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Systematic Review

Perceptions and concerns regarding medical exposure to ionizing radiation in women of reproductive age: A systematic review

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ABSTRACT

Introduction: Ionizing radiation plays a fundamental role in clinical practice for diagnosis and therapy. However, patients with reproductive potential, including women of reproductive age who may be pregnant or become pregnant in the future, often report limited knowledge and increased anxiety regarding these procedures. Although medical exposures involve inherent risks, when examinations are appropriately justified and optimized, clinical benefits generally outweigh potential radiation-related risks. Nevertheless, misconceptions and risk overestimation may lead to refusal or delay of necessary imaging. This study aims to evaluate perceptions and concerns of women of reproductive age regarding medical exposure to ionizing radiation.
Methods: A systematic review was conducted in April 2026, following the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* guidelines. Searches were performed in PubMed, Scopus, and Web-of-Science using the keywords perception, concern, ionizing radiation, and women.
Results: Seven studies published between 2017 and 2025 were included. The review identified variability in knowledge and persistent gaps in radiation awareness among women, often associated with increased levels of concern. Lower levels of radiation literacy were generally reported among participants without health-related training, whereas higher awareness was observed among those with medical background. During pregnancy, risk perception was frequently overestimated and primarily focused on fetal harm.
Conclusion: Perceptions and concerns about medical radiation are heterogeneous and influenced by sociodemographic, cultural, and psychological factors. These findings highlight the need for targeted educational strategies and further research to enhance the understanding of how these patients perceive the risks associated with ionizing radiation.
Implications for practice: Healthcare professionals should individualize communication about radiation risks according to each patient's sociodemographic and cultural background, providing accurate and comprehensible information aligned with the patient's level of health literacy and informational needs.

Introduction

In recent decades, medical imaging and therapeutic procedures using ionizing radiation have become essential components of modern medicine. The use of imaging techniques and radiotherapy has increased substantially, with a sustained rise in the number of examinations and treatments performed across multiple specialties and clinical indications.[1–6]

Currently, medical imaging using ionizing radiation plays a central role across the entire healthcare continuum, from screening to early diagnosis, treatment planning, and monitoring of treatment response.[7–10] The diversity and sophistication of available imaging techniques enable healthcare professionals to

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make more informed clinical decisions, improve diagnostic accuracy, and optimize patient management.[1,2,4,11]

On the other hand, radiotherapy constitutes one of the most important therapeutic modalities in the treatment of cancer, with approximately half of cancer patients benefitting from this treatment at some point during the clinical process.[12,13] Despite its therapeutic benefits, radiotherapy involves the delivery of relatively high radiation doses and is associated with well-recognized risks to healthy tissues, requiring careful planning and optimization.

Nevertheless, patients often report limited knowledge of medical procedures involving ionizing radiation[14] as well as varying levels of anxiety depending on the context.[7,15–17] This psychological impact may be influenced by multiple factors. These include body positioning during the procedure, duration of the examination, fear of diagnostic results, limited knowledge about the nature of the procedure, communication difficulties between professionals and patients, and concerns regarding the use of ionizing radiation.[14,17] Concerns regarding the effects of radiation exposure are particularly relevant in sensitive populations, including women of reproductive age, who may be pregnant or may become pregnant in the future.[18,19]

However, it is essential to distinguish between the well-established risks associated with high-dose or specific exposure scenarios and the low radiation doses typically used in most diagnostic imaging examinations.

Numerous studies have documented the harmful effects of radiation exposure, particularly during pregnancy and in young children.[19–22] In utero exposure to high doses of ionizing radiation can lead to a range of adverse outcomes, including developmental abnormalities. Exposure to ionizing radiation during early childhood, at higher doses, has been associated with an increased risk of cancer, especially leukemia.[23,24] The magnitude of these risks depends on several factors, including the radiation dose received and the gestational age at the time of exposure.[25] However, in most cases, examinations with ionizing radiation performed during pregnancy, especially those that do not involve direct exposure to the abdomen or that use low doses (such as conventional radiography), result in radiation exposures well below levels associated with deterministic effects. Nevertheless, these procedures are not entirely risk-free, and risk–benefit assessment and optimization remain essential.[19,26,27]

Scientific evidence shows that imaging tests involving ionizing radiation can be performed with minimal risk during pregnancy when properly justified and optimized, providing significant clinical benefits that largely outweigh the associated risks.[19,26] However, unjustified refusal of these tests can delay the diagnosis[27] and treatment of conditions that may pose a risk to both the mother and the fetus.[28]

Despite the clinical relevance and sensitivity of the topic, no systematic reviews have yet explored the risk perception of medical procedures using ionizing radiation among women of reproductive age, nor the impact of this perception on the acceptance or refusal of such procedures. Therefore, this study aims to evaluate the perceptions and concerns of women of reproductive age regarding medical exposure to ionizing radiation.

Methods

Study design

A systematic review (SR) was performed to provide a comprehensive analysis of the perceptions and concerns of women of reproductive age. This population is typically defined as individuals aged 15–49 years, according to the World Health Organization,[29] although pregnancy may occur outside this range.[29] This definition was adopted to ensure consistency in population selection, while acknowledging that other national guidelines may use broader age ranges.

The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[30] (Fig. 1). The review protocol was registered in PROSPERO (CRD420251082522).

This review included studies addressing women of reproductive age with exposure to ionizing radiation in diagnostic imaging or radiotherapy. Eligible studies reported perceptions, concerns, or experiences related to radiation exposure. Studies focusing exclusively on populations outside reproductive age (e.g., postmenopausal or elderly individuals) were excluded. Studies with mixed populations were included when subgroup data relevant to individuals of reproductive age were available.

The term “women” is used in accordance with the terminology of the included studies and primarily refers to individuals with reproductive potential. This review acknowledges that people of diverse gender identities may also fall within this category; however, such distinctions were not consistently addressed in the available literature.

Search strategies

In April 2026, a bibliographic search was conducted in the PubMed, Scopus, and Web of Science databases using keywords and the Boolean operators AND and OR, as detailed in Table 1.

The keywords were selected after the PEO strategy was defined, and the inclusion and exclusion criteria were determined, as shown in Table 2.

Rayyan software was used to facilitate the screening. The initial exclusion criteria were systematic reviews and articles published before 2015, as the aim was to capture contemporary perceptions and concerns of women, considering the significant advancements in imaging modalities, equipment, and healthcare practices in recent years. Duplicate records were removed prior to screening. Two authors independently reviewed the full texts for eligibility according to the inclusion criteria. Discrepancies were resolved by consensus with the involvement of other authors.

Quality appraisal

For quality appraisal, the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies (JBI, 2020), which comprises eight criteria, was used for studies with a cross-sectional design. For qualitative studies, the JBI Critical Appraisal Checklist for Qualitative Research, which comprises ten criteria, was applied.[31]

Two authors independently rated all the articles according to the JBI criteria as “yes”, “no”, “unclear”, or “not applicable”. Disagreements were resolved through consensus, with two other authors available to do so. After discussing and resolving any discrepancies, the final quality rating for each study was calculated by averaging the scores assigned to each dimension (“No” = 1, “Unclear” = 2, “Yes” = 3).

Data extraction and synthesis

Data were extracted according to the following headings: author, year, study design, sample size, radiation knowledge, radiation perceptions, radiation concerns.

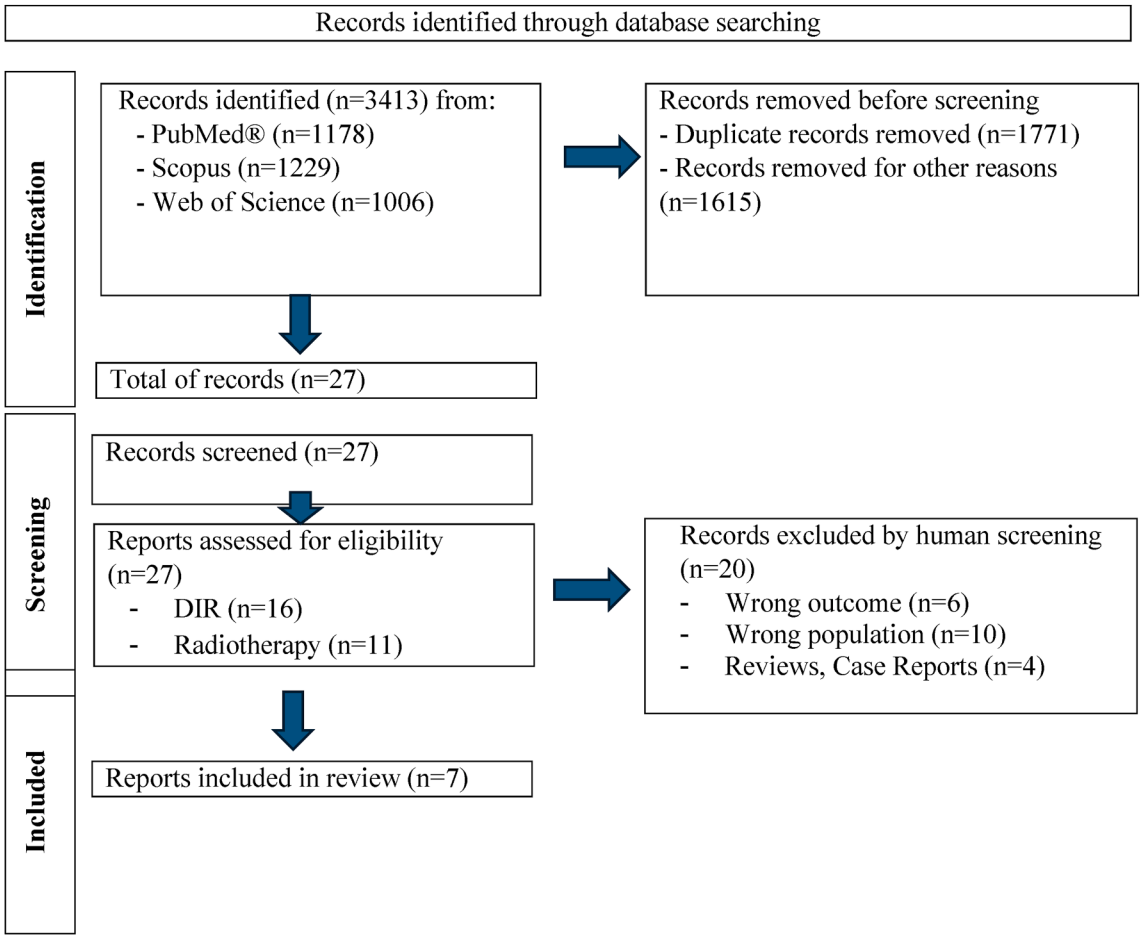

Figure 1. PRISMA flow diagram for search and study selection.

Table 1
Detailed description of the keywords used in each scientific database.

Databases	Detailed description of the keywords used in each scientific database.
PubMed	((perception*[Title/Abstract]) OR (concern*[Title/Abstract]) AND (radiation [Title/Abstract]) OR (ionizing [Title/Abstract]) AND (woman [Title/Abstract] OR women [Title/Abstract]))
Scopus	((TITLE-ABS-KEY (perception*) OR TITLE-ABS-KEY (concern*)) AND ((TITLE-ABS-KEY (radiation) OR TITLE-ABS-KEY (ionizing)) AND TITLE-ABS-KEY (women OR woman)
Web of science	TOPIC=(perception*) OR TOPIC=(concern*) AND TOPIC= (radiation) OR TOPIC=(ionizing) AND TOPIC= (women) OR TOPIC=(woman)

Table 2
PEO criteria for inclusion and exclusion of articles.

Parameters	Inclusion Criteria	Exclusion Criteria
P = participants	• Women of reproductive age (15–49 years), including those who may be pregnant.	• Age younger than 15 years; • Healthcare professionals work with ionizing radiation;
E = exposure	• Ionizing radiation in medical imaging, including diagnostic imaging, radiotherapy, and prototherapy.	• Women undergoing diagnostic and/or treatment procedures that do not use ionizing radiation.
O = outcome	• Radiation-related perceptions; • Radiation-related concerns; • Radiation-related knowledge.	• Results not presented for subgroups of women with age/age category with the 15–49 years old interval.
Types of evidence	• Qualitative and quantitative research.	• Books, integrative review, systematic review, narrative review, editorials, and articles published before 2015.

Results

Study selection

The initial database search yielded 3413 articles from advanced searches across the PubMed (1,178), Scopus (1,229), and Web of Science (1,006) databases. Of these, 1771 articles were identified as duplicates and removed, and 1615 articles were excluded as they did not meet the predefined inclusion criteria.

The PRISMA flow diagram (Fig. 1) illustrates the number of records retrieved from each database, the number of records screened, the number of full-text articles assessed for eligibility, and the number of articles included in the review. Seven studies[32–38] met the inclusion criteria and were included in the final analysis. Studies that did not meet the inclusion criteria were excluded. The reasons for exclusion are provided in Fig. 1.

Table 3
General overview of the main characteristics of the reviewed articles.

Author(s), year of publication	Country	Study approach	Study population	Sample	Method(s)	Main aim(s) of the study	Quality appraisal
Rayne et al., 2017[32]	South Africa	Quantitative	Adult breast cancer patients receiving treatment in South Africa	263 adult breast cancer patients receiving treatment at two South African health centers (16% aged ≤40 years)	Cross-sectional survey	Identify fears among breast cancer patients to guide education and care improvements	21
Habibullah et al., 2018[33]	Pakistan	Qualitative	Adult women with breast cancer receiving radiation therapy in Pakistan	14 women (aged 20–60) with breast cancer receiving radiation therapy at a hospital in Pakistan. Only one woman older than 50 years.	Semi-structured interviews	Explore breast cancer patients' experiences with radiotherapy in Pakistan	26
Shumway et al., 2018[34]	US	Quantitative	Women newly diagnosed with breast cancer in SEER registries (Georgia and Los Angeles County, US)	538 women with newly diagnosed breast cancer in SEER registries	Cross-sectional survey	Describe radiotherapy patterns for DCIS and evaluate patient and provider decision-making about RT omission	22
Reitan & sanderud, A., 2021[35]	Norway	Qualitative	Pregnant women in Norway (gestational weeks 13–38)	7 pregnant women from the Oslo metropolitan area (gestational weeks 16–33, no X-ray exposure during current pregnancy)	Semi-structured interviews	Identify pregnant women's information needs and preferred communication about X-rays	25
Bahanan et al., 2021[36]	Saudi Arabia	Quantitative	Adult women (18+) living in Saudi Arabia	410 women	Cross-sectional survey	Assess women's awareness of dental imaging safety during pregnancy	24
Seven et al., 2022[37]	Turkey	Quantitative	Pregnant women seeking teratological consultation in Turkey	674 pregnant women (461 exposed to radiation)	Cross-sectional survey	Evaluate teratogenic risk overestimation and the role of counselling in correcting misconceptions	24
Ataalla et al., 2024[38]	Saudi Arabia	Quantitative	Women not employed as healthcare professionals in Saudi Arabia	290 women with various occupational backgrounds (university staff, university students, hospital administrative staff, patients aged 20–50 years)	Cross-sectional survey	Assess non-healthcare professional women's knowledge of radiation hazards during pregnancy	22

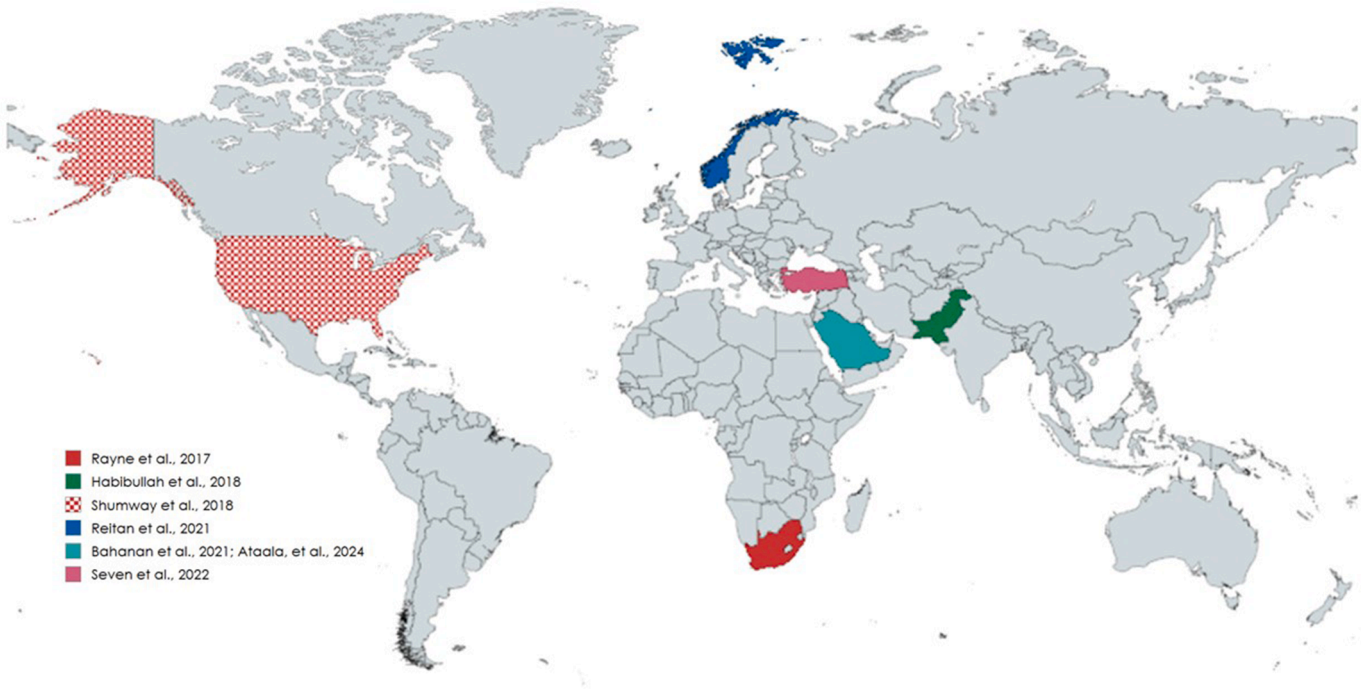

Figure 2. Geographical focus of included articles.

The JBI checklist results for all items and global ratings for each article are organized into two separate tables (see Supplementary Materials). The overall appraisal and quality scores ranged from 21 to 24 for studies assessed with the cross-sectional checklist, and from 25 to 26 for those assessed using the qualitative research checklist and are presented in Table 3.

General literature characteristics

The seven articles included in this review were published between 2017 and 2025, with four of them being published in the last five years.[35–38] Two studies were conducted in Saudi Arabia,[36,38] one in the United States of America,[34] and the remaining studies were conducted in Norway,[35] South Africa,[32] Pakistan,[33] and Turkey,[37] as shown in Fig. 2.

In terms of the methodologies used, most articles (n = 5) used a quantitative approach, while two articles were based on qualitative studies (Table 3). The former category relied on survey methods for data collection, including items assessing radiation knowledge and awareness,[36,38] and risk perception.[37] In contrast, studies using qualitative research designs employed semi-structured interviews as their primary data collection method, as reported by Habibullah et al.[33] and Reitan et al.[35]

Some of the included studies had a wider focus on respondents' age and/or sexes. For example, they included data on both men and women[32] or wider age groups.[36] In several articles, women of older age (≥50 years old) were included.[33,34,36] These articles were included as they provide insights for the specific age groups in focus. Two articles[35,37] reported on pregnant women. While Seven et al.[37] only report on the mean age (31.7 years old, standard deviation 5.6), and not on the full age range, all women were logically considered to be of reproductive age.

Radiation awareness and knowledge

Various studies had a prime interest in respondents' knowledge and awareness of ionizing radiation and its potential effects in the medical context. Ataalla[38] explicitly focused on the knowledge of female patients regarding medical radiation risks during pregnancy. A survey with knowledge-related questions (for example 'Which one of the following radiological imaging modalities carries the highest risk for the fetus?', 'Do you think that there is a limit on the number of CT scans during pregnancy?'). The author concludes that a lack of awareness about X-rays, radiation dosage, and their potential effects on pregnant women and fetuses can be observed among female patients in Saudi Arabia. The study also reveals that radiation awareness is significantly different between respondents with a medical and nonmedical educational background, with the former, as can be expected, being more knowledgeable about the topic. It is noteworthy that one of the first knowledge questions in (the English version of) the questionnaire was 'Do you know that some medical imaging examinations use dangerous ionizing radiation?', which arguably entails a rather strong (negative) framing of the topic for the remainder of the survey.[38]

Building on a qualitative research design, Reitan et al.[35] concluded from their interviews with seven Norwegian pregnant women that participants had varying levels of knowledge about the risks of X-rays during pregnancy, with some respondents revealing inadequate knowledge (e.g., being unsure whether fetal dose depends on the anatomical area of the procedure). In relation to awareness regarding radiation use during dental procedures in Saudi Arabia, Bahanen et al.[36] found no differences in the level of knowledge about radiation safety for diagnostic dental imaging during pregnancy between women younger than 30 years old and those in other age categories (e.g., 30–39, 40–49). They also found

that many respondents in their sample (n = 410) of adult women tended to perceive the risks as larger than those estimated by experts.

Radiation perceptions and concerns

Seven et al.[37] argue that pregnant women tend to overestimate the actual effects of radiation during pregnancy. However, it is not clear how this argument was derived from a sample of pregnant Turkish women undergoing teratological consultation. The data they gathered did not seem to include specific items measuring risk perception, or such items were not reported in their paper.

Three studies provided more specific insights regarding radiation risk perception, including two qualitative studies[33,35] and one quantitative study.[32]

Rayne et al.[32] studied the concerns of South African women with breast cancer. While the perceived risks entailed a broad range of factors, when extending beyond medical procedures, radiation exposure was an important concern among the studied population. One of the key arguments provided is that "*women are far less fearful of how they will negotiate life during treatment (including work, finances, and family commitments) than they are of the planned treatments*".[32]

With respect to the two qualitative studies included in our database, the study of Reitan et al.[35] among pregnant women in Norway found that their respondents would not feel very comfortable taking a medical imaging procedure (X-Ray) during pregnancy, even though they considered the fetus' risk to be rather low. The low-risk perception among the interviewed pregnant women was attributed by the authors to the fact that the doctor's prescription of the imaging procedure reassured respondents about the risks. Furthermore, the authors argue that those respondents who expressed higher concern about pregnancy, in general, also seemed to have higher risk perceptions regarding X-rays.[35] Interestingly, in the study by Habibullah et al.,[33] fear of radiation was not brought up by their Pakistani female respondents as the main perceived risk of undergoing medical imaging; instead, they expressed anxiety about exposing themselves to male staff during the procedure, which was perceived as a loss of dignity or honor.

Communication on procedures and risks

A recurring topic entailed communication between healthcare providers and patients regarding medical procedures involving the use of ionizing radiation. Some articles provide recommendations regarding communication and information-provision without explicitly investigating these topics in the presented studies. This is the case for studies by Ataalla,[38] Seven et al.,[37] Bahanan et al.,[36] and Shumway et al.[34] In all these studies, arguments are presented to dedicate more attention to the information provided to patients. Ataalla,[38] and Bahanan et al.[36] emphasize the need to educate caregivers, in order to enable them to provide correct and factual information to patients. Seven et al.[37] connect the importance of information-provision to a more general plea for teratological counselling. They argue that "*teratological counseling is effective in preventing abortions based on groundless anxieties and risk assessment is necessary to understand the outcomes of teratogen exposure*".[37] Finally, Shumway et al.[34] argue that better communication is needed, and that radiation oncologists could be considered as the primary source of information.

Finally, several studies have explored communication approaches and procedures that can be used. Reitan et al.[35] found that pregnant women interviewed expressed a need for specific information regarding medical imaging procedures, including their justification and potential risks. Participants also indicated preferences regarding both the source of information, often their general practitioners, complemented by explanations provided immediately before the examination by healthcare professionals, and the format in which it should be delivered (verbal or written). The authors[35] emphasized the importance of effective communication skills among healthcare providers, including active listening, appropriate body language, and flexibility to accommodate individual patient needs and preferences.

Similarly, Habibullah et al.[33] highlighted the importance of adapting communication to the cultural and linguistic context. In their study involving Pakistani participants, anxiety was partly attributed to the terminology used. Specifically, expressions such as images being "shot" were interpreted as a direct translation from Western terminology, leading some patients to associate the procedure with an electric shock.

Discussion

This review provides an overview of various studies that have been conducted over the past 10 years (since 2015) on perceptions regarding medical imaging procedures among women of reproductive age. Seven articles[32–38] were included, which is indicative of the very limited attention this topic has received in the literature over the past decade. Nonetheless, the use of medical imaging has shown significant growth, and is likely to expand in the future. The identified articles addressed radiation knowledge and risk perception as dominant empirical themes.

Limited empirical attention has been given to communication and information provision, although various studies[34–38] provide recommendations on the topic.

Based on the general state of the current literature on medical imaging perceptions among women of reproductive age, five key observations can be made.

First, there seems to be a dominance of quantitative studies,[32,34,36–38] using surveys with closed questions as the data collection method. However, as shown by the few qualitative studies[30,32] found in this review, such studies allow us to better understand some of the reported quantitative findings (e.g., why certain risks are perceived as high or low), but are very limited in number and contexts studied. Complementing quantitative analyses with qualitative analysis or setting up mixed-methods studies combining both methodological approaches, would extend our insights into how radiation knowledge can be improved among healthcare providers and patients, why certain perceptions exist regarding medical imaging procedures, or which communication processes would be most suitable to particular medical contexts or patient groups.

Second, the social scientific focus of the presented studies points to the need for robust methodologies and conceptual frameworks. While this was indeed the case for some contributions, others lacked methodological aspects. For instance, the survey design or sampling procedures should be addressed more carefully. The articles were generally transparent regarding their methodological choices, which allowed readers to make their own assessments of quality(Supplementary Material). Nonetheless, there remains a risk that readers less attuned to methodological nuances may interpret or draw conclusions from the findings in ways that are not aligned with the methodologies used.

Third, the limited number of published studies indicates that the current literature covers a relatively narrow geographical scope. However, as some of the reviewed studies highlight,[33] and which are corroborated by McNierney-Moore et al.,[39] Alghamdi[40] and Hofmmann et al.,[41] cultural differences can significantly shape how patients perceive and relate to the use of ionizing radiation in

medical imaging. These insights underline the risks of relying on 'one-size-fits-all' approaches, particularly in patient–caregiver communication and interaction. Previous studies[40–42] have demonstrated the influence of geographical and cultural factors on how patients understand and interpret information about radiation in medical imaging. Therefore, expanding the geographical and cultural diversity of research in this area emerges as an important priority.

Fourth, the limited number of empirically grounded studies on the interactions between patients and healthcare professionals points to a clear path for future research. While many publications[34–38] emphasize the need to provide patients with more or better information about medical imaging, only a few base their claims on empirical evidence.

Moreover, existing studies often highlight the perceived demand for information and communication, but rarely specify how or when this should be delivered, by whom, or with what content. This gap is closely linked to the underrepresentation of qualitative research, which allows the exploration of such questions in greater depth.

Fifth, this study highlighted some socio-demographic characteristics, such as higher anxiety with respect to medical examinations involving the use of ionizing radiation among pregnant women concerned about pregnancy in general, compared to those with lower general pregnancy concerns; as well as culturally anchored anxieties about the medical procedure as such, rather than about the ionizing radiation risks involved.

Conclusion

In conclusion, this review emphasizes the need for additional, mixed-methods research studies on how women of reproductive age perceive and understand medical imaging that uses ionizing radiation, what their information needs are, and how the communication content and process can be improved, taking into account the particular sensitivities of women who are concerned not only with their own health but also with that of their unborn children. Therefore, addressing this gap remains an important task in future research.

Ethics approval and consent to participate

This research did not require Institutional Review Board approval because is a Systematic Review.

Availability of data

Data required for this study may be made available by the author(s) upon reasonable request.

Author contributions

LV: Conceptualisation, Methodology, Data curation, Visualisation, Writing – original draft, Writing-review & editing.

RG: Data curation, Visualisation, Writing- Original Draft preparation, Writing-review & editing.

CT: Methodology, Data curation, Writing-review & editing.

MAS: Methodology, Data curation, Writing-review & editing.

Generative AI use

During the preparation of this manuscript, the authors used Paperpal solely for language editing. After using this tool, the authors reviewed and edited the manuscript as needed and take full responsibility for the content of the published article.

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Conflict of interest statement

The author(s) declare(s) that there are no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.radi.2026.103481.

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