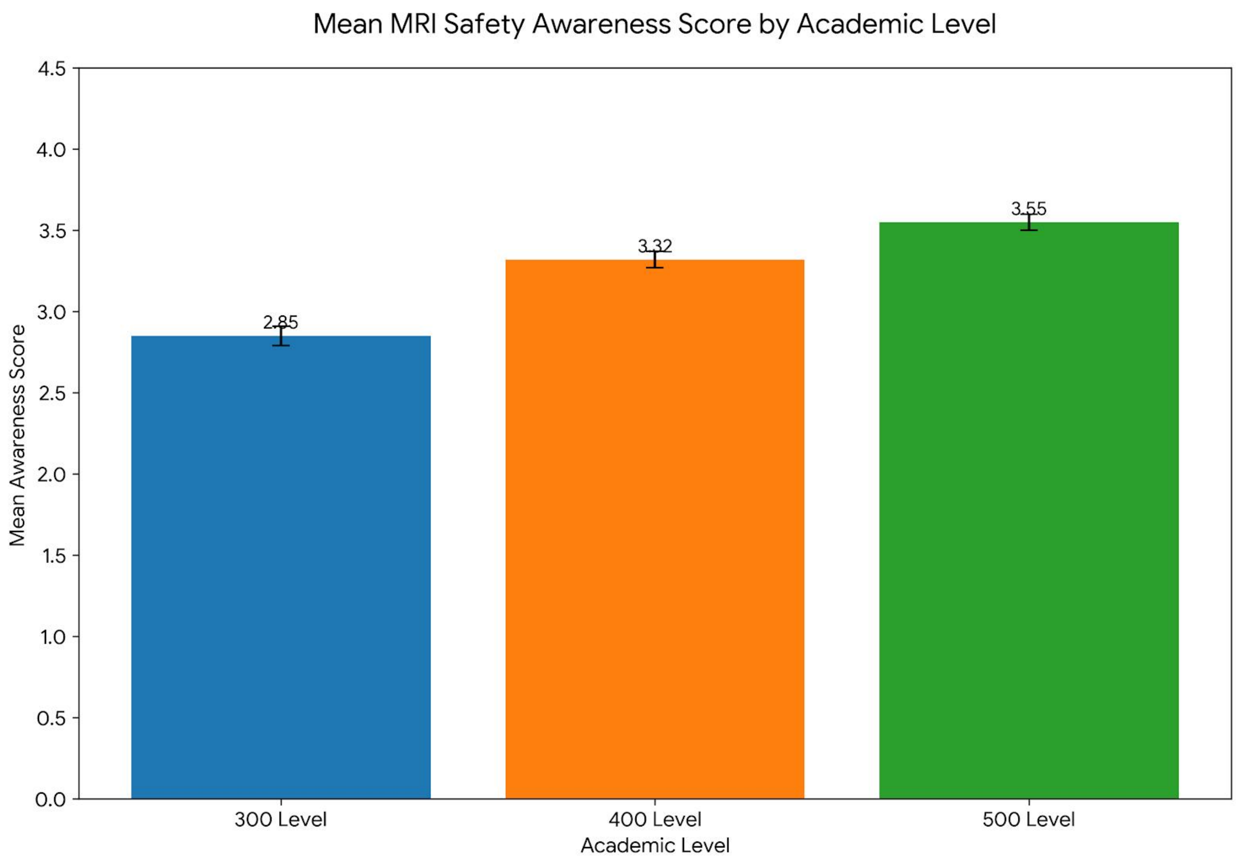

Figure 4.6: Mean MRI Safety Awareness Score by Academic Level. *The chart illustrates a steady rise in MRI safety awareness that corresponds with academic progression. 500 Level students (M = 3.55, SE = 0.05) had the highest mean score, followed by 400 Level (M = 3.32, SE = 0.05) and 300 Level (M = 2.85, SE = 0.06). Error bars represent the standard error of the mean for each group.*

Table 4.5(b): ANOVA

Source	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	20.44	2	10.22	31.91	.000
Within Groups	66.36	207	0.32		
Total	86.80	209			

Table 4.5(c): Multiple Comparisons (Tukey HSD)

(I) Academic Level	**(J) Academic Level**	**Mean Difference (I–J)**	**Sig.**	**Significance**
300	400	-0.47	.000	Significant
300	500	-0.70	.000	Significant
400	500	-0.23	.020	Significant

Interpretation:

The ANOVA results in Table 4.5(b) show that MRI safety awareness differed significantly across academic levels, $F(2, 207) = 31.91$, $p < .001$. Post-hoc analysis using Tukey's HSD test (Table 4.5(c)) revealed that 500-level students had the highest awareness, followed by 400-level, while 300-level students had the lowest. This shows a steady increase in knowledge as students progress academically, likely due to increased clinical exposure and learning experience. The null hypothesis of no difference across levels is therefore rejected.

4.1.6 SUMMARY OF MAJOR FINDINGS

Table 4.6: Summary of Major Findings in Relation to Study Objectives

Objective	**Key Statistical Result**	**Interpretation**
1. Assess awareness of MRI-related risks	M = 2.99 (Hazard), M = 2.51 (Compatibility)	Students have moderate awareness of MRI hazards but limited knowledge of equipment compatibility.
2. Identify familiar MRI safety protocols	M = 3.38 (Procedural), M = 3.77 (Attitude)	Students are familiar with standard safety procedures and have positive attitudes toward safe MRI practice.
3. Explore influence of academic level	ANOVA: $F(2,207) = 31.91$, $p < .001$	Awareness increases significantly with higher academic levels.
Test hypothesis on training effect	$t(145.11) = 6.20$, $p < .001$	Formal training significantly improves MRI safety awareness and readiness.

Interpretation:

The findings indicate that radiography students possess moderate awareness of MRI safety, with strong procedural understanding and positive attitudes but weaker technical knowledge.

Academic progression and formal training both significantly enhance MRI safety competence, emphasizing the need for structured and practical MRI safety education.

4.2DISCUSSION OF FINDINGS

This study aimed to assess the awareness of MRI safety hazards among clinical radiography students at the University of Benin. The results presented above provide a robust quantitative foundation for understanding the specific knowledge, attitudes, and training levels of these students. This section synthesizes these findings, interpreting them through the lens of the conceptual and empirical literature reviewed in Chapter two. The discussion is structured around three central themes that emerged from the data:

1. The systemic disconnect between clinical posting and formal safety education.
2. The specific "Attitude-Competence" profile of student awareness, which reveals both a key strength and a critical weakness.
3. The comparative impact of passive academic progression versus active, formal training on awareness levels.

Collectively, this discussion contextualizes the study's findings within the broader Nigerian healthcare landscape, providing empirical evidence to address the research gaps identified in the literature.

4.2.1 The "Experience-Training" Paradox: A Systemic Vulnerability

The demographic data revealed a striking and paradoxical finding: a significant majority of students (66.2%) had been posted to an MRI unit, yet an even larger majority (73.3%) reported receiving no formal MRI safety training. This is not merely a statistical anomaly; it is a clear indicator of a systemic vulnerability within the current radiography curriculum. It suggests a prevailing educational model that prioritizes experiential exposure over foundational, prerequisite knowledge. Students are, in effect, being placed in one of the most hazardous environments in a modern hospital—the ACR-defined Zone III and Zone IV —without the formal cognitive "armour" required to navigate its unique, non-intuitive risks.

This finding provides a clear origin point for the widespread safety concerns documented in the literature on Nigerian radiography. The literature review highlighted studies by Ogunleye et al. (2014), which found poor adherence to safety laws among registered radiographers, and Olusegun et al. (2021), which identified a "knowledge gap" in interns. This study's data strongly suggests that this gap does not suddenly appear upon graduation or internship; it is ingrained much earlier, at the undergraduate level. These students are the interns and radiographers of tomorrow. If they are graduating with significant training deficits, they will inevitably carry these deficits into their professional practice, perpetuating a cycle of substandard safety adherence.

This "experience-training" paradox directly confirms the concerns raised by Zaiton et al. (2020) regarding "curriculum gaps in MRI safety education" and validates the urgent calls from Nwafor et al. (2023) for official guidelines and regular workshops. The 73.3% "no training" figure is a direct, quantitative measure of this curriculum gap. Furthermore, this lack of formal training is compounded by the environment in which students are being trained. Okonkwo and Nwobi (2022) found that many MRI centers in southeastern Nigeria had "poor safety setups," including missing signs and unclear zones. When students who lack formal training are placed in clinical settings that themselves model poor safety infrastructure, the risk of normalizing these substandard practices becomes exceptionally high. This creates a feedback loop where institutional and educational gaps reinforce one another, ultimately compromising the patient and staff safety that this study is intended to improve.

4.2.2. Profiling Awareness: The Critical 'Attitude-Competence' Gap

The descriptive statistics for the four awareness dimensions (Table 4.3) paint a nuanced and highly instructive portrait of the students' knowledge profile. The most significant finding from this analysis is the wide chasm between the students' attitudes and their technical competence.

On one hand, students scored highest on 'Attitude and Perception' ($M = 3.77$). This is an exceptionally positive and crucial finding. It indicates that the student body is not apathetic or resistant to safety culture. They inherently understand that MRI safety is a serious and important matter, and they possess a positive disposition toward safe practices. This high level of "receptiveness" is an invaluable asset for the faculty, as it suggests that any future educational interventions would be met with engagement rather than resistance.

On the other hand, this positive attitude did not correlate with practical knowledge. The students recorded their lowest mean score on 'Compatibility Knowledge' ($M = 2.51$). This is arguably the most alarming finding of the entire study. 'Compatibility Knowledge' is not abstract or theoretical; it is the specific, technical, and practical knowledge required to prevent the most catastrophic and well-documented MRI accidents. A low score in this dimension directly implies a poor understanding of:

- The Projectile Effect: The risk of ferromagnetic objects being drawn into the scanner. A score of 2.51 suggests students cannot reliably differentiate safe from unsafe materials, which is precisely the knowledge needed to prevent an accident like a fire extinguisher or a metal chair being brought into Zone IV. This danger was a central focus in the literature, highlighted by Schaefer et al. (2020).

- RF-Induced Burns: The danger of thermal injury from conductive materials, a risk explicitly detailed by Shellock & Spinazzi (2008).
- Implant and Device Malfunction: The potentially fatal risks posed to patients with pacemakers, cochlear implants, or other devices, as documented by Russo et al. (2017) and Nyenhuis et al. (2005).

This "Attitude-Competence" gap is not unique to the University of Benin; it directly corroborates the findings of several international studies cited in the literature review. Asiri (2022), in a study on Saudi Arabian students, found that while they possessed "general knowledge," they specifically lacked a deep understanding of "implants or how radiofrequency energy could cause harm". Similarly, Alyami et al. (2023) noted that students had "average" awareness but a poor grasp of the "dangers of metallic objects or electromagnetic effects". Crucially, Alyami et al. blamed this directly on the "absence of structured MRI safety teaching" —a cause-and-effect relationship that this study's findings strongly reinforce.

This result provides a clear directive for any educational reform. Attitude alone does not stop a gas cylinder from becoming a projectile. This finding pinpoints the exact, high-priority weakness that a revised curriculum must target.

4.2.3 Drivers of Awareness: Passive Progression vs. Active Intervention

The study's final objective was to explore the factors that influence awareness, specifically academic level and formal training. The analysis provided two clear, distinct, and actionable answers.

First, awareness is not static; it improves passively with academic progression. The one-way ANOVA (Table 4.5b) revealed a highly significant difference in awareness scores across the three academic levels ($F(2, 207) = 31.91$, $p < .001$). The post-hoc Tukey HSD test confirmed this was a clear, linear, and statistically significant rise in knowledge with each year of study: 300 Level ($M = 2.85$) was significantly lower than 400 Level ($M = 3.32$), which in turn was significantly lower than 500 Level ($M = 3.55$. This directly answers Research Question 3 and confirms the conceptual framework's assertion on the value of clinical training. As students spend more time in the clinical environment, they "passively absorb" knowledge and experience, as suggested by the work of Mraity et al. (2014).

Second, and more importantly, formal training is a powerful, active intervention that dramatically improves awareness. The independent samples t-test (Table 4.4) provided the study's most conclusive result. Students who had received formal training had a mean awareness score ($M = 3.68$) that was significantly higher than those who had not ($M = 3.00$). The difference was statistically profound ($t(145.11) = 6.20$, $p < .001$). This finding decisively rejects the null hypothesis (H_0) and confirms the alternative hypothesis (H_1) that structured training significantly improves knowledge and readiness.

When these two findings are synthesized, a critical insight emerges. Relying on "passive progression" is a slow, inefficient, and high-risk educational strategy. It takes students three full years of study and clinical exposure to reach a mean awareness score of 3.55. In stark contrast, a single "active intervention" (formal training) achieves an even higher mean score of 3.68. This suggests that a well-designed training module, implemented early, could potentially elevate a 300-level student's awareness to a level exceeding that of an untrained 500-level student. This result provides powerful, local evidence for the claims made in the international literature. Vilar-

Palop et al. (2019) found that training was directly linked to better test performance, and Gibson & Davidson (2012) argued that practical learning improves retention of safety protocols. This study's t-test provides the definitive Nigerian data to support those claims.

In conclusion, this study validates many of the concerns raised in the literature regarding gaps in Nigerian MRI safety education. It confirms that University of Benin radiography students, while possessing a positive attitude, have significant and dangerous deficiencies in their technical safety knowledge, particularly regarding equipment compatibility. This gap appears to be a direct consequence of a curriculum that has normalized clinical exposure without mandating equivalent formal training. However, the study's findings are ultimately optimistic. They prove conclusively that this problem is solvable. The data provides a clear, evidence-based mandate for the Department of Radiography to implement a structured, formal MRI safety training module. Such an intervention, as the results show, is the single most effective method to improve competence, bridge the "Attitude-Competence" gap, and ultimately fulfill the institution's duty of care to its students, their future colleagues, and their patients.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

This study investigated the level of awareness of MRI safety hazards among clinical radiography students at the University of Benin. The main objective was to evaluate how well the students understood MRI safety principles, possible hazards, and safety precautions required in MRI environments.

From the data obtained, most respondents were aware that MRI uses a strong magnetic field and radio waves to create body images. However, the results showed that many students lacked a detailed understanding of the potential risks associated with MRI, such as the projectile effect, implant interference, and burns from conductive materials. Awareness of screening procedures and contraindications before MRI examinations was also found to be limited among some students.

Although general awareness of MRI safety was present, the study revealed that structured training and practical exposure to MRI safety procedures were inadequate. Many respondents had not received formal instruction or orientation on MRI safety during their clinical postings. This indicates a knowledge gap that could increase the risk of accidents or unsafe practices in MRI units if not addressed.

Overall, the findings suggest that clinical radiography students at the University of Benin have a fair level of awareness of MRI safety but still require further education and hands-on training to reach the level expected for professional radiography practice.

5.2 **CONCLUSION**

The study concluded that while most clinical radiography students at the University of Benin are generally aware of MRI safety hazards, their knowledge of specific safety practices is insufficient. MRI remains one of the safest and most advanced imaging modalities, yet it also carries potential dangers if proper safety measures are ignored.

A limited understanding of safety principles can lead to avoidable incidents such as burns, hearing injuries, or accidents caused by ferromagnetic objects. Therefore, it is crucial to strengthen MRI safety education among students. Regular training, classroom instruction, and supervised clinical experience will help build competence and confidence in maintaining safety within MRI environments.

By improving awareness and promoting strict adherence to safety protocols, the future generation of radiographers will be better equipped to protect both patients and healthcare workers from potential hazards associated with MRI examinations.

5.3 **RECOMMENDATIONS**

Based on the findings and conclusion of this study, the following recommendations are made:

1. Incorporate MRI safety education as a compulsory part of the undergraduate radiography curriculum to ensure all students gain formal and consistent knowledge.

2. Organize regular seminars, workshops, and demonstrations on MRI safety for students and clinical instructors to reinforce practical understanding.

3. Provide mandatory MRI orientation sessions before students begin clinical postings in MRI units to improve their preparedness and confidence.

4. Make safety manuals and visual guides available in MRI departments for easy reference and continuous learning.

5. Encourage collaboration between academic lecturers and hospital supervisors to ensure students are properly guided and monitored in applying safety protocols during clinical rotations.

5.4 **LIMITATIONS**

This study was limited to clinical radiography students at the University of Benin, which restricts the generalization of its findings to other radiography schools in Nigeria. The use of self-administered questionnaires relied on the accuracy and honesty of the participants' responses. Time constraints and limited access to MRI facilities also affected the possibility of direct observation of safety practices.

5.5 **SUGGESTIONS FOR FURTHER STUDIES**

Future studies should include radiography students from several universities across Nigeria to allow for a more comprehensive comparison of MRI safety awareness levels. Research can also be carried out to assess the effectiveness of specific teaching methods, such as simulation-based training or safety workshops, on students' knowledge and practical skills. Additionally, studies involving practicing radiographers could help determine whether knowledge gained during training is retained and applied in professional practice.

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QUESTIONNAIRE

Questionnaire on AWARENESS OF MRI SAFETY HAZARDS AMONG CLINICAL RADIOGRAPHY STUDENTS IN THE UNIVERSITY OF BENIN.

This questionnaire is designed for an academic research project titled "MRI Safety Awareness among Radiography Students of the University of Benin." The purpose of this study is to evaluate students' knowledge, awareness, and perception of MRI safety practices. Your participation is voluntary, and all responses will be treated as confidential and used strictly for academic purposes. Please respond honestly by ticking (✓) the option that best reflects your opinion.

Scale: 1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree

Section A: Demographic/ Background Information

1. Gender: ☐ Male ☐ Female ☐ Prefer not to say
2. Academic Level: ☐ 300 ☐ 400 ☐ 500
3. I have been posted to an MRI unit before: ☐ Yes ☐ No
4. I have received formal training on MRI safety: ☐ Yes ☐ No
5. Duration of MRI posting: ☐ None ☐ <2 weeks ☐ 2–4 weeks ☐ >1 month

Section B: Procedural Awareness of MRI Safety

1. I am aware that the MRI suite is divided into safety zones to control access.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

2. I always ensure that all patients and staff are screened for metallic objects before entering the MRI room.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

3. I understand that only trained MRI personnel should be allowed into the MRI scanner room.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

4. I know that an MRI emergency (quench) should only be performed by qualified staff.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

5. I can confidently identify the different safety zones in an MRI environment.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Section C: Awareness of MRI Hazards

1. I understand that loose metallic objects can become dangerous projectiles inside the MRI room.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

2. I am aware that burns can result from MRI coils or monitoring wires during scans.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

3. I know that patients should always be given hearing protection during MRI examinations.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

4. I am aware that magnetic fields can cause pacemakers and implants to malfunction.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

5. I know the possible steps to take in the event of an MRI-related accident or incident.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Section D: Knowledge of MRI Compatibility

1. I can identify medical implants or devices that are unsafe in MRI.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

2. I know that pacemakers are contraindicated for MRI examinations.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

3. I can differentiate between MRI-compatible and non-compatible equipment.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

4. I know that metallic jewelry and electronic devices must be removed before entering MRI rooms.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

5. I am familiar with the safety labels used to indicate MRI-compatible materials.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Section E: Attitude and Perception Toward MRI Safety

1. I consider MRI safety an important part of radiography education.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

2. I feel confident in identifying and preventing MRI-related hazards.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

3. I believe that more MRI safety workshops should be organized for students.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

4. I would be willing to attend extra training sessions on MRI safety.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

5. My department provides adequate orientation about MRI safety procedures.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Section F: Open-Ended Feedback

In your opinion, what measures can improve MRI safety awareness among radiography students?

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