Patients’ perceptions and attitude towards MRI safety in Asir Region, Saudi Arabia

Purpose: To assess the knowledge and attitudes of Saudi patients toward the safety of magnetic resonance imaging (MRI).

Methods: A cross-sectional study was conducted on 142 Saudi patients at King Khalid hospital, Asir, Saudi Arabia. Data were collected using a self-questionnaire based on MRI safety issues gained from the literature. The questionnaire was divided into two sections, one containing the respondents’ sociodemographic information and the other assessing their knowledge and attitudes toward participating in MRI.

Results: A total of 142 patients responded to the survey, and their average age was 31.5 ± 4 years. The majority were married and held a bachelor’s degree. The mean knowledge score regarding MRI safety was 0.29 ± 0.25, which reflects poor knowledge, whereas the attitude score was 0.67 ± 0.20, reflecting a moderately positive attitude. Awareness and attitude among patients improved as education levels increased. Finally, only 53.5% of the respondents were aware of the noise produced by the MRI scanner.

Conclusion: This study demonstrated that the awareness of MRI safety among patients in the Asir Region is poor, although they showed positive attitudes toward the issue. Thus, education is necessary for patients to improve awareness of MRI safety to facilitate MRI examinations, which will help decrease scan time and image artefacts.

Keywords: perceptions, attitudes, MRI safety, awareness, patients

Introduction

Magnetic resonance imaging (MRI) is a non-invasive imaging tool that generates 3D images with superior diagnostic, anatomical, and physiological information of the body. MRI does not use ionizing radiation, as in CT and general radiology, making it a useful tool for follow-up appointments regarding disease without exposing the body to hazardous radiation.

The basic MRI principle relies primarily on the technique that excites and records changes in the direction of the rotational axis of hydrogen nuclei within the water molecules found in all the tissues of the body. Therefore, MRI is the perfect diagnostic tool for the joints, brain, breast, and other soft tissues of the body due to its high soft tissue contrast resolution compared with that of other imaging methods. This superior resolution gives the opportunity to obtain some angiographic images without the need for contrast enhancement, unlike CT and conventional angiography.

It was reported that patient hazards during such examinations could result from MRI’s strong static magnetic field, the time varying dynamic gradient, the radiofrequency field (RF), or the high acoustic noises during MRI scan. To ensure the
safety of patients and health workers, the “foundational
American College of Radiology White Paper on MR
Safety” was issued in the year 2002.5

The principles of MR Safe Practice Guidelines are intention-
ally applied to patients as well as diagnostic settings,
research subjects, and health care personnel safety and for all MRI
settings.6 The main concern in MRI is its strong static magnetic
field from the highly powered magnet, which was reported to cause
serious bioeffects to patients, operators, or the machine.7–9 There-
fore, a number of considerations must be taken before beginning
an MRI scan, and patients should be aware of safety information.

The need for documented guidelines on MR safety
practices emerged from a growing awareness of the MR
environment’s potential risks that involve patients, per-
sonnel, and equipment. In previous studies, some patients
have reported a twitching sensation during MRI examina-
tions, nerve stimulation, and burns.10,11 Additionally, claustrophobia
has also been reported.12 Patients suffering from claustrophobia
will struggle to endure the excessively long scan time within the MRI
machine.

Furthermore, a patient’s lack of knowledge regarding
MRI examination may lead to anxiety or the inability to
remain still during the exam, resulting in motion artifact
and insufficient image quality. Therefore, the primary con-
cern of this study was patient awareness about MR safety
hazards, which is crucial to ensure proper and safe MRI
examination, especially with the growing indications for
MRI examinations. The ultimate aim of this study was to
assess patient perceptions and attitudes toward MRI safety
in the Asir Region, Saudi Arabia.

Patients and Methods

Survey Assessment and Administering
This was a descriptive, cross-sectional study conducted to
assess the knowledge and attitudes of patients toward MRI
safety. Study approval was obtained from the ethical com-
mittee of King Khalid University. An electronic question-
naire was designed to contain variables related to
knowledge of and attitudes toward MRI safety issues.
The survey was generated on Google Surveys and was built as close-ended “Yes/No” answers.

The study was conducted in Asir Central Hospital and
Armed Forces Hospital in the Kingdom of Saudi Arabia. Participants were chosen using the convenience sampling
method from February to March 2021. They were asked to
fill out the electronic questionnaire before starting the MRI
examination and were told to answer the questionnaire
individually. A total of 142 responses were received.

The study population contained a spectrum of patients
with different levels of education, including primary
school, middle school, high school, bachelor’s degrees,
and diplomas. Only four patients had master’s degrees.
All the participants were divided into five different age
groups. The survey contained independent variables,
which included sociodemographic characteristics such as
gender, marital status, and education level, whereas the
dependent variables included questions related to the
patient’s awareness of and attitudes toward MRI safety.

Data Analyses
The data were analyzed and interpreted using the statistical
software SPSS version 22.0 (IBM Corporation, Armonk,
NY). The reliability of the questions was estimated using
Cronbach’s alpha, which measured 75.6. The frequency and
percentage of participants’ responses were estimated.
Descriptive statistics was used to estimate the means of
score knowledge and attitude across gender, age groups,
and educational status. A chi-square test was applied to find
an association between claustrophobia and gender. The level
of significance was set at 0.05. Finally, the number of correct
responses was calculated to assess the mean score of attitude
and level of knowledge among the participants.

Results
The questionnaire was sent to 250 patients, and 142 sheets
were returned, a response rate of 56.8%. The evidence of
internal consistency for the questions was 75.6%, indicat-
ing the reliability of the instrument.

Table 1 shows the socio-demographics of the partici-
pants. Of the 142 patients, there were 103 (72.5%) men
and 39 (27.5%) women. Participants of 20–29 years were
the most populated group (27.5%), followed by those aged
40–49 years (27.2%). There were only four patients aged
<20 years (2.8%). In the realm of education level, most of
the patients had a bachelor’s degree 68 (47.9%), followed
by a diploma, higher secondary school, and primary and
middle schools. Lastly, patients with master’s degrees
were the least common (2.8%).

With regard to participants’ history of claustrophobia
(Figure 1), 83.6% (n=56) of females has claustrophobia,
while 16.4% (n=11) of males had history of claustropho-
bia. Therefore, claustrophobia in females was significantly
higher than males (p-value= 0.005).
Table 1 Social Characteristics of Participants

| Variables          | Frequency | Percent % |
|--------------------|-----------|-----------|
| Gender             |           |           |
| Male               | 103       | 72.5      |
| Female             | 39        | 27.5      |
| Age groups         |           |           |
| < 20 years         | 4         | 2.8       |
| 20–29 years        | 39        | 27.5      |
| 30–39 years        | 33        | 23.2      |
| 40–49 years        | 34        | 23.9      |
| 50–59 years        | 28        | 19.7      |
| > 60 years         | 4         | 2.8       |
| Average age = 31 ± 4 years | | |
| Marital status     |           |           |
| Single             | 44        | 31.0      |
| Married            | 98        | 69.0      |
| Level of education |           |           |
| Primary & middle school | 16       | 11.3      |
| Higher secondary school | 26      | 18.3      |
| Diploma            | 28        | 19.7      |
| Bachelor’s degree  | 68        | 47.9      |
| Master’s degree    | 4         | 2.8       |

Knowledge

The first set of questions (1–11) aimed to assess the MRI knowledge of patients, and Table 2 shows the distribution and percentages of correct and incorrect responses to each question. The awareness of the patients toward preparation, types, differences between ionizing and non-ionizing radiations, differences between MRI compatible and incompatible devices, and the adverse reactions of MRI contrast agents were 115 (81), 113 (79.6%), 126 (88.7), and 121 (85.2%), respectively (Table 2). Furthermore, the patients showed satisfactory knowledge toward the production of noise from MRI 76 (53.5%). A total of 114 (80.3%) and 130 (91.5%) of respondents believed incorrectly that pregnant women could be scanned by MRI and given contrast agents, respectively (Table 2). The knowledge score increased in single participants compared to the married ones (0.37 vs 0.21), and the score increased in those who had Bachelor’s degree than the other ones. The knowledge score showed no difference among age groups and gender as shown in Table 3.

Attitude

The remaining questions (12–17) assessed the attitudes of patients toward MRI safety. The patients showed positive attitudes toward recognizing the MRI safety procedures (70.4%), screening of family members before entering the scan room (66.2%), questioning children in the presence of parents or guardians (80.3%), and completing the questionnaires before entering the MRI room (47.9%). In addition, the patients responded with positive attitudes toward the technologist for explaining the MRI procedure (66.2%), assuring and monitoring the patients at all times (71.8%), and caring for patient during the procedure (69%), as shown in Table 4. The mean attitude score was 0.67 ± 0.20. The attitude score increased in Bachelor educational level compared to Diploma and secondary schools (Table 5).

Discussion

The aim of this study was to assess levels of knowledge and attitudes toward MRI safety among patients in Saudi Arabia. The findings showed that the respondents had poor knowledge about MRIs, which might be attributed to limited background recognition for MRI safety and protection. In addition, patients were asked to do MRI examinations and were told they should be aware of the relevant safety issues.

Furthermore, this study showed that most of the patients had read or heard about the MRI safety procedures (70.4%). In contrast, 81% responded that they were not aware of the patient preparation before the MRI.
Table 2 Knowledge of Patients Towards MRI Safety

| Questions                                                                 | n (%)     |
|---------------------------------------------------------------------------|-----------|
| Q1: Are you aware of the patient preparation guidelines before MRI procedures? |           |
| Yes                                                                       | 27 (19)   |
| No                                                                        | 113 (81)  |
| Q2: Are you aware of the MRI zones?                                       |           |
| Yes                                                                       | 100 (70.4%) |
| No                                                                        | 42 (29.6%)  |
| Q3: Do you know the types of radiation used in MRI?                        |           |
| Yes                                                                       | 29 (20.4%) |
| No                                                                        | 113 (79.6%)  |
| Q4: Do you know the difference between ionizing and non-ionizing radiation? |           |
| Yes                                                                       | 16 (11.3%) |
| No                                                                        | 126 (88.7%)  |
| Q5: Do you know the difference between MRI-compatible and MRI-incompatible devices? |           |
| Yes                                                                       | 21 (14.8%) |
| No                                                                        | 121 (85.2%)  |
| Q6: Are you aware of the noise produced by the MRI scanner?                |           |
| Yes                                                                       | 76 (53.5%) |
| No                                                                        | 66 (46.5%)  |
| Q7: If there are no patients, do you think that the MRI scanner is on?     |           |
| Yes                                                                       | 44 (31.0%) |
| No                                                                        | 98 (69.0%)  |
| Q8: Do you know the adverse reactions to MRI contrast agents?             |           |
| Yes                                                                       | 34 (23.9%) |
| No                                                                        | 108 (76.1%)  |
| Q9: Are you aware of why patients undergoing MRI with contrast agents must have their creatinine levels (glomerular filtration rate or GFR) checked? |       |
| Yes                                                                       | 45 (31.7%) |
| No                                                                        | 96 (67.6%)  |
| Q10: Can a pregnant woman be scanned by MRI?                              |           |
| Yes                                                                       | 28 (19.7%) |
| No                                                                        | 114 (80.3%)  |
| Q11: Can a pregnant woman be giving an MRI contrast agent?                 |           |
| Yes                                                                       | 12 (8.5%)  |
| No                                                                        | 130 (91.5%)  |

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12 (8.5%)

130 (91.5%)

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patients, and 88.6% did not recognize the difference between ionizing and non-ionizing radiation. Additionally, 76.1% of the participants did not recognize the adverse reactions of MRI contrast agents. Notably, 53.5% were aware of the noise produced by the MRI scanner. The responses of the participants reflected low levels of patient knowledge regarding adverse reactions to MRI contrast agents, the difference between ionizing and non-ionizing radiation, and exposure of pregnancies to MRI. Furthermore, the patients lacked knowledge of the difference between MRI-compatible and MRI-incompatible devices, and patient preparation guidelines before MRI procedures. However, the majority had read or heard about MRI safety procedures.

Approximately 88.7% of respondents did not recognize the difference between ionizing and non-ionizing radiation, and 79.6% did know the type of radiation used in MRI. This is not surprising; in a previous study, the majority (85%) of health care professionals in the Kingdom of Saudi Arabia and responded incorrectly that ionizing radiation is used for brain MRI in larger amounts than thorax X-rays. Another study reported poor knowledge about radiation exposure among radiographers, interns, and resident doctors.

Table 3 The Total Knowledge Score Against Various Socio-Demographic Data

| Variables                  | Mean Knowledge Score |
|----------------------------|----------------------|
| Gender                     |                      |
| Male                       | 0.28 ± 0.26          |
| Female                     | 0.31 ± 0.25          |
| Age groups                 |                      |
| 20–29 years                | 0.35 ± 0.35          |
| 30–39 years                | 0.30 ± 0.25          |
| 40–49 years                | 0.20 ± 0.15          |
| 50–59 years                | 0.26 ± 0.19          |
| Marital status             |                      |
| Single                     | 0.37 ± 0.33          |
| Married                    | 0.21 ± 0.31          |
| Education level            |                      |
| Primary & middle school    | 0.19 ± 0.13          |
| Higher secondary school    | 0.27 ± 0.26          |
| Diploma                    | 0.27 ± 0.23          |
| Bachelor                   | 0.38 ± 0.34          |

Overall mean knowledge score = 0.29 ± 0.25
Table 4 Assessment of Study-Participant Attitudes About MRI Safety

| Questions                                                                 | n(%) |
|---------------------------------------------------------------------------|------|
| Q12: Have you had done an MRI scan before?                                |      |
| Yes                                                                       | 100% |
| No                                                                        | 0    |
| Q13: Have you read or heard about the MRI safety procedures?              |      |
| Yes                                                                       | 100 (70.4%) |
| No                                                                        | 42 (29.6%) |
| Q14: Do you think family members should be screened before entering the scan room? |      |
| Yes                                                                       | 94 (66.2%) |
| No                                                                        | 48 (33.8%) |
| Q15: Do you think children should be questioned in the presence of parents or guardians? |      |
| Yes                                                                       | 114 (80.3%) |
| No                                                                        | 28 (19.7%) |
| Q17: Did the technologist assure you that you would be monitored at all times? |      |
| Yes                                                                       | 102 (71.8%) |
| No                                                                        | 40 (28.2%) |

Consistently, Alghamdi et al found that Saudi patient knowledge in Tabuk regarding the zoning system and type of radiation was extremely limited. Additionally, other studies have reported that participants believed incorrectly that MRIs and ultrasounds do not depend on ionizing radiation, whereas others stated that MRIs and ultrasounds produce ionizing radiation. The responses of the participants reflected low levels of knowledge regarding the types of and differences between ionizing and non-ionizing radiation in MRI.

The present study showed that 81% of participants stated that they did not know patient preparation guidelines for MRI procedures. This result was attributed to their insufficient knowledge about MRI investigation, about which many of them might never before have been questioned. These findings showed satisfactory attitudes in screenings of family members and caring for children before entering the MRI scan room. In addition, they revealed satisfactory attitudes toward the role of MRI technologists in caring for patients undergoing MRI procedures. Elsewhere, Alghamdi and Shrestha reported similar findings. Furthermore, it was reported that MRI technologists must keep patients safe and be capable of assessing MRI safety, patients’ conditions, and compatibility of medical devices. This increases the need for patients to understand MRI examinations, which in most cases require preparations to improve image quality.

This study shows that knowledge of MRI safety is not affected by gender differences. Beyond this, knowledge scores increased in patients whose ages were less than 29 years compared with the other groups. Interestingly, the single patients achieved higher knowledge scores than the married ones. There has been a lack of studies concerning the awareness of MRI among different gender and age groups. In addition to this, the knowledge scores were not different in relation to the educational statuses of the participants. In contrast, Hossen et al., reported a statistically significant association between knowledge and educational status of patients. They stated that the educational statuses of the patients affected their knowledge of MRI hazards.

Without giving sufficient knowledge to the patients, the MRI examination would not easily be able to produce highly diagnosable image quality or to prevent potential hazards. Therefore, education regarding MRI is crucial in increasing general knowledge of MRI safety.

Table 5 The Total Attitude Score Against Various Socio-Demographic Data

| Variables | Mean Attitude Score |
|-----------|---------------------|
| Gender    |                     |
| Male      | 0.6581 ± 0.22       |
| Female    | 0.68 ± 0.19         |
| Age groups |                   |
| 20–29 years | 0.66 ± 0.19       |
| 30–39 years | 0.67 ± 0.23       |
| 40–49 years | 0.66 ± 0.21       |
| 50–59 years | 0.68 ± 0.18       |
| > 60 years  | 0.64 ± 0.25        |
| Marital status |           |
| Single     | 0.71 ± 0.19        |
| Married    | 0.65 ± 0.21        |
| Education level |       |
| Primary & middle school | 0.59 ± 0.24 |
| Higher secondary school | 0.69 ± 0.18 |
| Diploma     | 0.66 ± 0.21        |
| Bachelor's degree | 0.71 ± 0.18 |

Mean attitude score = 0.67 ± 0.20
Limitations
This study faced several problems, as it was a single-center study without a large sample size. Thus, future studies are recommended to include a wider, more diverse population for the generalization and validation of the present results. In addition, this study included only the patients, so further studies are needed to compare patients’ knowledge and attitudes with those of health care providers. For this reason, international study may be needed to examine the influence of MRI informational programs through social media, radio, and television to increase patients’ knowledge of MRI safety.

Conclusion
Although the majority of patients have heard and read about MRI, heightened awareness is still lacking. Naturally, disseminating more information about MRI safety would contribute to predicting potential risks. In this note, the findings of our study highlighted the awareness of patients toward issues of MRI safety. More generally, patients should be informed about MRI exams, and useful improvements could be provided through educational interventions.

Ethics Approval and Informed Consent
Written informed consent was obtained from each participant prior to the commencement of the questionnaire responses, as requested by the Research Ethics Committee at King Khalid University (ECM#2021-3504). “All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the Helsinki declaration.”

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Author Contributions
All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval for the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure
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