RESEARCH
www.commprac.com
ISSN 1462 2815

UNDERSTANDING PATIENT KNOWLEDGE AND PERCEPTION OF MRI SCANS: INSIGHTS FROM A TERTIARY CARE HOSPITAL

Sanjay Kanth Balachandar [1], Arun Kumar Mahendran [2], Karthik Krishna Ramakrishnan [3], Sidharth AV [4]*, Chevvu Bhavya Sree [5] and Karpagam Kanadasan [6]

[1] Postgraduate Student, Department of Radio-Diagnosis, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS) Deemed University, Saveetha Nagar, Thandalam, Chennai, Email: sanjaykanth.b@gmail.com
[2] Postgraduate Student, Department of Radiodiagnosis, Vinayaka Missions Kirupananda Variyar Medical College, Seeragapadi, Salem. Email: srivariarun9000@gmail.com
[3] Associate Professor, Department of Radiology, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS) Deemed University, Saveetha Nagar, Thandalam, Chennai. Email: kkdrkr@gmail.com
[4] MBBS Student, Saveetha Medical College, Saveetha Medical College, Saveetha Nagar, Thandalam, Chennai. Email: sidharthavineeth@gmail.com
[5] Senior Resident, Department of Radio Diagnosis , Panimalar Medical College , Varadharajapuram, Chennai Outer Ring Road, Kancheepuram, Email: bhavyasreedr913@gmail.com
[6] Postgraduate Student, Department of Radio-Diagnosis, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai, Tamil Nadu - 602105, India. Email: rkkarpagam97@gmail.com

DOI: 10.5281/zenodo.11195306

Abstract:

Introduction: The comprehension of patients regarding Magnetic Resonance Imaging (MRI) is critical for their adherence and safety, which consequently enhances workflow efficiency, patient comfort, and conserves precious scanning time. Therefore, this study aimed to evaluate the awareness of patients undergoing MRI scans in terms of knowledge, perception, and safety. **Methodology**: This cross-sectional study was conducted at a tertiary care hospital in Kancheepuram district, Tamil Nadu, from February to September 2022. A cohort of 200 patients referred for MRI scans was evaluated using a questionnaire divided into four sections: Section 1 aimed to collect sociodemographic data; Section 2 focused on knowledge about MRI scans and safety; Section 3 assessed patient perception prior to the MRI scan; and Section 4 examined patient perception post-MRI scan. The questionnaire was completed by the researchers through face-to-face interviews after obtaining informed consent from the patients. **Results**: Out of the 200 patients, 15.5% were illiterate and 30.5% had completed high school. A majority (51.5%) of patients incorrectly believed that MRI utilizes harmful ionizing radiation similar to CT scans and radiography. Additionally, the study revealed that a significant proportion (22.5%, n = 45) of patients experienced claustrophobia and anxiety during the scan. **Conclusion**: This study found that a notable number of patients experienced increased pain or were uncertain about their pain levels post-diagnosis. The majority of patients encountered anxiety and claustrophobia during the MRI scan. Evaluating patient knowledge, perception, and safety concerning MRI scans is crucial for enhancing patient compliance and optimizing scanning time.

Keywords: MRI, Safety and Compliance, Claustrophobia, Anxiety, Patient Awareness, Knowledge and Perception.

INTRODUCTION

MRI has become a ubiquitous imaging modality in the radiology departments of hospitals across urban India. Despite its widespread availability, the accessibility of MRI technology remains skewed, primarily serving the middle- and upper-class populations in major cities due to its high cost. Government-run hospitals, in particular, face significant challenges in acquiring such advanced medical technologies due to limited resources [1, 2].

The safety protocols in MRI suites are of paramount importance due to the ferromagnetic nature of the equipment and the potent magnetic fields employed in its operation [2]. Negligence in adhering to these safety guidelines has led to severe, and in some cases, fatal consequences, highlighting the critical need for stringent safety measures [3]. In response, the American College of Radiology has developed comprehensive safety guidelines to mitigate risks and ensure patient safety during MRI scans [4-6].

The duration of an MRI scan, which typically ranges from 30 to 60 minutes, necessitates patient cooperation in remaining still and following breath-holding instructions, depending on the type of scan [7]. The patient's comfort and compliance are further challenged by the loud noise and potential heat generation during the scan.

Recent research has indicated that MRI during pregnancy, particularly in the second or third trimester, is generally considered safe for the fetus [8]. However, concerns persist regarding the exposure to radiofrequency fields and the loud acoustic environment during the first trimester [9].

MRI's utility spans a wide range of applications, from cranial to abdominal imaging, with ongoing advancements in pulse sequences enhancing its diagnostic capabilities [10, 11]. The long scan durations and high-pitched noise can significantly impact patient emotions, sometimes necessitating sedation or even termination of the scan due to non-compliance [12].

The interaction between healthcare providers and patients plays a crucial role in patient compliance and the overall MRI experience. Radiographers, in particular, are instrumental in providing support, care, and clear communication to guide patients through the scanning process [13]. The emotional response of patients entering the MRI scanner, including feelings of abandonment, disorientation, and fear, can lead to motion artifacts, which compromise image quality and necessitate repeated sequences [14].

Patient perception of the MRI experience can be influenced by previous encounters with the modality. Therefore, understanding patients' pre- and post-scan perceptions and maintaining effective communication between radiologists and patients are essential in mitigating adverse outcomes and enhancing the overall quality of care [15]. The aim of this cross-sectional study at Saveetha Medical College and Hospital is to assess patients' knowledge, perceptions, and safety concerns regarding MRI scans. The objectives include collecting sociodemographic data of patients undergoing MRI scans to understand the demographic distribution and its potential impact on knowledge and perceptions; evaluating patients' knowledge regarding MRI scans and safety measures to identify gaps in understanding and areas for improvement in patient education; assessing patients' perceptions and anxieties before undergoing the MRI scan to identify common concerns and misconceptions; evaluating changes in patients' perceptions after undergoing the MRI scan to assess the impact of the scanning experience on their understanding and comfort levels; determining the level of awareness among patients regarding the safety protocols and precautions associated with MRI scans; and analyzing the correlation between sociodemographic factors, knowledge levels, and patient perceptions before and after the MRI scan.

MATERIALS & METHODS

This cross-sectional study was conducted at a tertiary care hospital in Kancheepuram, Tamil Nadu, from February 1, 2022, to September 30, 2022. The study included all patients undergoing MRI scans, while those from emergency and ward departments were excluded. A comprehensive self-administered questionnaire was developed after an extensive review of relevant literature. The questionnaire consisted of four sections with a total of 19 questions. The first section aimed to collect sociodemographic data, such as age, gender, occupation, and educational status of the patients. The second section focused on assessing the patients' knowledge regarding MRI and its safety protocols. The third section aimed to understand the patients' perceptions before undergoing the MRI scan, while the fourth section sought to gauge their perceptions after the scan. The researchers themselves filled out the questionnaire forms after obtaining informed consent, during face-to-face interviews with the patients

Statistics analysis: The statistical analysis of the study was conducted using IBM SPSS Statistics Version 27. Descriptive statistics were utilized to summarize the demographic characteristics, educational background, and occupational distribution of the participants, as well as their knowledge and perceptions regarding MRI safety and function. Chi-square tests, performed using SPSS Version 27, were employed to examine the associations between patients' educational status and their knowledge regarding MRI's function and safety, as well as the relationship between patients' knowledge of the scan and their comfort during the MRI procedure. Additionally, chi-square tests were used to assess the association between patients' knowledge of MRI's function and their pain status post-scan. The level of significance was set at $p < 0.05$ for all statistical tests. The results, analyzed using SPSS Version 27, indicated significant associations between educational status and knowledge of MRI safety and function, as well as between knowledge of the scan and patient comfort.

RESULTS

Study Population:

The study involved 200 outpatients, comprising 136 males and 64 females. The participants' ages ranged from 18 to 81 years, with a mean age of 38.495 years. The age distribution was as follows: 22% (n=44) were 25 years or younger, 54.5% (n=109) were between 26 and 50 years, and 23.5% (n=47) were older than 50 years (Table 1).

Table 1: Socio demographic characteristics

Age group of patients	Frequency	Percent
≤25	44	22
26-50	109	54.5
≥51	47	23.5
Total	200	100

Occupational Distribution:

The occupational distribution of the patients showed that the largest group was employed individuals (n=40), followed by those in domestic occupations (n=36), professionals (n=36), laborers (n=33), business owners (n=28), and students (n=27). Among the female patients, the majority were engaged in domestic occupations (n=36), while male patients were primarily employed in various sectors, including labor (n=26), business (n=27), and education (n=22) (Table 2).

Table 2: Occupational distribution of the patients

Occupation	Frequency	Percent
Employee	40	20
Labourer	33	16.5
Business	28	14
Domestic	36	18
Student	27	13.5
Professional	36	18
Total	200	100

Educational Background:

The educational background of the patients varied, with most having completed high school (n=61) or university (n=59). A smaller number had obtained a master's degree (n=9), completed primary school (n=25), or secondary school (n=15). Notably, 31 patients were illiterate (Table 3).

Table 3: Educational background of the patients

Educational Status	Frequency	Percentage
Illiterate (upto class 1)	31	15.5
Graduated from primary school (upto class 7)	25	12.5
Graduated from secondary school (upto class 10)	15	7.5
Graduated from high school (upto +12)	61	30.5
University Graduate (bachelor)	59	29.5
Master's Degree	9	4.5
Total	200	100

MRI Safety Knowledge:

Regarding the safety of MRI, 51.5% (n=103) of the patients incorrectly believed that MRI uses harmful ionizing radiation, similar to radiography and CT scans. In contrast, 41.5% (n=83) correctly identified MRI as safe due to its use of non-ionizing radiation. However, 7% (n=14) were unsure about the nature of MRI radiation (Table 4).

Table 4: Safety of MRI of the patients

Does MRI use harmful ionising radiation as in radiography and CT?	Frequency	Percentage
Don't know	14	7
Yes	103	51.5
No	83	41.5
Total	200	100

Function of MRI:

When asked about the function of MRI, 70.5% (n=141) of patients correctly identified it as a diagnostic tool, while 7.5% (n=15) mistakenly thought it was used for treatment. The remaining 22% (n=44) were uncertain about its function (Table 5).

Table 5: Patients knowledge on Function of MRI:

Will MRI diagnose or treat your disease?	Frequency	Percentage
Don't know	44	22
Diagnose	141	70.5
Treat	15	7.5
Total	200	100

MRI Safety During Pregnancy:

Concerning MRI safety during pregnancy, only 44% (n=88) of patients correctly believed that MRI is safe during pregnancy under certain conditions. In contrast, 52% (n=104) incorrectly thought that pregnant patients should not undergo MRI scans, and 4% (n=8) were unsure about MRI safety during pregnancy (Table 6).

Table 6: Safety of MRI During Pregnancy

Can a pregnant patient undergo MRI scan at any time?	Frequency	Percentage
Don't know	8	4
Yes	88	44
No	104	52
Total	200	100

Patient Perception During MRI Scan:

In terms of patient perception during the MRI scan, 10.5% of patients reported experiencing only a headache, 9.5% experienced anxiety along with claustrophobia, isolation, and headache, and 17.5% had a positive perception, feeling relaxed during the scan. Other reported experiences included anxiety (5.5%), claustrophobia with isolation and headache (1%), and isolation with headache (4.5%) (Figure 1).

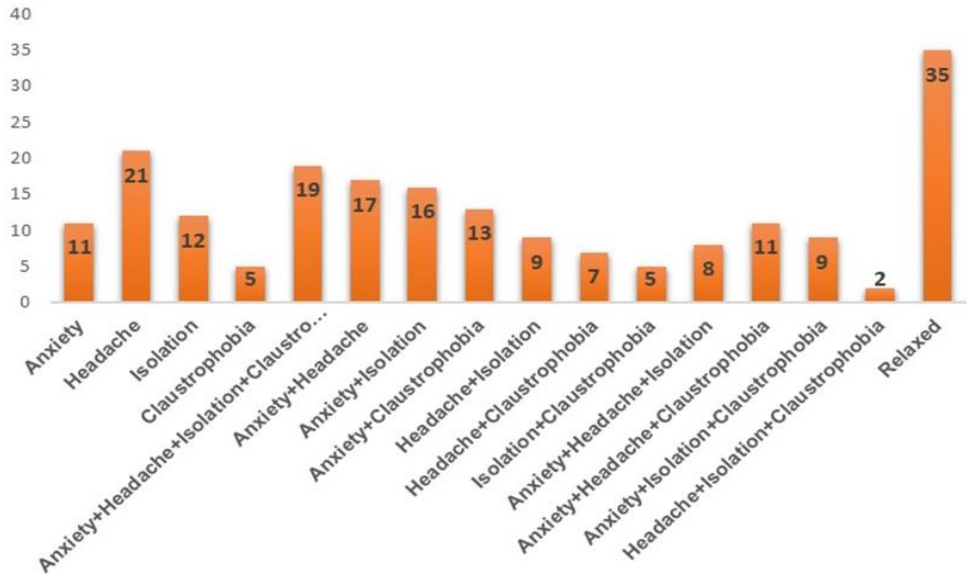

Figure 1: During the MRI scan, patient perceptions varied: 10.5% reported experiencing only headaches; 9.5% encountered a combination of anxiety, claustrophobia, isolation, and headaches; 17.5% had a positive experience, feeling relaxed throughout the procedure. A smaller percentage of participants reported singular discomforts, with 5.5% feeling anxious, 1% experiencing claustrophobia in addition to isolation and headaches, and 4.5% feeling isolated while also suffering from headaches

Pain Status Post-Scan:

Regarding pain status post-scan, 82% of patients reported no change, 9% reported an increase, and another 9% reported a decrease in their pain status (Figure 2).

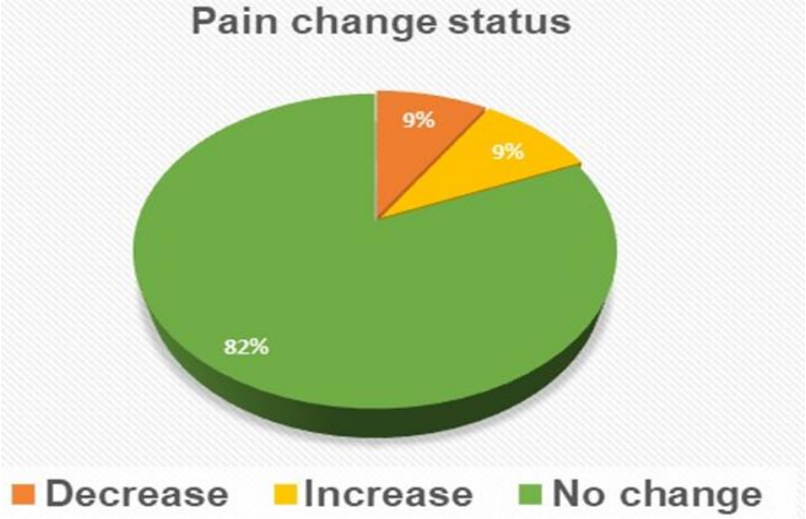

Figure 2: Pain status post-scan: 82% of patients reported no change, 9% reported an increase, and another 9% reported a decrease in pain

Associations:

The study found significant associations between patients' educational status and their knowledge regarding MRI's function in diagnosis or treatment, as well as its safety in terms of ionizing radiation. Additionally, there was a significant association between patients' knowledge of the scan and their comfort during the MRI, indicating that patients who were educated about the scan by clinicians were more comfortable undergoing it. Lastly, there was a significant association between patients' knowledge of MRI's function and their pain status post-scan, with those understanding its diagnostic function reporting no change in pain, while those who thought it was for treatment reported changes in pain status (Table 7).

Table 7: Association between clinician derived knowledge on MRI and comfort on undergoing the scan by the patient

Did the clinician educate you about the scan before taking it?	Are you comfortable in taking the scan?		Total
	Yes	No	
Yes	112	28	140
No	36	24	60
Total	148	52	200

DISCUSSION

Previous research on patients' perceptions and knowledge of MRI scans has been somewhat limited, primarily focusing on the experiences and understanding of the procedure [15]. This study expands on this by assessing not only the knowledge and perceptions of MRI and its safety but also the associations between patients' perceptions, their sociodemographic characteristics, and their understanding of MRI safety [15].

The current study included 200 patients, with a majority (68%, n=136) being male and the remaining (32%, n=64) female. The age distribution showed that most participants (54.5%, n=109) were between 25 and 50 years old, followed by those between 50 and 75 years (23.5%, n=47) and those under 25 years (22%, n=44). The range of experiences reported varied from feelings of relaxation during the scan to various

emotional responses, which may have been influenced by prior knowledge of MRI and the scanning experience, including the confined space of the scanner.

This study explored the perception of pain relief associated with magnetic resonance imaging (MRI) and aimed to understand the public's awareness of MRI. The research included a prospective survey of 302 patients (107 men and 195 women, average age 43.11±15.18 years) undergoing MRI at a radiology clinic. The findings revealed that almost half of the patients had low levels of education, with women being less educated than men. The majority believed that MRI would diagnose their condition. Among the participants, 209 reported no change in pain levels before and after MRI, 30 experienced increased pain, 62 reported decreased pain, and one did not respond. Notably, most patients who reported a decrease in pain had undergone lumbar or cervical MRI [16].

Research by Hamd et al. (2023), MRI exams may cause patients to feel anxious before or during the scan, which affects the scanning outcome and leads to motion artifacts. Adequate preparation can effectively alleviate patients' anxiety before the scan. We aimed to assess the effect of different preparation methods on MRI-induced anxiety: We conducted a prospective randomized study on MRI patients between March and May 2022. This study divided 30 patients into two groups: the control group, which received routine preparation (RP), and the experimental group, which received video preparation (VP). Authors used the State-Trait Anxiety Inventory (STAI) to measure anxiety levels before and after the interventions. We assessed patients' self-satisfaction after the scan: After preparation, VP (STAI mean = 10.7500) and RP (STAI mean = 12.7857), we observed a significant association between the pre- and post-STAI results in VP ($p = 0.025$). The effects of both methods in decreasing anxiety were more significant for first-timers ($p = 0.009$ in RP/0.014 in VP). Authors noted high satisfaction levels for both forms of preparation. The VP technique was superior in reducing patient anxiety, especially in first-time MRI patients. Similarly, patients in this current study experienced anxiety and claustrophobia, which could be attributed to psychological factors, the narrowness of the scanner bore, acoustic noise, and the duration of the scan [17].

In the current study, there was also a significant association between educational status and the understanding of MRI's safety compared to CT scans and radiography. About half of the literate patients believed that MRI emits harmful ionizing radiation, similar to CT scans and radiography. In contrast, most patients who understood that MRI does not emit harmful ionizing radiation were high school graduates (29 out of 61) and university graduates (21 out of 59). Illiterate patients and those with primary school education were more likely to be unsure about MRI's safety.

Furthermore, a recent study conducted semi-structured interviews with 28 patients and employed qualitative content analysis to interpret the data. The primary observation was that patients frequently experienced a sense of losing control during the examination, characterized by feelings of being trapped, disoriented in time, and uncertain. While many patients did not have a definitive preference for either breath-hold technique, approximately half showed a tendency to favor self-initiated breath-hold, as it was perceived as easier and less stressful. Conversely, those who preferred the radiographer-directed technique felt more reassured by entrusting the responsibility to the professional. In general, patients acknowledged the significance of acquiring high-quality images. The study concluded that magnetic resonance

examinations could induce feelings of loss of control, yet not all patients desired active participation in the process, with some opting to rely on the radiographer. These insights can guide radiographers in tailoring and enhancing patient care during magnetic resonance examinations [18]. Additionally, the patients reported experiencing anxiety or claustrophobia during the scan, which corroborates previous findings and our study that identified anxiety and claustrophobia as common reactions to MRI scans. These results indicate that a substantial portion of patients undergoing MRI scans experience feelings of panic or anxiety in the MRI environment

The study also explored patients' knowledge regarding MRI during pregnancy. Out of 200 patients, 88 believed that MRI is safe during pregnancy, while 104 considered it harmful. This highlights a lack of awareness among patients about the risks and benefits of MRI, as it does not pose the same hazards as CT scans or other radiographic procedures.

In conclusion, this study underscores the need for improved patient education regarding MRI and its safety to address misconceptions and enhance patient comfort and compliance during the scanning process (Williams & Thompson, 2023).

CONCLUSION

The findings highlight a significant gap in understanding among patients, particularly regarding the non-ionizing nature of MRI and its safety compared to other radiographic techniques. The study also underscores the influence of educational status on patients' understanding of MRI's function and safety, as well as the association between patients' knowledge and their comfort during the scanning process. Anxiety and claustrophobia were identified as common responses to the MRI environment, emphasizing the need for effective communication and patient education to alleviate fears and enhance the overall experience. Additionally, the study revealed misconceptions about MRI during pregnancy, indicating a need for targeted information to ensure patient safety and informed decision-making. Overall, the study suggests that improving patient education and addressing misconceptions about MRI can lead to better patient compliance, reduced anxiety, and more efficient scanning processes, ultimately enhancing the effectiveness of MRI as a diagnostic tool.

Acknowledgements

We would like to express our sincere gratitude to the patients who participated in this study, as their cooperation and willingness to share their experiences were instrumental in the success of this research. We also extend our appreciation to the radiology department staff at the tertiary care hospital in Kancheepuram, Tamil Nadu, for their support and assistance throughout the data collection process.

Conflict of Interest: None

Funding Sources: None

References

1) Prasad, Amit. Social Adoption of a Technology: Magnetic Resonance Imaging in India. International Journal of Contemporary Sociology. 2006 Jan;43.327-335

2) Shen FX, Wolf SM, Bhavnani S, Deoni S, Elison JT, Fair D, et al. Emerging ethical issues raised by highly portable MRI research in remote and resource-limited international settings. Neuroimage. 2021 Sep;238:118210.

3) Piersson AD, Gorleku PN. A national survey of MRI safety practices in Ghana. Heliyon. 2017 Dec 28;3(12):e00480

4) Hussain S, Mubeen I, Ullah N, Shah SSUD, Khan BA, Zahoor M, Ullah R, Khan FA, Sultan MA. Modern Diagnostic Imaging Technique Applications and Risk Factors in the Medical Field: A Review. Biomed Res Int. 2022 Jun 6;2022:5164970.

5) Watson RE Jr, Tesfaldet M, Warren J, Hoff MN. MR Imaging Safety Events: Analysis and Improvement. Magn Reson Imaging Clin N Am. 2020 Nov;28(4):593-600.

6) American College of Radiology (ACR) (2024). MRI Safety Guidelines. https://www.acr.org/-/media/ACR/NOINDEX/Radiology-Safety/MR-Safety/Draft-ACR-Manual-on-MR-Safety.pdf

7) Lockwood P, Burton C, Woznitza N, Shaw T. Assessing the barriers and enablers to the implementation of the diagnostic radiographer musculoskeletal X-ray reporting service within the NHS in England: a systematic literature review. BMC Health Serv Res. 2023 Nov 16;23(1):1270.

8) Gatta G, Di Grezia G, Cuccurullo V, Sardu C, Iovino F, Comune R, Ruggiero A, Chirico M, La Forgia D, Fanizzi A, Massafra R, Belfiore MP, Falco G, Reginelli A, Brunese L, Grassi R, Cappabianca S, Viola L. MRI in Pregnancy and Precision Medicine: A Review from Literature. J Pers Med. 2021 Dec 23;12(1):9.

9) Zarei S, Vahab M, Oryadi-Zanjani MM, Alighanbari N, Mortazavi SM. Mother's Exposure to Electromagnetic Fields before and during Pregnancy is Associated with Risk of Speech Problems in Offspring. J Biomed Phys Eng. 2019 Feb 1;9(1):61-68.

10) Yoon JH, Nickel MD, Peeters JM, Lee JM. Rapid Imaging: Recent Advances in Abdominal MRI for Reducing Acquisition Time and Its Clinical Applications. Korean J Radiol. 2019 Dec;20(12):1597-1615.

11) Zarei S, Vahab M, Oryadi-Zanjani MM, Alighanbari N, Mortazavi SM. Mother's Exposure to Electromagnetic Fields before and during Pregnancy is Associated with Risk of Speech Problems in Offspring. J Biomed Phys Eng. 2019 Feb 1;9(1):61-68.

12) Bolderston A. Patient Experience in Medical Imaging and Radiation Therapy. J Med Imaging Radiat Sci. 2016 Dec;47(4):356-361

13) Ajam AA, Tahir S, Makary MS, Longworth S, Lang EV, Krishna NG, Mayr NA, Nguyen XV. Communication and Team Interactions to Improve Patient Experiences, Quality of Care, and Throughput in MRI. Top Magn Reson Imaging. 2020 Jun;29(3):131-134.

14) Alahmari DM, Alsahli FM, Alghamdi SA, Alomair OI, Alghamdi A, Alsaadi MJ. Assessment of Patient Knowledge Level Towards MRI Safety Before the Scanning in Saudi Arabia. Int J Gen Med. 2022 Jul 28;15:6289-6299.

15) Zheng Y, Wang Y, Liu X, Zhang L, Zhang H, Liu Jet al. Study on the positivity rate and influencing factors of anxiety in pregnant women during the first fetal magnetic resonance examination: A cross-sectional study. PLoS One. 2024 Jan 22;19(1):e0297177.

16) Duymuş M, Orman G, Asal N, Avcu S. Magnetic Resonance Imaging Perception of the Society in Kars: A Local StudSy. Pol J Radiol. 2016 Jan 25;81:29-33

17) Hamd ZY, Alorainy AI, Alrujaee LA, Alshdayed MY, Wdaani AM, Alsubaie AS, et al. How Different Preparation Techniques Affect MRI-Induced Anxiety of MRI Patients: A Preliminary Study. Brain Sci. 2023 Feb 27;13(3):416.

18) Funk E, Thunberg P, Anderzen-Carlsson A. Patients' experiences in magnetic resonance imaging (MRI) and their experiences of breath holding techniques. J Adv Nurs. 2014 Aug;70(8):1880-90.