International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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Public Awareness and Education on Radiation Risks during Pregnancy

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International Journal of Science and Research Archive, 2025, 17(01), 261-268

Publication history: Received on 25 August 2025; revised on 05 October 2025; accepted on 07 October 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.17.1.2661

Abstract

Background: Radiation exposure during pregnancy is a critical concern due to its potential harmful effects on fetal development. While healthcare professionals play a vital role in ensuring radiation safety, their level of awareness significantly influences patient protection. This study aims to assess the awareness and understanding of radiation risks during pregnancy among radiology students and to highlight the importance of education in promoting safe imaging practices.

Methods: A cross-sectional, survey-based study was conducted from **[January 2025 – July 2025]**among radiology students using a structured questionnaire comprising multiple-choice questions related to types of radiation, imaging safety, fetal risks, radiation protection measures, and regulatory guidelines. The responses were analyzed to evaluate knowledge levels and identify areas requiring educational reinforcement.

Results: The study revealed a high level of awareness among participants regarding the risks of ionising radiation during pregnancy, with 82% identifying it as the most harmful type. Ultrasound was correctly chosen by 92.1% as the safest imaging modality for pregnant patients. Most students (67.3%) recognized multiple fetal risks such as miscarriage, birth defects, and developmental delays due to radiation exposure. Additionally, 88% identified CT scans as the imaging technique posing the highest risk during pregnancy. A strong understanding of radiation safety practices was observed, with over 90% correctly answering questions related to shielding, patient protocols, and the ALARA principle. However, some misconceptions persisted regarding the effects of non-ionising radiation and communication strategies.

Conclusion: The findings indicate that radiology students possess a substantial understanding of radiation risks during pregnancy and demonstrate good awareness of safe imaging practices. Nonetheless, continued education is necessary to address residual misconceptions, particularly regarding non-ionising radiation and patient counseling. Enhancing awareness through targeted educational programs will contribute significantly to maternal and fetal safety in radiologic practice.

Keywords: Radiation Risks; Pregnancy; Public Awareness; Radiology Students; Radiation Safety; Imaging; ALARA; Fetal Exposure; Survey Study

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1. Introduction

Medical imaging plays a critical role in the diagnosis and management of various clinical conditions. However, its use during pregnancy raises important safety concerns, particularly when it involves ionizing radiation, such as X-rays, computed tomography (CT), and nuclear medicine procedures. Ionizing radiation has sufficient energy to cause damage at the cellular level, potentially resulting in teratogenic, carcinogenic, or mutagenic effects on the developing fetus.[1]

The fetal sensitivity to radiation depends on the gestational age at the time of exposure, with the period of organogenesis (2–15 weeks of gestation) being the most vulnerable. Radiation doses above 100 milligray (mGy) during this stage may increase the risk of developmental anomalies, growth restriction, or neurological deficits. Even lower doses (<50 mGy), though generally considered safe, can create psychological stress in pregnant patients due to poor understanding of actual risks.[2]

Public awareness and understanding of radiation safety—especially during pregnancy—are essential for informed healthcare decision-making. However, studies have shown that awareness among patients and even healthcare workers is often inadequate. For instance, a study found that less than 50% of physicians and patients could correctly identify the relative radiation doses of common imaging procedures. Similarly, a research showed that a large proportion of pregnant women had limited knowledge regarding which imaging modalities were considered safe during pregnancy.[3]

Ultrasoundandmagnetic resonance imaging (MRI) are generally preferred during pregnancy, as they do not use ionizing radiation. However, there are instances where X-rays or CT scans may be medically justified, and in such cases, appropriate shielding and dose minimizationtechniques are crucial. This underscores the need for radiation education and effective communication between healthcare professionals and patients.[4]

Radiology professionals and students must be thoroughly trained in radiation protection principles and risk communication. As future healthcare providers, radiology students need to be adequately equipped not only with technical knowledge but also with the ability to educate patients, especially vulnerable groups like pregnant women, about the risks and benefits of imaging procedures. Without this awareness, there is a risk of inappropriate imaging, patient refusal of necessary exams, or unintended fetal exposure .[5]

This study aims to assess the level of awareness and understanding among radiology students regarding radiation risks during pregnancy. Identifying knowledge gaps at the educational level will help inform curriculum development, public awareness campaigns, and safer radiological practices.

2. Methodology

2.1. Study Design

This research was conducted as a cross-sectional descriptive survey-based study to assess the level of public awareness and education regarding radiation risks during pregnancy. The study utilized a structured questionnaire distributed among participants to gather data on their knowledge, perceptions, and attitudes toward radiation exposure in pregnant individuals.

2.2. Study Population

The target population for the study comprised students pursuing radiology and related health sciences programs in selected educational institutions. These participants were chosen due to their presumed foundational knowledge of radiation and its effects, allowing for an informed assessment of awareness levels within a semi-educated population group.

2.3. Sample Size and Sampling Technique

A convenience sampling method was employed to recruit participants who were available and willing to participate during the study period. Inclusion criteria included students currently enrolled in radiology courses and those who consented to participate voluntarily.

2.4. Data Collection Tool

A self-administered structured questionnaire was developed based on existing literature and expert input. The questionnaire included multiple-choice questions divided into the following sections:

2.5. Data Collection Procedure

The questionnaire was distributed through digital platforms (such as Google Forms) after obtaining verbal informed consent from each participant. Data collection was carried out over a period of [January 2025 – July 2025].

2.6. Data Analysis

Data from the completed questionnaires were entered into **Microsoft Excel** and analyzed using **descriptive statistics**. Frequency distributions, percentages, and graphical representations (pie charts, bar graphs) were used to summarize the data. Further interpretation was carried out to identify knowledge gaps and patterns in awareness levels among the participants.

3. Result

The survey was conducted among radiology students to assess their awareness and knowledge regarding radiation risks during pregnancy. The findings revealed that a majority of the respondents (82%) correctly identified ionizing radiation as the most concerning type during pregnancy, while only 6% considered non-ionizing radiation to be more harmful.

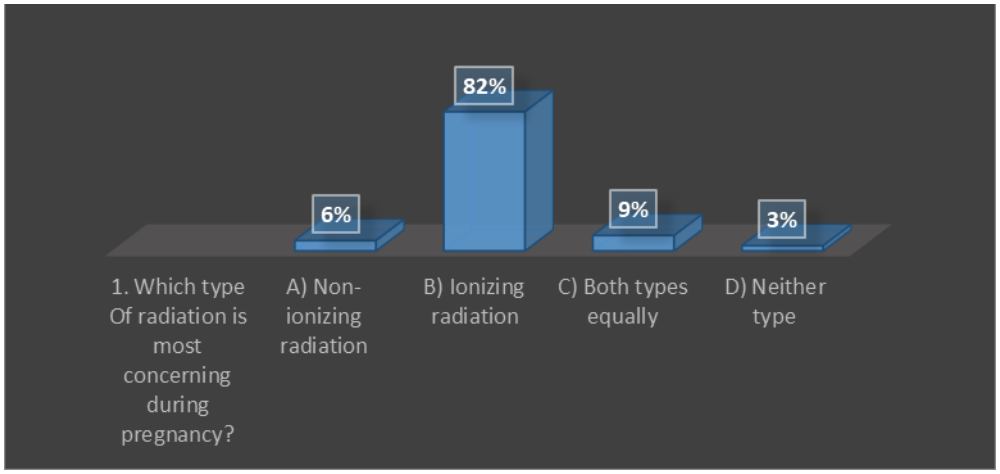

Figure 1 Concerning radiation during pregnancy

When asked about safe imaging alternatives, an overwhelming 92.1% selected ultrasound (USG) as the safest modality, whereas very few chose X-ray (2%), CT (4%), or mammography (2%).

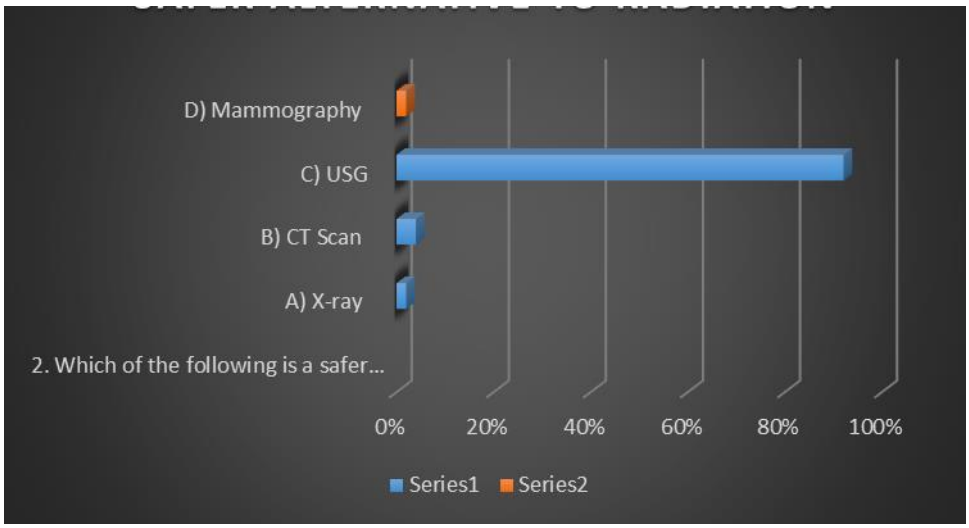

Figure 2 Safer alternative to radiation

In terms of fetal risks, 67.3% of participants recognized that miscarriage, birth defects, and developmental delays are all potential outcomes of radiation exposure during pregnancy.

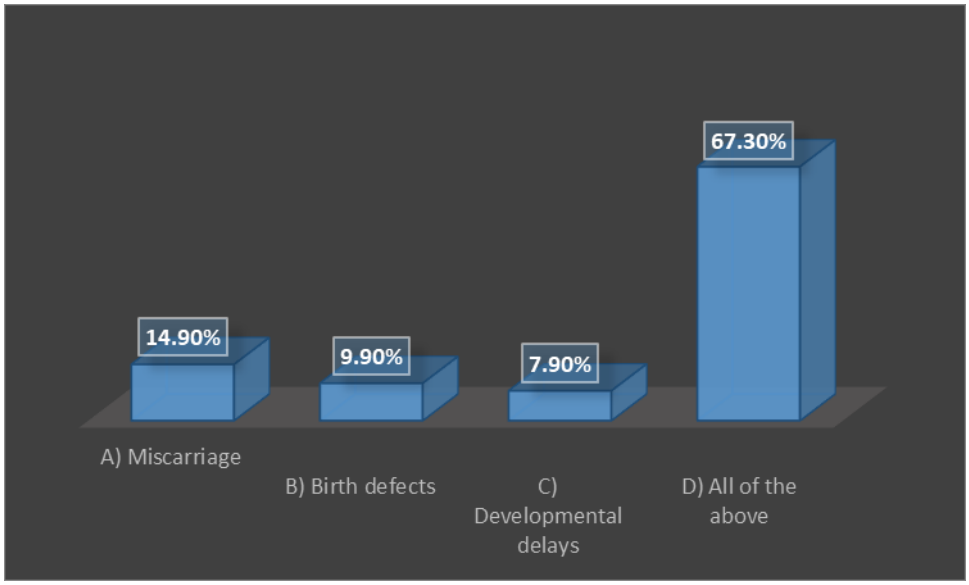

Figure 3 Outcomes of radiation during pregnancy

Additionally, 88% of respondents indicated that CT scans pose the highest risk to the fetus, highlighting a strong understanding of relative radiation intensities across different modalities. However, awareness regarding non-ionizing radiation, such as that from mobile phones, showed some variation. Although 67% believed it to be less harmful than ionizing radiation, 14% incorrectly considered it more dangerous, while 11% believed it poses no risk.

Regarding the importance of education, 79% of students agreed that educating pregnant women about radiation risks helps empower them with accurate knowledge, whereas 11% felt it could increase anxiety. Knowledge about radiation protection practices was also found to be strong, with 90.9% correctly identifying the purpose of shielding as protecting the fetus during imaging procedures.

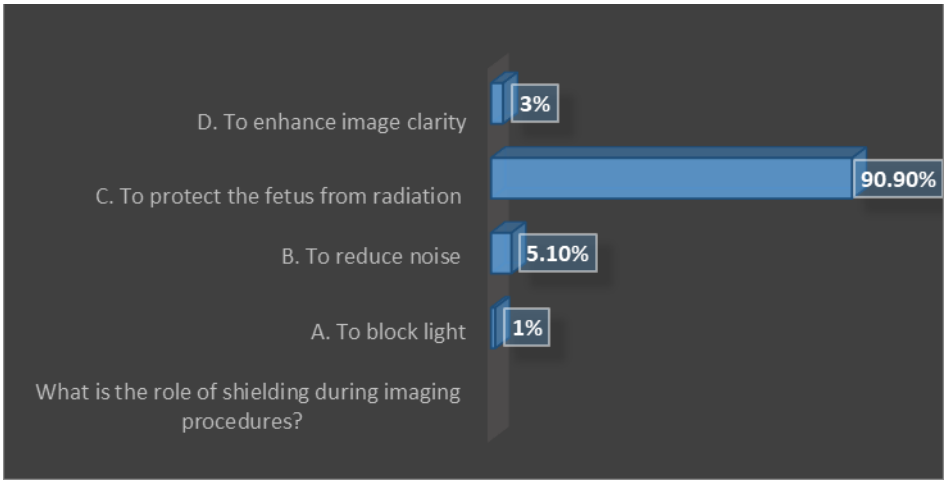

Figure 4 Role of shielding

Similarly, 92.1% of respondents knew that pregnant women should inform the radiologic technologist before undergoing any imaging.

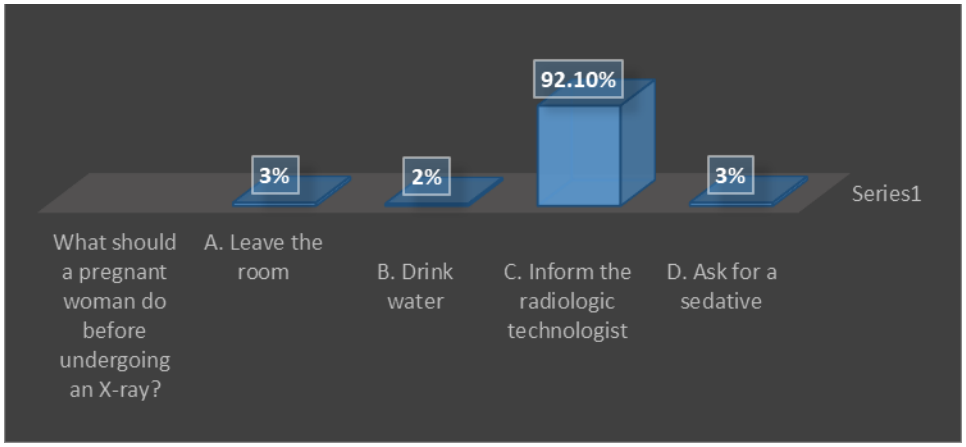

Figure 5 Pregnant woman do before undergoing x-ray

Most students (94.1%) acknowledged the importance of asking women about pregnancy status prior to imaging, in order to prevent unnecessary fetal exposure.

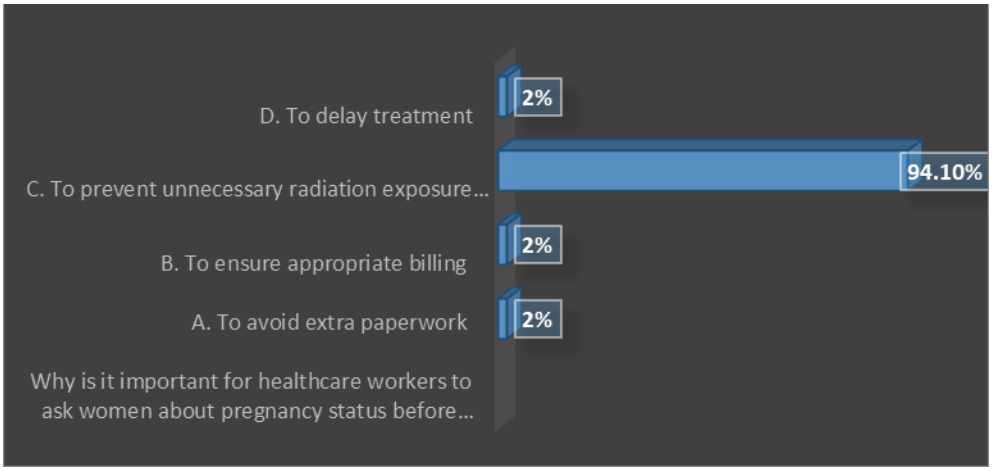

Figure 6 Importance to ask about pregnancy before procedure

When questioned about appropriate educational messaging, 60.6% agreed that some imaging is necessary and can be safely performed during pregnancy, reflecting a balanced understanding of clinical decision-making.

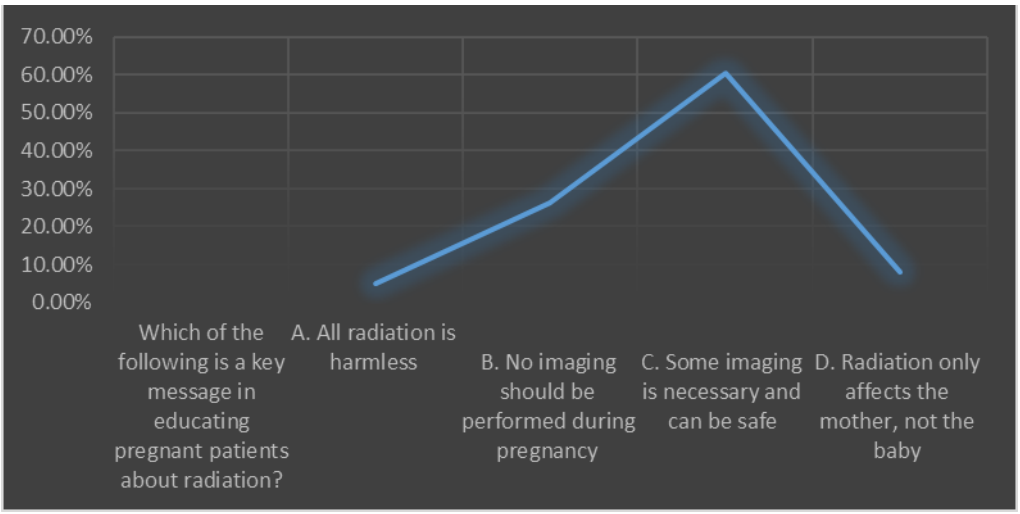

Figure 7 Key message to educate about radiation in pregnant patient

Awareness of the ALARA (As Low As Reasonably Achievable) principle was high, with 87% correctly identifying its meaning, and 91.9% recognized the International Commission on Radiological Protection (ICRP) as the primary organization providing guidelines on radiation safety in pregnancy. Finally, 78.2% of respondents correctly identified the first trimester as the most sensitive period for fetal radiation exposure.

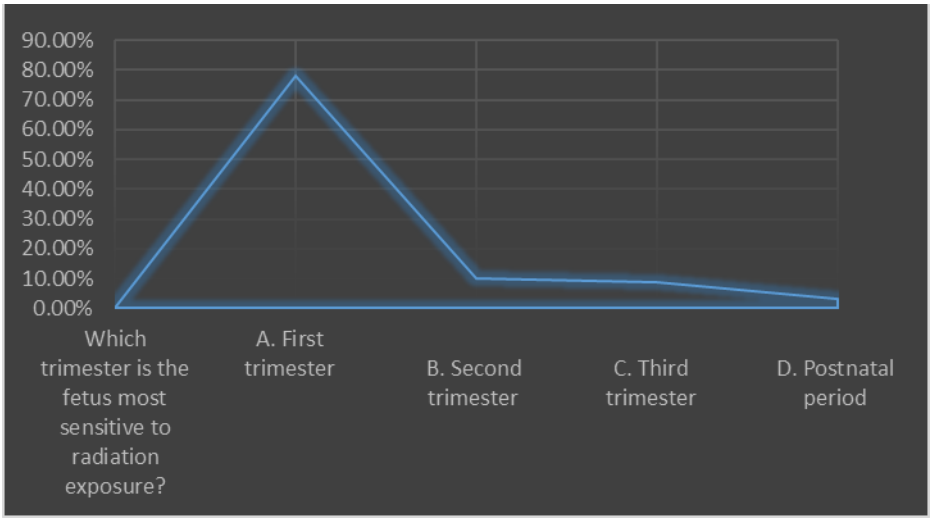

Figure 8 Most sensitive trimester to radiation

4. Discussion

The findings of this study highlight a generally high level of awareness among radiology students regarding radiation risks during pregnancy. A significant majority of respondents correctly identified ionising radiation as the most concerning type during pregnancy, aligning with existing literature that underscores the potential teratogenic, carcinogenic, and mutagenic effects of ionising radiation on the developing fetus[6]. This awareness is critical, as exposure to ionising radiation during organogenesis (particularly in the first trimester) can result in congenital malformations, intellectual disabilities, and increased cancer risks in later life[7].

In the current study, 92.1% of respondents identified ultrasound (USG) as the safest imaging modality during pregnancy, demonstrating a strong understanding of imaging alternatives. Ultrasound, being a non-ionising technique, is considered the first-line imaging method for pregnant patients and is endorsed by the American College of Radiology (ACR) and the American College of Obstetricians and Gynecologists (ACOG) as safe for fetal evaluation[8]. However, the presence of a small percentage of students (8%) who believed that CT or X-ray is acceptable during pregnancy without acknowledging the associated risks indicates a need for continuous curriculum reinforcement.

The survey also revealed that 67.3% of students understood that multiple risks—including miscarriage, developmental delays, and birth defects—can result from radiation exposure, supporting studies[9], which emphasize dose-dependent effects on fetal development. Moreover, the identification of CT scans as the highest risk modality (88%) corresponds with published dose estimates indicating that abdominal CT imparts a fetal radiation dose significantly higher than other imaging techniques[10].

Encouragingly, most respondents showed strong awareness of radiation safety principles. For example, 90.9% understood the protective role of shielding, and 92.1% acknowledged that pregnant patients should inform the radiologic technologist before undergoing imaging. These practices are fundamental components of patient safety protocols outlined by the ICRP and the European Commission[11]. Furthermore, the ALARA (As Low As Reasonably Achievable) principle was correctly understood by 87% of participants, suggesting that radiology education is effectively communicating the importance of minimizing radiation exposure.

In terms of regulatory awareness, 91.9% of students correctly identified the ICRP as the primary body responsible for radiation protection guidelines. This is notable, given the ICRP's influential role in shaping international standards and recommendations for radiological safety[12]. However, misconceptions remain in certain areas—such as the risks of non-ionising radiation. While the majority acknowledged its lower risk, a minority believed it to be either completely safe or

more harmful than ionising radiation, contrary to current research that suggests the biological effects of non-ionising radiation, particularly from mobile devices, are still under investigation and may not be entirely benign[13].

The study also examined students' perspectives on the importance of education and communication. A large proportion (79%) believed that educating pregnant women empowers them to make informed decisions, a perspective strongly supported by WHO and ACR guidelines that advocate for patient-centered communication (WHO, 2016). Still, a small percentage of respondents expressed concerns about causing anxiety, highlighting the delicate balance between awareness and reassurance in patient counseling.

Lastly, 78.2% of students correctly identified the first trimester as the most sensitive period to radiation exposure. This reflects established radiobiological evidence that the first trimester, especially weeks 2–15, is the most critical window for radiation-induced teratogenic effects (ICRP, 2003).

5. Conclusion

The data indicates that radiology students have a high level of awareness regarding radiation risks during pregnancy, particularly in identifying hazardous procedures, appropriate precautions, and regulatory guidelines. However, minor misconceptions regarding non-ionizing radiation and communication strategies were noted. These findings highlight the importance of continuous education and curriculum reinforcement

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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