

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

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Abstract

Background: Magnetic Resonance Imaging (MRI) is an essential diagnostic modality that offers excellent soft-tissue contrast and multiplanar imaging without ionizing radiation. However, MRI examinations may induce anxiety, discomfort, and various sensory experiences that can adversely affect patient cooperation, examination completion, image quality, and overall healthcare satisfaction. Evidence regarding factors influencing patient experience during MRI examinations in the Indian healthcare setting remains limited.

Purpose: To evaluate patient experiences during MRI examinations and identify demographic and examination-related factors associated with MRI-related anxiety among adult patients undergoing routine MRI procedures.

Materials and Methods: A descriptive cross-sectional analytical study was conducted among 400 adult patients undergoing MRI examinations at a tertiary care imaging centre in Jaipur, Rajasthan, India. Consecutive sampling was employed over an 18-month period. Data were collected using a structured questionnaire assessing multiple domains of patient experience, including MRI-related anxiety, acoustic noise disturbance, discomfort due to prolonged scan duration, dizziness, fear associated with scanner structure, metallic taste sensation, warm sensation, previous MRI familiarity, and claustrophobic anxiety. Demographic characteristics and MRI examination variables were also recorded. Statistical analyses were performed using IBM SPSS Statistics Version 23. Descriptive statistics were expressed as frequencies, percentages, means, and standard deviations, while associations between variables were evaluated using Pearson's Chi-square test. Statistical significance was set at $p < 0.05$.

Results: The study included 400 participants, comprising 206 males (51.5%) and 194 females (48.5%), with a mean age of 33.62 ± 9.28 years. MRI-related anxiety was reported by 149 participants (37.3%), discomfort associated with prolonged scan duration by 145 (36.3%), and previous claustrophobic anxiety by 148 (37.0%). Fear related to scanner structure was reported by 134 participants (33.5%), acoustic noise disturbance by 125 (31.3%), dizziness by 122 (30.5%), metallic taste sensation by 125 (31.3%), and warm sensation by 133 (33.3%). No statistically significant associations were observed between MRI-related anxiety and gender ($\chi^2 = 0.392$, $p = 0.822$), age group ($\chi^2 = 1.849$, $p = 0.764$), contrast administration ($\chi^2 = 0.879$, $p = 0.644$), or previous MRI familiarity ($\chi^2 = 0.256$, $p = 0.992$).

Conclusion: More than one-third of patients experienced anxiety and discomfort during MRI examinations, indicating that adverse experiences remain common in routine clinical practice. Demographic characteristics and selected examination-related variables were not significant predictors of MRI-related anxiety, suggesting that patient experiences during MRI are multifactorial and influenced by broader psychological and environmental factors. Implementation of universal patient-centred strategies, including effective pre-scan counselling, continuous communication, and optimization of examination protocols, may improve examination tolerance and overall patient experience during MRI procedures.

Keywords: Magnetic resonance imaging; Patient experience; MRI-related anxiety; Claustrophobia; Acoustic noise; Patient-centred care; Cross-sectional study.

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INTRODUCTION

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Magnetic Resonance Imaging (MRI) has revolutionized diagnostic imaging by providing exceptional soft tissue contrast, multiplanar image acquisition, and high diagnostic accuracy without exposing patients to ionizing radiation. During the past four decades, MRI has evolved into an indispensable component of contemporary medical practice and is routinely employed in the diagnosis, treatment planning, and follow-up of neurological, musculoskeletal, cardiovascular, abdominal, pelvic, and oncological disorders. Continuous technological advancements, including higher magnetic field strengths, accelerated pulse sequences, parallel imaging techniques, compressed sensing, and artificial intelligence-assisted image reconstruction, have substantially improved image quality while reducing acquisition time and expanding the clinical applications of MRI [1–4].

Despite these remarkable technological developments, successful MRI examinations continue to depend not only on scanner performance but also on patient cooperation throughout image acquisition. Unlike many diagnostic imaging procedures, MRI requires patients to remain motionless within a confined cylindrical bore for prolonged periods while simultaneously being exposed to repetitive acoustic noise generated by rapidly switching gradient magnetic fields. These procedural characteristics may provoke anxiety, physical discomfort, claustrophobic reactions, sensory disturbances, and reduced examination tolerance. Such responses frequently contribute to patient movement during image acquisition, resulting in motion artefacts, repeated imaging sequences, prolonged examination duration, reduced departmental efficiency, and compromised diagnostic image quality [5–9].

Over the last decade, patient-centred healthcare has become an essential indicator of healthcare quality. International healthcare organizations increasingly recognize that healthcare outcomes should be evaluated not only by diagnostic accuracy and treatment effectiveness but also by patients' experiences throughout the care pathway. Within diagnostic imaging departments, positive patient experiences have been associated with improved examination compliance, greater patient satisfaction, reduced appointment cancellations, fewer repeated imaging sequences, and more efficient utilization of healthcare resources. Consequently, assessment of patient experience has become an integral component of quality improvement initiatives within radiology practice [10–13].

MRI-related anxiety remains one of the most extensively investigated psychological responses associated with diagnostic imaging. Anxiety may arise from multiple sources, including unfamiliarity

with the MRI procedure, anticipation of diagnostic findings, perceived confinement within the scanner bore, inability to move during image acquisition, previous negative healthcare experiences, and concerns regarding examination duration. Elevated anxiety has consistently been associated with increased patient motion, reduced examination tolerance, incomplete MRI studies, and additional healthcare costs related to repeated image acquisition. Previous investigations have demonstrated that MRI-related anxiety affects a substantial proportion of patients, highlighting the importance of identifying individuals who may benefit from targeted pre-scan interventions [14–18].

Another important determinant of subject experience during MRI examinations is acoustic noise. Rapid switching of gradient coils during image acquisition produces repetitive knocking, buzzing, and tapping sounds that may exceed 100 dB depending upon pulse sequence design, magnetic field strength, and scanner configuration. Although hearing protection devices are routinely provided, acoustic noise remains one of the most frequently reported causes of patient discomfort during MRI examinations. Persistent exposure to high-intensity acoustic noise may increase psychological stress, reduce patient comfort, and negatively influence overall examination experience. Recent advances in quiet MRI technologies have demonstrated promising improvements; however, conventional MRI systems continue to generate considerable acoustic noise during routine clinical practice [19–23].

Physical discomfort associated with prolonged scan duration and restricted body movement represents another important contributor to negative patient experience. MRI examinations frequently require patients to maintain a fixed body position for extended periods to minimize motion artefacts and preserve image quality. Patients presenting with spinal disorders, musculoskeletal injuries, chronic pain, degenerative joint disease, or traumatic conditions may find prolonged immobility particularly challenging. Consequently, discomfort arising from extended examination duration may increase involuntary movement, reduce examination tolerance, prolong scanner occupancy, and ultimately compromise diagnostic efficiency [24–27].

Several patients also report transient sensory experiences during MRI examinations, including dizziness, vertigo, metallic or unusual taste sensations, warmth, vibration-like perceptions, and mild disequilibrium. Although these effects are generally transient and clinically insignificant, they may contribute to patient apprehension, particularly among individuals undergoing MRI for the first

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

time. Experimental and clinical studies suggest that these sensory responses may result from interactions between static magnetic fields, radiofrequency energy deposition, rapidly switching gradient fields, and the vestibular or sensory systems. Appropriate patient education before scanning may reduce unnecessary concern by informing patients that such sensations are expected, temporary, and generally harmless [28–31].

Subject experience during MRI examinations is influenced by considerably more than scanner characteristics alone. Demographic factors such as age and gender, previous MRI experience, educational level, communication with radiographers, waiting time, examination type, pain severity, and psychological preparedness have all been reported to influence patient perceptions during MRI procedures. Individuals undergoing MRI for the first time frequently demonstrate greater uncertainty regarding the examination process, whereas patients with previous MRI experience often exhibit improved procedural confidence and lower anxiety levels. Similarly, effective communication before and during image acquisition has consistently been associated with improved patient cooperation, reduced examination-related stress, and enhanced overall satisfaction [32–36].

In recent years, radiology departments have increasingly adopted patient-centred approaches to improve MRI examination tolerance. These strategies include structured pre-scan counselling, audiovisual educational materials, continuous communication throughout the examination, improved patient positioning, noise-reduction technologies, accelerated pulse sequences, wider-bore MRI systems, and relaxation techniques. Emerging technologies, including artificial intelligence-assisted image acquisition and compressed sensing, have further reduced scan duration while maintaining diagnostic image quality, thereby improving patient comfort. Nevertheless, implementation of these interventions requires a clear understanding of the factors that most strongly influence subject experience within routine clinical practice [37–40].

Although numerous studies have investigated MRI-related anxiety, claustrophobia, or patient discomfort, the majority have focused primarily on describing the prevalence of individual symptoms or evaluating selected patient populations. Comparatively fewer investigations have comprehensively examined the demographic and examination-related factors influencing overall subject experience using structured analytical methodologies. Furthermore, published evidence from the Indian healthcare setting remains relatively limited despite the rapidly increasing utilization of MRI across tertiary healthcare institutions.

Differences in healthcare infrastructure, patient education, cultural perceptions, referral patterns, and clinical workflow may influence patient experience across geographical regions, emphasizing the importance of generating locally relevant evidence to guide patient-centred MRI practice [41–44].

The present study was therefore undertaken to identify the demographic and MRI examination-related factors influencing subject experience among adult patients undergoing Magnetic Resonance Imaging examinations at a tertiary care imaging centre in Jaipur, Rajasthan, India. Unlike previous descriptive investigations, the present study evaluates the relationships between participant characteristics, examination-related variables, and multiple dimensions of patient-reported experience within a complete cohort of 400 adult participants. The findings are expected to provide clinically relevant evidence for improving patient preparation, optimizing MRI workflow, enhancing examination tolerance, reducing motion-related image degradation, and strengthening patient-centred imaging services within routine clinical practice.

AIM: To identify the demographic and MRI examination-related factors influencing subject experience among adult patients undergoing Magnetic Resonance Imaging examinations.

OBJECTIVES

1. To evaluate MRI-related anxiety experienced by adult patients during Magnetic Resonance Imaging examinations.
2. To determine the influence of demographic characteristics, including age and gender, on subject experience during MRI examinations.
3. To assess the association between MRI examination characteristics, including examination type, contrast administration, and previous MRI familiarity, and patient-reported experiences.
4. To evaluate the prevalence of MRI-related discomfort, including acoustic noise disturbance, prolonged scan duration, dizziness, fear associated with scanner structure, metallic taste sensation, warm sensation, and claustrophobic anxiety.
5. To identify independent factors associated with adverse subject experience during MRI examinations using appropriate statistical analyses.

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

MATERIALS AND METHODS

Study Design and Setting: This descriptive cross-sectional analytical study was conducted to evaluate factors influencing patient experience during Magnetic Resonance Imaging (MRI) examinations. The study was carried out at a tertiary care MRI centre in Jaipur, Rajasthan, India, which provides routine and specialized MRI services, including neurological, musculoskeletal, spinal, abdominal, pelvic, vascular, and joint imaging examinations.

Study Duration: The study was conducted over an 18-month period following Institutional Ethics Committee approval. Patient recruitment and data collection were conducted prospectively in accordance with a predefined study protocol.

Study Population: The study population comprised adult patients referred for MRI examinations from outpatient departments and specialty clinics. Participants represented a broad spectrum of clinical indications routinely encountered in MRI practice.

Sample Size: 400 adult patients were included in the study.

Sampling Technique: A consecutive sampling technique was employed. All eligible patients attending the MRI department during the study period who fulfilled the inclusion criteria and provided written informed consent were enrolled until the target sample size was achieved.

Eligibility Criteria

Inclusion Criteria

Participants were included if they:

- were aged between 18 and 50 years;
- were referred for MRI examination irrespective of the anatomical region under investigation;
- were conscious, cooperative, and oriented;
- were willing to provide written informed consent; and
- underwent either contrast-enhanced or non-contrast MRI examinations.

Exclusion Criteria

Participants were excluded if they:

- were younger than 18 years or older than 50 years;
- required sedation or general anaesthesia;
- were critically ill or medically unstable;

- were unable to understand or complete the study questionnaire;
- declined participation; or
- had contraindications to MRI according to institutional safety guidelines.

MRI Equipment and Examination Protocol: All examinations were performed using a 1.5-T superconducting MRI system following standardized institutional imaging protocols. Appropriate radiofrequency coils were selected according to the anatomical region under evaluation.

Routine examinations included brain MRI, cervical spine MRI, dorsal spine MRI, lumbar spine MRI, MR angiography, MR venography, MR cholangiopancreatography, knee MRI, wrist MRI, ankle MRI, and other musculoskeletal and abdominal examinations.

Standard patient preparation procedures were followed for all examinations. Hearing protection devices, including earplugs or headphones, were routinely provided before image acquisition. Contrast-enhanced MRI examinations were performed only when clinically indicated and in accordance with institutional protocols.

Data Collection Instrument: Data were collected using a structured questionnaire developed after an extensive review of published literature on MRI-related anxiety, patient comfort, and patient experience during diagnostic imaging examinations.

The questionnaire consisted of two sections.

Section I: Demographic and Examination Characteristics

The first section recorded:

- age;
- gender;
- type of MRI examination;
- contrast administration; and
- previous MRI exposure and familiarity.

Section II: Patient Experience Assessment

The second section evaluated patient-reported experiences during MRI examinations across the following domains:

1. MRI-related anxiety;
2. acoustic noise disturbance;
3. dizziness during scanning;

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

4. fear associated with the enclosed scanner structure;
5. metallic or unusual taste sensation;
6. discomfort due to prolonged examination duration and restricted body movement;
7. previous familiarity with MRI examinations;
8. warm sensation during MRI; and
9. previous claustrophobic anxiety.

Responses to each item were recorded using a three-point Likert scale (Agree, Neutral, and Disagree). The questionnaire was prepared in both English and Hindi to improve comprehension and minimize language-related response bias.

Validity and Reliability of the Questionnaire: Content validity was established through expert review by senior faculty members in Radiology and Radiation and Imaging Technology. Each item was evaluated for clarity, relevance, comprehensiveness, and appropriateness.

A pilot study was conducted prior to commencement of the main study to assess questionnaire feasibility and participant understanding. Necessary modifications were incorporated based on feedback obtained during pilot testing.

The questionnaire's internal consistency was assessed using Cronbach's alpha, with a value ≥ 0.70 considered acceptable.

Data Collection Procedure: Eligible participants attending the MRI department were approached before their scheduled examination. The objectives and significance of the study were explained, and written informed consent was obtained.

Demographic information and MRI examination details were recorded using a standardized case record form.

Immediately after completion of the MRI examination, participants completed the questionnaire independently. Assistance was provided only when clarification regarding questionnaire items was requested, without influencing participant responses.

All questionnaires were reviewed on the same day to ensure completeness and minimize missing data.

Outcome Measures

Primary Outcome

The primary outcome was MRI-related anxiety experienced during MRI examination.

Secondary Outcomes

Secondary outcomes included:

- acoustic noise disturbance;
- discomfort due to prolonged scan duration;
- dizziness;
- fear associated with scanner structure;
- metallic taste sensation;
- warm sensation; and
- previous claustrophobic anxiety.

Independent Variables

The following variables were considered potential determinants of patient experience:

Demographic Variables

- Age
- Gender

MRI Examination Variables

- MRI examination type
- Contrast administration
- Previous MRI familiarity

Statistical Analysis: Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 23.0 (IBM Corp., Armonk, NY, USA).

Continuous variables were reported as mean $\pm$ standard deviation (SD), median, interquartile range (IQR), minimum, and maximum, as appropriate. Categorical variables were presented as frequencies and percentages.

Associations between categorical variables were evaluated using Pearson's chi-square test or Fisher's exact test whenever expected cell frequencies were less than five. Comparisons between groups were performed using the independent samples t-test, Mann-Whitney U test, one-way analysis of variance (ANOVA), or Kruskal-Wallis test, as appropriate.

Variables demonstrating potential associations in univariate analyses were entered into multivariable logistic regression models to identify independent predictors of MRI-related anxiety. Adjusted odds ratios (AORs) and corresponding 95% confidence intervals (CIs) were calculated.

All statistical tests were two-tailed, and a p-value of <0.05 was considered statistically significant.

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of NIMS University Rajasthan, Jaipur. Written informed consent was obtained from all participants before enrolment.

Participation was voluntary, and participants were informed that refusal to participate or withdrawal from the study would not affect their medical care. Confidentiality and anonymity were maintained by assigning unique identification numbers and removing all personally identifiable information from the analytical dataset.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its subsequent amendments.

RESULTS

Participant Characteristics

A total of 400 adult participants undergoing magnetic resonance imaging were included in the final analysis. All participants met the eligibility criteria and completed the questionnaire successfully; therefore, no questionnaires were excluded due to incomplete or missing responses.

Gender Distribution

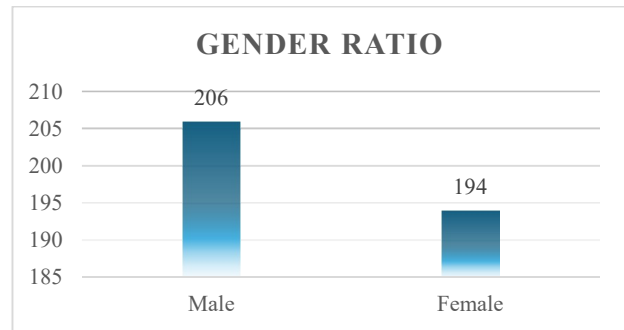
Among the study participants, 206 (51.5%) were male, while 194 (48.5%) were female, indicating an almost equal gender distribution within the study population as shown in Table 1 and Figure 1.

The balanced representation of both sexes minimized gender-related sampling bias and provided an appropriate basis for evaluating the influence of demographic characteristics on subject experience during MRI examinations.

Table 1. Gender distribution of participants (N = 400)

Gender	Frequency (n)	Percentage (%)
Male	206	51.5
Female	194	48.5
Total	400	100

Figure 1. Gender distribution of participants (N = 400)



Age Distribution

Participants ranged in age from 18 to 50 years.

The mean age of the study population was 33.62 ± 9.28 years, while the median age was 33 years as shown in Table 2.

The interquartile range (IQR) was 26–42 years, indicating that half of the participants were concentrated within this age interval.

Table 2. Descriptive statistics of participant age

Parameter	Value
Mean age	33.62 years
Standard deviation	± 9.28
Median	33 years
Interquartile range	26–42 years
Minimum age	18 years
Maximum age	50 years

MRI Examination Characteristics

The study population represented a broad spectrum of MRI examinations routinely performed in clinical practice, including neurological, spinal, musculoskeletal, abdominal, vascular, and joint imaging.

To ensure balanced representation of examination protocols, 200 participants (50.0%) underwent contrast-enhanced MRI, and 200 participants (50.0%) underwent non-contrast MRI, as shown in Table 3.

The most frequently performed examinations included cervical spine MRI, MR angiography of the brain, MR venography of the brain, dorsal spine MRI, lumbar spine MRI, brain MRI, MR cholangiopancreatography (MRCP), knee MRI, wrist MRI, and ankle MRI.

Table 3. MRI examination characteristics

Characteristic	Frequency	Percentage
Contrast MRI	200	50.0
Non-contrast MRI	200	50.0
Total	400	100.0

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

Subject Experience During Magnetic Resonance Imaging Examinations

Subject experience during MRI examinations was evaluated using a structured questionnaire comprising 9 domains: anxiety, acoustic noise disturbance, dizziness, fear associated with the scanner structure, metallic taste sensation, discomfort due to prolonged scan duration, familiarity with previous MRI examinations, warm sensation, and previous claustrophobic anxiety. Responses were categorized as Agree, Neutral, and Disagree.

MRI-Related Anxiety

MRI-related anxiety was one of the most frequently reported psychological responses. Among the 400 participants, 149 (37.3%) agreed that they experienced anxiety during the MRI examination, while 118 (29.5%) reported a neutral response and 133 (33.3%) disagreed. These findings indicate that more than one-third of the participants experienced anxiety during MRI examinations, as shown in Table 4.

Table 4. Distribution of MRI-related anxiety (N = 400)

Response	Frequency (n)	Percentage (%)
Agree	149	37.3
Neutral	118	29.5
Disagree	133	33.3
Total	400	100.0

Acoustic Noise Disturbance

Participants were asked whether the acoustic noise produced during MRI scanning caused discomfort. A total of 125 (31.3%) participants agreed that scanner noise was disturbing, 134 (33.5%) remained neutral, and 141 (35.3%) disagreed, as shown in Table 5.

Although a considerable proportion of participants tolerated MRI acoustic noise without major difficulty, approximately one-third found scanner noise uncomfortable.

Table 5. Acoustic noise disturbance during MRI examination (N = 400)

Response	Frequency (n)	Percentage (%)
Agree	125	31.3
Neutral	134	33.5
Disagree	141	35.3
Total	400	100.0

Dizziness During MRI Examination

Dizziness was reported less frequently than anxiety. Overall, 122 (30.5%) participants agreed that they experienced dizziness during scanning, an equal proportion (122; 30.5%) remained neutral, while 156 (39.0%) disagreed, as shown in Table 6.

These findings suggest that dizziness was not a predominant symptom among the study population.

Table 6. Dizziness experienced during MRI examination (N = 400)

Response	Frequency (n)	Percentage (%)
Agree	122	30.5
Neutral	122	30.5
Disagree	156	39.0
Total	400	100.0

Fear Associated with MRI Scanner Structure

When participants were asked whether the appearance or enclosed structure of the MRI scanner induced fear, 134 (33.5%) agreed, 139 (34.8%) reported a neutral response, and 127 (31.8%) disagreed, as shown in Table 7.

The responses were relatively evenly distributed, suggesting considerable individual variation in perception of the MRI environment.

Table 7. Fear associated with MRI scanner structure (N = 400)

Response	Frequency (n)	Percentage (%)
Agree	134	33.5
Neutral	139	34.8
Disagree	127	31.8
Total	400	100.0

Metallic or Unusual Taste Sensation

A metallic or unusual taste sensation during MRI was not consistently experienced across participants. Overall, 125 (31.3%) participants agreed, 140 (35.0%) remained neutral, and 135 (33.8%) disagreed, as shown in Table 8.

These findings indicate that metallic taste sensation was relatively uncommon and demonstrated substantial variability among individuals.

Table 8. Metallic or unusual taste sensation during MRI examination (N = 400)

Response	Frequency (n)	Percentage (%)
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Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

Agree	125	31.3
Neutral	140	35.0
Disagree	135	33.8
Total	400	100.0

Discomfort Due to Prolonged Scan Duration

Participants were asked whether prolonged examination duration and the requirement to remain motionless caused discomfort. A total of 145 (36.3%) participants agreed, 147 (36.8%) reported a neutral response, and 108 (27.0%) disagreed, as shown in Table 9.

Although responses were distributed across all three categories, discomfort associated with prolonged examination duration was reported by more than one-third of participants, indicating that examination length remains an important consideration in patient-centred MRI practice.

Table 9. Discomfort due to prolonged MRI examination (N = 400)

Response	Frequency (n)	Percentage (%)
Agree	145	36.3
Neutral	147	36.8
Disagree	108	27.0
Total	400	100.0

Previous MRI Familiarity

Among the study participants, 132 (33.0%) reported familiarity with MRI examinations, 142 (35.5%) responded neutrally, and 126 (31.5%) disagreed, as shown in Table 10.

These findings suggest that previous MRI exposure varied considerably within the study population.

Table 10. Previous familiarity with MRI examination (N = 400)

Response	Frequency (n)	Percentage (%)
Agree	132	33.0
Neutral	142	35.5
Disagree	126	31.5
Total	400	100.0

Warm Sensation During MRI Examination

A warm sensation during MRI examination was reported by 133 (33.3%) participants, while 136 (34.0%) remained neutral and 131 (32.8%) disagreed, as shown in Table 11.

The responses demonstrated a nearly equal distribution across categories, indicating that warmth was neither universally experienced nor universally absent.

Table 11. Warm sensation during MRI examination (N = 400)

Response	Frequency (n)	Percentage (%)
Agree	133	33.3
Neutral	136	34.0
Disagree	131	32.8
Total	400	100.0

Previous Claustrophobic Anxiety

When asked about previous claustrophobic anxiety, 148 (37.0%) participants agreed, 132 (33.0%) remained neutral, and 120 (30.0%) disagreed, as shown in Table 12.

This finding indicates that a substantial proportion of participants had experienced claustrophobic anxiety before undergoing MRI examinations.

Table 12. Previous claustrophobic anxiety (N = 400)

Response	Frequency (n)	Percentage (%)
Agree	148	37.0
Neutral	132	33.0
Disagree	120	30.0
Total	400	100.0

Overall Summary of Subject Experience

Analysis of the questionnaire responses demonstrated that MRI-related anxiety and discomfort associated with prolonged examination duration were among the most frequently reported concerns. Responses related to acoustic noise, scanner structure, dizziness, warm sensation, metallic taste sensation, and previous MRI familiarity were more evenly distributed across the three response categories, suggesting that subject experience during MRI examinations varies considerably among individuals.

Association Between Demographic Characteristics and MRI-Related Anxiety

To determine whether demographic characteristics influenced MRI-related anxiety, associations between participant gender, age group, and anxiety responses were evaluated using the Pearson Chi-square test.

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

Association Between Gender and MRI-Related Anxiety

- Among the 206 male participants, 74 (35.9%) agreed that they experienced anxiety during MRI, 61 (29.6%) reported a neutral response, and 71 (34.5%) disagreed.
- Among the 194 female participants, 75 (38.7%) agreed that they experienced anxiety, 57 (29.4%) were neutral, and 62 (32.0%) disagreed as shown in Table 13 and Figure 2.
- Although a slightly higher proportion of female participants reported anxiety, the difference was not statistically significant ($\chi^2 = 0.392$, $df = 2$, $p = 0.822$).

Table 13. Association between gender and MRI-related anxiety (N = 400)

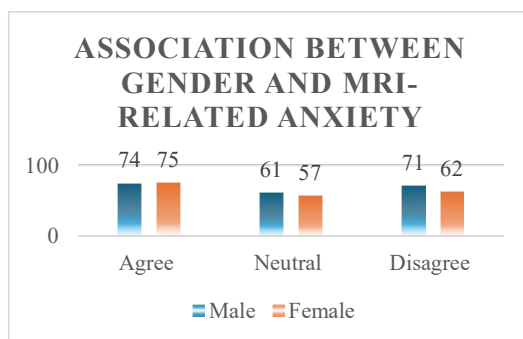
Gender	Agree n (%)	Neutral n (%)	Disagree n (%)	Total
Male	74 (35.9)	61 (29.6)	71 (34.5)	206
Female	75 (38.7)	57 (29.4)	62 (32.0)	194

Pearson Chi-square = 0.392, $df = 2$, $p = 0.822$

Interpretation

Gender was not significantly associated with MRI-related anxiety among the study participants.

Figure 2. Association between gender and MRI-related anxiety (N = 400)



Association Between Age Group and MRI-Related Anxiety

- Participants were categorized into three age groups (18–30 years, 31–40 years, and 41–50 years).

- Among participants aged 18–30 years, 59 reported anxiety, 50 remained neutral, and 47 disagreed.
- Among participants aged 31–40 years, 43 agreed, 37 remained neutral, and 42 disagreed.
- Among participants aged 41–50 years, 47 agreed, 31 remained neutral, and 44 disagreed as shown in Table 14 and Figure 3.

No statistically significant association was observed between age group and MRI-related anxiety ($\chi^2 = 1.849$, $df = 4$, $p = 0.764$).

Table 14. Association between age group and MRI-related anxiety

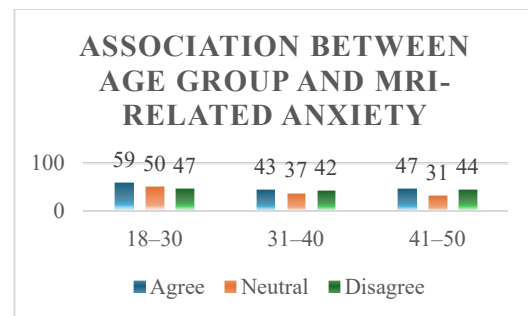
Age Group (years)	Agree	Neutral	Disagree	Total
18–30	59	50	47	156
31–40	43	37	42	122
41–50	47	31	44	122

Pearson Chi-square = 1.849, $df = 4$, $p = 0.764$

Interpretation

MRI-related anxiety was observed across all age groups; however, no statistically significant differences were identified.

Figure 3. Association between age group and MRI-related anxiety



Association Between MRI Examination Characteristics and MRI-Related Anxiety

Contrast Administration and MRI-Related Anxiety

- The relationship between contrast administration and MRI-related anxiety was also evaluated.

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

- Among participants undergoing contrast-enhanced MRI, 78 (39.0%) reported anxiety, 55 (27.5%) remained neutral, and 67 (33.5%) disagreed.
- Among those undergoing non-contrast MRI, 71 (35.5%) agreed, 63 (31.5%) were neutral, and 66 (33.0%) disagreed as shown in Table 15 and Figure 4.

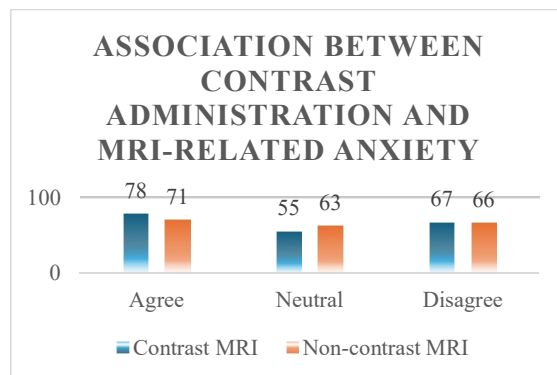
Although anxiety was reported slightly more frequently among participants receiving contrast-enhanced examinations, the association was not statistically significant ($\chi^2 = 0.879$, $df = 2$, $p = 0.644$).

Table 15. Association between contrast administration and MRI-related anxiety

Examination Type	Agree	Neutral	Disagree	Total
Contrast MRI	78	55	67	200
Non-contrast MRI	71	63	66	200

Pearson Chi-square = 0.879, $df = 2$, $p = 0.644$

Figure 4. Association between contrast administration and MRI-related anxiety



Previous MRI Familiarity and MRI-Related Anxiety

Participants' familiarity with MRI procedures before the current examination was compared with MRI-related anxiety.

No statistically significant association was identified between prior MRI familiarity and anxiety responses ($\chi^2 = 0.256$, $df = 4$, $p = 0.992$), indicating that prior exposure to MRI examinations did not

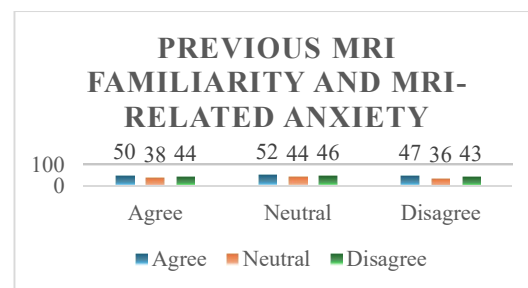
significantly influence anxiety levels in the present study population as shown in Table 16 and Figure 5.

Table 16. Previous MRI familiarity and MRI-related anxiety

Previous MRI Familiarity	Agree	Neutral	Disagree	Total
Agree	50	38	44	132
Neutral	52	44	46	142
Disagree	47	36	43	126

Pearson Chi-square = 0.256, $df = 4$, $p = 0.992$

Figure 5. Previous MRI familiarity and MRI-related anxiety



Inferential statistical analysis revealed that gender, age group, contrast administration, and prior MRI experience were not significantly associated with MRI-related anxiety in the present study ($p > 0.05$ for all comparisons).

Although MRI-related anxiety was reported by more than one-third of participants, its occurrence appeared to be distributed across demographic and examination-related categories without statistically significant differences. These findings suggest that anxiety experienced during MRI examinations may be influenced by factors other than those evaluated in the present investigation, including individual psychological characteristics, coping mechanisms, previous healthcare experiences, communication with healthcare professionals, and personal perceptions of the MRI environment.

The absence of statistically significant associations does not diminish the clinical importance of MRI-related anxiety. Rather, it indicates that anxiety may be a broadly experienced phenomenon affecting patients irrespective of age, gender, previous MRI exposure, or contrast administration. Consequently, patient-centred communication and supportive strategies should be considered for all individuals

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

undergoing MRI examinations rather than being limited to specific demographic groups.

DISCUSSION

The present study evaluated the factors influencing subject experience during Magnetic Resonance Imaging (MRI) examinations among 400 adult patients undergoing routine MRI procedures. Unlike many previous studies that primarily described the prevalence of anxiety or claustrophobia, the present investigation simultaneously assessed multiple domains of subject experience, including MRI-related anxiety, acoustic noise disturbance, dizziness, fear associated with the scanner structure, metallic taste sensation, prolonged examination discomfort, previous MRI familiarity, warm sensation, and previous claustrophobic anxiety. This comprehensive approach provides a broader understanding of patient experiences during MRI examinations and contributes additional evidence from the Indian healthcare setting.

One of the principal findings of the present study was that 37.3% of participants reported experiencing anxiety during MRI examinations. Although anxiety was one of the most commonly reported responses, most participants either reported neutral responses or disagreed that they experienced anxiety. These findings indicate that MRI-related anxiety remains a clinically relevant concern but is not experienced uniformly by all patients.

Previous investigations have consistently identified MRI anxiety as an important factor influencing patient cooperation, examination completion, and image quality. Murphy and Brunberg reported that anxiety may contribute to patient movement, incomplete examinations, and increased healthcare costs due to repeated imaging sequences. More recent studies have similarly demonstrated that psychological preparedness and effective communication significantly improve patient tolerance during MRI procedures. The findings of the present study support these observations by demonstrating that anxiety remains a common patient experience during MRI examinations, although its occurrence varies among individuals [57–60].

An important observation in the present study was that gender was not significantly associated with MRI-related anxiety ($\chi^2 = 0.392$, $p = 0.822$). Female participants demonstrated only a marginally higher proportion of anxiety than male participants, and the observed difference was not statistically significant. These findings suggest that anxiety during MRI examinations should not be considered a gender-

specific phenomenon within the present study population.

The relationship between gender and MRI-related anxiety has been inconsistently reported in the literature. Several investigators have described higher anxiety levels among female patients, whereas others have found no statistically significant gender differences after adjusting for additional psychological and clinical variables. The findings of the present investigation are therefore consistent with studies suggesting that MRI-related anxiety is influenced by multiple interacting factors rather than gender alone [61–63].

Similarly, age group was not significantly associated with MRI-related anxiety ($\chi^2 = 1.849$, $p = 0.764$). Anxiety responses were distributed relatively evenly across younger and older adult participants, indicating that age alone may not adequately predict patient experience during MRI examinations. Although previous studies have occasionally reported greater anxiety among younger adults because of unfamiliarity with medical procedures, the present findings suggest that patients across all adult age groups may experience similar levels of psychological stress during MRI examinations.

Another important finding of the present study was the absence of a statistically significant association between contrast administration and MRI-related anxiety ($\chi^2 = 0.879$, $p = 0.644$). Participants undergoing contrast-enhanced MRI demonstrated anxiety levels comparable to those undergoing non-contrast examinations. This finding suggests that administration of intravenous contrast material itself may not substantially influence patient anxiety when appropriate explanation and reassurance are provided before the procedure.

Likewise, previous familiarity with MRI examinations was not significantly associated with anxiety ($\chi^2 = 0.256$, $p = 0.992$). Although previous MRI experience has often been proposed as a factor reducing examination-related anxiety, the present findings indicate that prior exposure alone may not guarantee improved psychological comfort. Individual coping strategies, previous examination experiences, communication with healthcare professionals, and personal expectations may exert greater influence than simple familiarity with the procedure.

Evaluation of individual questionnaire domains demonstrated considerable variability in patient-reported experiences. Approximately one-third of participants agreed that MRI acoustic noise was disturbing, while a similar proportion reported neutral or disagreeing responses. This distribution

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

indicates that perception of scanner noise differs substantially between individuals. MRI acoustic noise remains an unavoidable consequence of rapidly switching gradient magnetic fields; however, individual tolerance appears to vary considerably depending on personal sensitivity, examination duration, and expectations.

Discomfort related to prolonged scan duration was another notable finding. More than one-third of participants reported discomfort associated with remaining motionless during MRI examinations, whereas another substantial proportion selected neutral responses. These findings suggest that prolonged examination time may contribute to patient discomfort even when severe anxiety is absent. Previous investigators have reported similar observations, emphasizing that prolonged immobility may increase musculoskeletal discomfort, reduce patient cooperation, and contribute to motion artefacts during image acquisition [64–66].

Responses relating to dizziness, metallic taste sensation, warm sensation, and fear associated with scanner structure were distributed relatively evenly across the three response categories. These findings suggest that such sensory experiences are neither universal nor exceptionally rare but instead vary considerably among individuals. Previous experimental investigations have similarly concluded that transient sensory perceptions associated with MRI are generally mild, self-limiting, and clinically insignificant despite being noticeable to some patients [67–69].

An important contribution of the present study is the observation that none of the demographic or examination-related variables evaluated were statistically significant predictors of MRI-related anxiety. Rather than indicating absence of anxiety, these findings suggest that psychological responses during MRI examinations are complex and multifactorial. Variables such as personality characteristics, baseline anxiety disorders, health literacy, perceived disease severity, previous healthcare experiences, social support, and communication with radiographers may have greater influence on subject experience than demographic characteristics alone. Future studies should therefore incorporate broader psychological and behavioural variables to develop more comprehensive predictive models of MRI-related anxiety.

From a clinical perspective, the present findings reinforce the importance of adopting universal patient-centred strategies rather than targeting only selected patient groups. Since anxiety and

discomfort were observed across all demographic categories, standardized pre-examination counselling, clear procedural explanations, continuous communication during image acquisition, appropriate hearing protection, comfortable patient positioning, and optimization of examination duration should be routinely implemented for all patients undergoing MRI examinations. Such interventions have the potential to improve patient cooperation, reduce motion-related image degradation, enhance diagnostic image quality, and improve overall patient satisfaction.

Strengths of the Study

The present investigation possesses several strengths. First, analysis of a relatively large sample of 400 participants provided adequate representation of adult patients undergoing routine MRI examinations. Second, inclusion of multiple MRI examination types improved the applicability of the findings to routine clinical practice. Third, evaluation of multiple domains of subject experience provided a broader understanding of MRI-related experiences than studies focusing exclusively on anxiety or claustrophobia. Finally, the analytical approach enabled assessment of associations between participant characteristics and MRI-related anxiety using standardized statistical methods.

Limitations of the Study

Certain limitations should also be acknowledged. The study was conducted at a single tertiary care centre, which may limit the generalizability of the findings to other institutions. The cross-sectional design allows identification of associations but cannot establish causal relationships. Subject experience was assessed using self-reported responses, introducing the possibility of reporting bias. Additionally, important psychological variables such as baseline anxiety disorders, educational status, socioeconomic background, coping style, and personality characteristics were not included in the present investigation and may influence patient experience during MRI examinations.

Clinical Implications

The findings of the present study provide several important implications for routine Magnetic Resonance Imaging (MRI) practice. Although demographic variables such as age and gender did not demonstrate statistically significant associations with MRI-related anxiety, more than one-third of the participants reported anxiety and discomfort during

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

MRI examinations. This observation indicates that psychological distress may occur across diverse patient groups and should not be considered exclusive to any specific demographic category.

Effective communication remains one of the simplest and most cost-effective interventions for improving subject experience during MRI examinations. Radiographers and MRI technologists should provide clear explanations regarding the purpose of the examination, expected scan duration, anticipated acoustic noise, the importance of remaining motionless, and sensations that may occur during scanning. Such communication may reduce uncertainty and improve patient confidence before image acquisition.

The present findings also emphasize the importance of maintaining continuous communication with patients throughout the MRI procedure. Informing patients regarding examination progress, remaining scan time, and expected sequence completion may reduce anxiety and improve cooperation during prolonged examinations.

Although MRI acoustic noise did not emerge as the predominant negative experience within the present study, approximately one-third of participants reported discomfort related to scanner noise. Consistent use of appropriate hearing protection, implementation of quieter pulse sequences where available, and adoption of modern noise-reduction technologies should therefore continue to be encouraged in routine MRI practice.

Similarly, discomfort associated with prolonged examination duration highlights the need for protocol optimization. Advances in parallel imaging, compressed sensing, deep learning-based image reconstruction, and artificial intelligence-assisted acceleration techniques provide opportunities to reduce acquisition time while maintaining diagnostic image quality. Implementation of these technologies may improve patient comfort and reduce motion-related image artefacts.

Overall, the findings support the integration of patient-centred care into routine MRI services. Universal application of structured patient education, effective communication, optimized examination protocols, and individualized patient support has the potential to enhance subject experience irrespective of demographic characteristics.

Recommendations for Future Research

The present study provides a foundation for future investigations evaluating patient-centred MRI practice. Several recommendations are proposed.

First, multicentre studies involving public hospitals, private diagnostic centres, and academic medical institutions should be conducted to improve the generalizability of the findings across different healthcare settings.

Second, future investigations should incorporate additional psychological variables including generalized anxiety, depression, coping strategies, personality characteristics, perceived disease severity, and health literacy to better understand determinants of MRI-related anxiety.

Third, longitudinal studies evaluating patient perceptions before, during, and after MRI examinations would provide greater insight into temporal changes in subject experience than cross-sectional investigations.

Fourth, comparative studies assessing patient experience across different MRI systems, including wide-bore scanners, open MRI systems, silent MRI technologies, and higher field strength systems, may further clarify the influence of scanner characteristics on patient comfort.

Finally, future research should evaluate the effectiveness of targeted interventions such as audiovisual education, music therapy, virtual reality-based preparation, relaxation techniques, structured communication protocols, and artificial intelligence-assisted workflow optimization in improving MRI examination tolerance.

Conclusion

Magnetic Resonance Imaging has become an indispensable diagnostic modality in modern healthcare; however, successful MRI examinations depend not only on technological excellence but also on positive patient experiences during image acquisition. The present study evaluated subject experience among 400 adult patients undergoing MRI examinations and demonstrated that MRI-related anxiety, discomfort associated with prolonged examination duration, and concerns related to the scanning environment remain important aspects of patient experience.

Inferential statistical analysis demonstrated that age, gender, contrast administration, and previous MRI familiarity were not significantly associated with MRI-related anxiety within the present study population. These findings suggest that MRI-related

Factors Influencing Subject Experience During Magnetic Resonance Imaging Examinations: A Cross-Sectional Study of 400 Adult Patients

anxiety is a multifactorial phenomenon that cannot be adequately explained by demographic or examination-related variables alone. Psychological responses during MRI examinations are likely influenced by complex interactions involving individual perceptions, previous healthcare experiences, communication with healthcare professionals, coping mechanisms, and environmental factors.

The findings highlight the importance of adopting universal patient-centred strategies rather than selectively targeting specific demographic groups. Comprehensive patient education, effective communication, reassurance throughout image acquisition, optimized examination protocols, and continued technological innovations aimed at improving patient comfort should remain integral components of MRI practice.

Overall, the present study provides valuable evidence on the subject experience during MRI examinations in the Indian healthcare setting and lays a foundation for future research exploring the behavioural, psychological, and technological determinants of patient-centred MRI services. Implementation of evidence-based interventions derived from these findings may improve patient satisfaction, reduce motion-related image degradation, enhance diagnostic image quality, and strengthen the overall quality of MRI services.

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Conflict of Interest

The authors declare that they have no competing financial or non-financial interests related to this study.

Ethical Approval

The study protocol was reviewed and approved by the Institutional Ethics Committee of NIMS University Rajasthan before commencement of participant recruitment. All participants provided written informed consent before enrolment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and subsequent amendments.

Informed Consent

Written informed consent was obtained from every participant before inclusion in the study.

Data Availability Statement

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request, subject to institutional policies and ethical requirements.

Author Contributions

Sahil Gupta: Conceptualization, methodology, data collection, investigation, statistical analysis, manuscript preparation, and final approval of the manuscript.

Dr. Mukesh Kumar Sharma: Study supervision, methodology review, critical revision of the manuscript, and final approval.

Dr. Ghalib Mirza: Scientific guidance, interpretation of results, manuscript review, and final approval.

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