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Review Article

Perceptions, educational expectations and knowledge gaps of patients with non-metastatic breast cancer regarding radiotherapy: Integrative review

Siret Kivistik^{a,b,c,*}, Eija Metsälä^{a,d}, Heli Virtanen^a

^a University of Turku, Department of Nursing Science, Turku, Finland

^b Tartu University of Applied Sciences, Department of Radiography and Biomedical Laboratory Science, Tartu, Estonia

^c Tartu University Hospital, Department of Radiation Therapy and Oncology, Tartu, Estonia

^d Metropolia University of Applied Sciences, Faculty of Healthcare and Nursing, Helsinki, Finland



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ABSTRACT

Objective: This integrative review investigates perceptions, educational expectations, and knowledge gaps of patients with breast cancer (BC) regarding radiotherapy (RT).

Methods: The included studies were analysed using a thematic analysis approach. Each segment of data was coded with open coding. The codes were gathered into subthemes as they emerged and into overarching themes, after which the data was analysed again.

Results: 22 studies were included: 11 qualitative, 10 cross-sectional, and 1 case study. Our findings indicate that breast cancer patients' perceptions of radiation therapy (RT) are influenced by their understanding of RT, its side effects, the treatment burden, emotional state or feelings, effectiveness of RT, prognosis, and viewing RT as the end-of-care phase. They expect education on the treatment pathway, psychosocial support, personalised aspects of RT, planning, delivery, follow-up, and side effects. Additionally, women undergoing RT have knowledge gaps related to preparedness and support, unforeseen risks and side effects, as well as daily practical issues.

Conclusion: Tailored, culturally sensitive education is essential to bridge gaps in understanding, manage anxiety, and build trust. It requires individualized communication strategies and psychosocial support. By integrating personalized information and leveraging technological solutions, healthcare providers can empower patients, improve adherence, and enhance outcomes, particularly in resource-limited settings.

Introduction

Patients diagnosed with breast cancer (BC) navigate complex treatment pathways that typically involve surgery, chemotherapy, biological therapies, and radiotherapy (RT) [1,2]. RT is a multifaceted treatment approach not widely understood, leading to misconceptions that may cause patients to approach treatment with apprehension [3–5]. Emotional distress is common, with about 45 % of cancer patients experiencing significant distress and approximately 35 % facing anxiety, particularly among those undergoing RT [6–8]. The challenges of a cancer diagnosis, along with limited control over treatment, create uncertainties about outcomes and well-being. As a result, anxiety is one of the most frequently reported psychological symptoms among these patients [9]. Factors contributing to anxiety include distrust in treatment efficacy, unfamiliarity with procedures, equipment and treatment duration, especially before the first session. [5,6]. Concerns about side

effects during and after RT have been documented, including misconceptions about becoming radioactive and potential impacts on fertility [5]. Patients' views on quality and safety depend on their trust in healthcare staff training and care reliability.

Perceptions shape a patient's journey through the healthcare system. They involve how individuals understand and evaluate their experiences, encompassing care quality, interactions with providers, and the overall healthcare atmosphere. A patient's view of quality care is closely tied to empathy, trust, and the sense of discrimination they perceive. [10,11]. The quality of information provided to patients is crucial in shaping their perceptions of the treatment they are about to receive. Effective communication and education are essential to facilitate acceptance and adherence to recommendations [5].

Patient education plays a significant role in shaping behaviours and enhancing knowledge, attitudes, and perceptions, ultimately leading to improved health outcomes [8]. Empowering patients through

* Corresponding author at: Valgjarve 6-20, Kose, Vorumaa, Estonia.

E-mail address: siretkivistik@nooruse.ee (S. Kivistik).

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knowledge enables informed decisions about their health and is often linked to their status within healthcare systems[12–14]. Knowledge, defined as familiarity with facts from various sources, makes effective information sharing and educational techniques before treatment essential for obtaining informed consent and promoting patient engagement [3,6,15]. Understanding patient concerns can inform educational initiatives for better decision-making [5].

Patients with cancer often prefer both written and verbal information, as well as one-on-one interactions with radiographers or radiation therapists [7]. Additionally, providing supplementary information between the initial consultation with the oncologist and the treatment planning appointment can enhance patient understanding. Metsälä et al. [2] found that being well-informed about treatment, experiencing a smooth care process, receiving personalized treatment, and having organized follow-up care are crucial for BC patients. Duoma et al. [16] indicated that while information needs typically decrease over time, they remain significant for most patients throughout treatment. Since the information given during the first consultation may be difficult to recall, it is essential to reinforce it during follow-up visits.

This integrative review clarifies breast cancer patients' perceptions, educational expectations, and knowledge gaps about radiotherapy. It aims to create an evidence-based foundation for educational interventions by thoroughly understanding these aspects, which will be examined separately despite their interconnection.

The research questions guiding this review are: 1. How do breast cancer patients perceive radiotherapy? 2. What educational expectations do these patients have regarding radiotherapy? 3. What knowledge gaps exist among breast cancer patients undergoing radiotherapy?

Materials and methods

Study design

The study was conducted as an integrative review [17] to assimilate results received from peer-reviewed research to reach comprehensive and reliable conclusions. The integrative review comprises the following steps: 1) Review question 2) Search strategy 3) Critical appraisal of the search results 4) Summary 5) Data extraction and reduction 6) Analysis 7) Conclusions and implications.

Review question

The PICOT question to determine main concepts is P-Patients with breast cancer; I- Perceptions, Educational expectations and perceptions; C- Radiotherapy; O- Any Outcome; T: Publications within the last 15 years.

Search strategy

A literature search used electronic data collection in Pubmed, CINAHL, Scopus, and Web of Science from 2009 to 2024. This timeframe reflects current technological developments and avoids outdated issues. The last 15 years is relevant for modern linear accelerators, daily imaging, systemic and local treatment combinations, personalized approaches, and artificial intelligence. The search included terms, synonyms, MeSH terms, and Boolean combinations of: Breast cancer, radiotherapy, perceptions, educational expectations, and knowledge (DOI [10.5281/zenodo.14000772](https://doi.org/10.5281/zenodo.14000772).) A manual search was carried out from the reference lists of the articles chosen for critical appraisal to find relevant sources.

The selection of papers began with extracting the database search results (n = 323) into the Rayyan application, an AI-assisted collaboration tool for systematic reviews [18]. This tool was chosen for its feasibility, free access, and capability for double-blinded reviews. The first author (XX) removed duplicates identified by the system and manually verified them. XX and the second author (YY) then conducted

double-blinded peer reviews to select articles based on title and abstract, adhering to the inclusion and exclusion criteria. The inclusion criteria were: Female patients with non-metastatic breast cancer or breast cancer in general (stage not defined); experience with being referred to or undergoing external beam radiotherapy treatment (either adjuvant or first line); focus on perceptions, education, expectations, and knowledge gaps related to the treatment method or other topics associated with active radiotherapy or follow-up; patient perspective; original studies published in English. Exclusion criteria included satisfaction studies (except those evaluating patient satisfaction with received information) and short communications or commentaries.

Critical appraisal of the search results

Selected studies for full-text evaluation underwent critical appraisal using the Joanna Briggs Institute (JBI) critical appraisal tools [19] to determine their appropriateness and sufficient quality for inclusion in the review [17]. Each checklist item was assessed by scoring: yes = 1, no = 0 and unclear or not applicable = 0. The total score obtained for each study is presented as a percentage, and each study is categorized according to different levels of risk of bias: high risk of bias if 20–50 % of items scored yes, moderate risk of bias if 50–80 % of items scored yes, and low risk of bias if 80–100 % of items scored yes, as per the JBI checklist. The appraisal process was peer-reviewed by XX and YY, and any discrepancies were discussed until a consensus was reached.

Data extraction and analysis

Data from selected articles were synthesized using thematic analysis [20]. This method identifies common themes across studies, which is essential for drawing broad conclusions and understanding trends in the literature. Synthesizing data highlights shared findings, reducing the impact of outliers or biases in any study. It minimizes the risk that individual characteristics, such as sample size or researcher bias, excessively influence conclusions. By focusing on commonalities—such as perceptions, educational expectations, and knowledge gaps—the analysis emphasizes themes widely represented in the research, grounding it in broader patterns instead of singular anomalies.

A data extraction form was created to collect relevant information from each selected study systematically: 1) study characteristics 2) methodology 3) key findings. From the key findings, data were categorized according to the research questions as follows: 1) Perceptions: findings reported as emotions, feelings, thoughts, opinions, experiences, beliefs, and understandings about RT 2) Educational expectations: findings reported as needs for information or specific topics of interest expressed regarding RT 3) Knowledge gaps: findings reported as awareness of specific topics concerning RT that influence preparedness for treatment or the follow-up period.

Thematic analysis of the collected data was conducted using Braun and Clarke's framework [21]. The process involved the following steps: 1) Familiarizing with data; key findings addressing specific research questions were extracted using NVivo 14 for qualitative analysis, ensuring transparency and minimizing biases through traceable data extraction and theme development. 2) Data were analyzed and coded using open coding, facilitating an unbiased examination, and preventing preconceived categories from influencing findings. 3) Codes were reviewed to identify recurring themes, which were arranged into initial themes. 4) Preliminary themes were evaluated and refined into overarching themes, each named and interpreted in the research context. This systematic approach reduced researcher bias and ensured consistent attention to detail at each stage.

Results

The literature search yielded 323 relevant articles. After reviewing titles and abstracts, duplicates were removed, and 268 ineligible articles

were excluded. Of the remaining papers, 36 met the exclusion criteria, and 15 were selected. Screening references identified 7 additional articles. Fig. 1 shows the PRISMA flow diagram of the literature review process.

Study characteristics

Around one-third of the studies were carried out in the USA (Table 1). Most of the studies used qualitative ($n = 11$) and cross-sectional study design ($n = 10$). Reporting of perceptions of radiotherapy by patients with breast cancer was identified in 13 of the studies, educational expectations were identified in 10 studies, and knowledge gaps were identified in 6 studies. One of the studies included all three categories of interest, 13 reported one of the categories, and 6 of the studies reported 2 categories. The number of participants per study ranged from 8 to 538. Seven of the 22 included studies reported fewer than 20, and 7 reported more than 100 participants (2 studies more than 500).

Quality assessment

Most of the studies ($n = 17$, 77 %) selected for quality assessment were categorized as low risk of bias, and none were excluded from the final review. All the qualitative studies were classified as having a low

risk of bias. Two studies fulfilled 100 %, three 90 %, and five 80 % of the assessment criteria. From the studies with cross-sectional study design, 50 % were categorized as low risk of bias (scores 90 %-100 %), and 50 % were scored moderate risk of bias (score 50 %-75 %). Although the studies presented a moderate bias risk due to insufficient identification and explanation of confounding factors, their inclusion is warranted. One study focused on awareness of psychological support initiatives, shedding light on previously unexplored areas in the literature and revealing crucial knowledge gaps for breast cancer (BC) patients. The second study examined BC patients' perceptions of radiotherapy (RT), offering vital insights into the first research question. A single case-series study was classified as low risk of bias, achieving a score of 90 %.

Breast cancer patients' perceptions of RT

The results of the selected studies reporting patients' perceptions of RT emphasized emotional responses such as fear, anxiety, and concern associated with perceptions shaped by many factors described below. The data analysis revealed 19 codes, four subthemes, and three overarching themes (Table 2).

Understanding and knowledge of RT

In 60 % of studies, patients with BC found RT difficult to understand, citing various reasons. Participants reported a lack of knowledge about

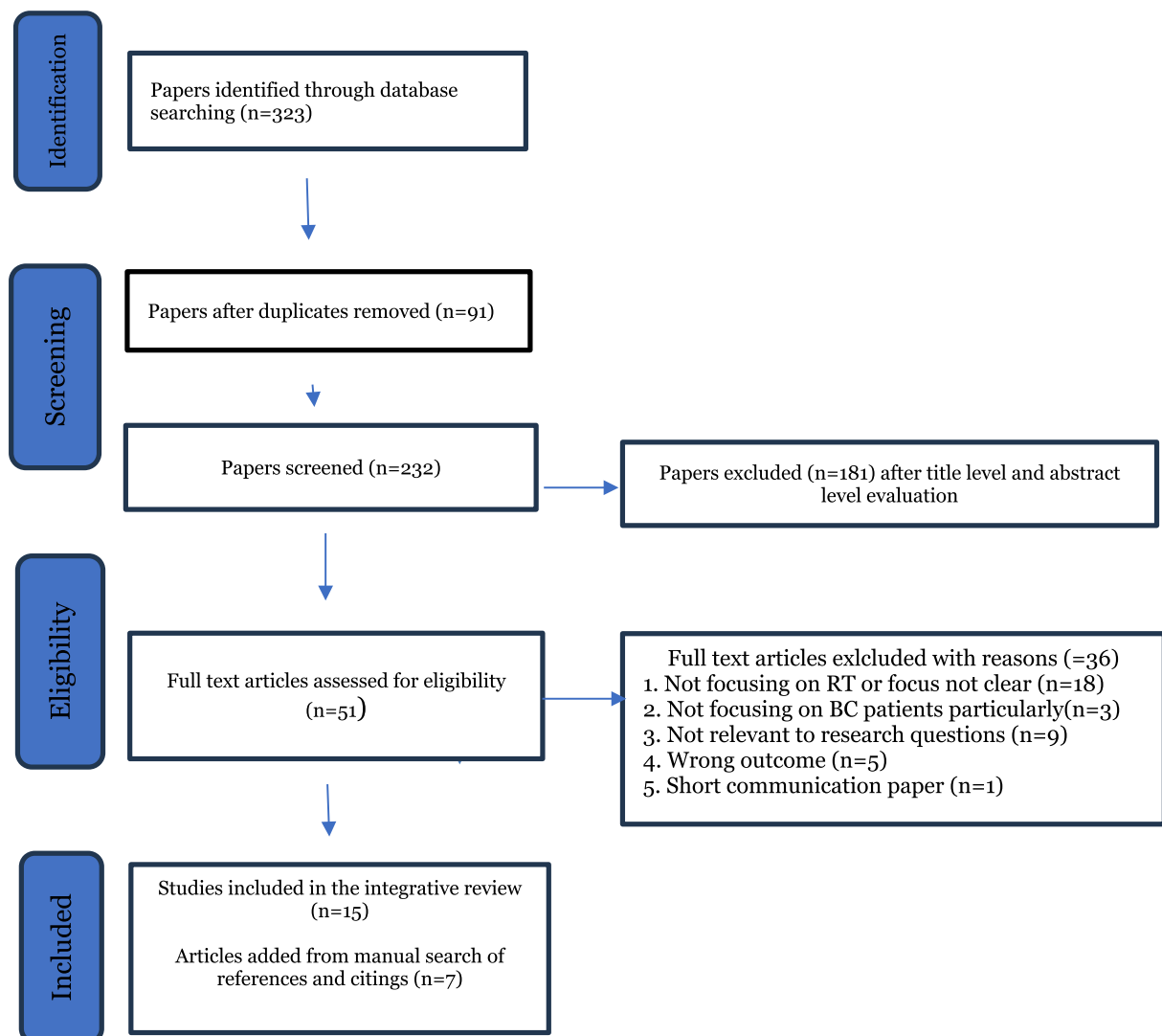


Fig. 1. PRISMA flow diagram of the review process.

Table 1

List of included studies, design and key findings.

Year	1st Author	Country	Design	n=	Key findings		
					Perceptions	Educational expectations	Knowledge gaps
2018	Beamer	USA	Qualitative Content analysis	40	Every breast cancer patient that receives RT develops severe skin toxicity	Information about skin changes	
2020	Beech	Canada	Cross-sectional	23			Limited awareness of psychological support initiatives
2014	Bergenmar	Sweden	Cross-sectional	88		Information about the disease-combined treatment group, younger women. Half of patients wish for further information about RT	
2021	Gal	The Netherlands	Cross-sectional	79		Information about individual CAC score	Unknown risk of treatment-induced cardiotoxicity awareness of higher risk if cardiovascular risk factors.
2017	Habibullah	Pakistan	Qualitative (Descriptive, exploratory)	14	Fear and anxiety of unknown treatment, terminology, cultural stigmatization, machine. Worrying prognosis, hesitations about effectiveness. RT as end of treatment. Grief, sorrow and shame, losing dignity from exposing to strangers and male staff		
2010	Halkett	Australia	Qualitative	34	Feeling tired and sick; Effect of RT to skin, heart, lungs, ribs. Changes of treatment plan impacts survival; Belief of not understanding the treatment until received.	Thorough explanation about planning appointment; What treatment involves, what to expect. The machines, side-effects; Steps of treatment planning. Timely information about after treatment period, how to manage ongoing side-effects.	
2012	Halkett	Australia	Longitudinal (Case-series)	123		Side-effects; damage to lungs and heart; why treatment is needed; skin care, breast volume treated; 1st treatment day, life after treatment. Planning, essence of RT	
Year	1st Author	Country	Design	N=	Key findings		
2020	Halkett	Australia	Qualitative	21	Perceptions Stress and psychological challenges to unknown treatment. Strange, unfamiliar treatment environment, especially the machine	Educational expectations	Knowledge gaps
2011	Hendry	UK	Qualitative	8	Fear and anxiety from poor knowledge about RT. Intimidating machine. Fear of last fraction and leaving safe hospital environment. Isolation.		
2011	Luutonen	Finland	Cross-sectional	276		Psychosocial support, especially in younger age group. Information about disease and treatments.	
2019	Murchison	Canada	Cross-sectional	118	Concerns, lack of knowledge of RT. Hesitations about the benefit of RT	BRT effects to: heart, immune system, lungs, skin, bones, healthy tissue. Association with pain and second cancers.	
2020	Pembroke	USA	Qualitative	25	Concerns of what happens after treatment, how to return to work. What if something happens and need to have to explain to the co-workers		Preparedness for the treatment, what to expect? Unmet needs in emotional health and relationships. Side-effects, unexpected impact of radiodermatitis- skin breaking, serious burns. Noise of the machines. Nutrition

(continued on next page)

Table 1 (continued)

Year	1st Author	Country	Design	n=	Key findings		
					Perceptions	Educational expectations	Knowledge gaps
2020	Probst	UK	Qualitative	9	Impersonal treatment, technology focused. Dehumanising, feeling vulnerable, frightened and disempowered. Fear of accuracy, minimizing errors.	Information to be given personally- not just by the protocol	Development of lymphedema, not prepared for this to happen.
2017	Rattay	UK	Qualitative	21		Future predictive radiogenomics tests to feel more empowered for decision making. Information overload: advance knowledge leading to anxiety, dread, powerlessness (absence of symptom management)	
Year	1st Author	Country	Design	N=	Key findings		
					Perceptions	Educational expectations	Knowledge gaps
2009	Schnur	USA	Qualitative	15	,RT is imperceptible, invisible, mysterious. Feeling of being too trusting. Damaging and destroying other body parts. Effectiveness?		
2021	Sharifzadeh	USA	Cross-sectional	185	Disbelief of RT's ability to reduce BC recurrence		
2018	Shaverdian	USA	Cross-sectional	502	Frightening stories heard about serious side-effects, Little or no knowledge of RT at time of diagnosis. Fear of damage to internal organs and skin burning.		
2018	Shumway	USA	Cross-sectional	538	Burden of RT led to omitting treatment (3 %)	Role of RT and risk of cancer recurrence to be discussed properly (risk of patients omitting treatment)	
2012	Zeguers	The Netherlands	Cross-sectional	159		Chances of getting cured, short- and long-term side-effects. Treatments after RT.	
2024	Ulman	UK	Qualitative	14	Limited options to discuss symptoms of lymphoedema after RT. feeling of falling after cliff after treatment ends.		Unawareness of breast, trunk lymphedema as a potential side-effect (limited to the arm). Patients not believed when reporting symptoms: It is psychological. Symptoms difficult to acknowledge.
2017	Wang	USA	Cross-sectional	83		information about chances of survival essential for decision making in terms of receiving RT in older age (<70). Information regarding risks of recurrence with vs without RT rated as essential	
2011	Wong	Canada	Qualitative	16			Impact to logistics of machine malfunctions. Temperature of treatment room. Parking, travelling

RT, linking this limited understanding to heightened fear, anxiety, and stress during a challenging psychological period. [22–26]. Despite receiving information, patients often felt they did not fully comprehend the essence of RT until they experienced it themselves [27]. Furthermore, unlike other BC treatment methods, RT appeared mysterious to patients, which contributed to fears about not receiving the correct treatment and relying on something unseen[28]. This sentiment was captured in a participant’s concern: “I’m not getting the correct treatment. I’m being too trusting”. RT, as a treatment method poorly understood, was also perceived as intimidating by patients with BC. Primarily, the intimidation was associated with fear of the treatment machine [24–26]. A quote from a participant illustrates this; “It was better to know what it does and what it looks like... before you go in there...even when you go in there...see it for the first time... it’s a pretty eerie feeling...” [24].

Perceived quality of life during the treatment

Side-effects and burden of treatment. In several studies, BC patients associated RT with severe skin toxicity and fear of skin burning [22,28,29]. Some patients believed that RT inevitably leads to severe skin damage for everyone receiving treatment [29]. However, a participant viewed skin toxicity more positively in one study: “I know they’re aiming it right. It’s a check” [28]. Additionally, patients expressed worries about RT damaging internal organs and healthy tissues, such as the heart, lungs, and ribs [22,27]. One study found that nearly half of the respondents had heard or read alarming stories about serious side effects [22]. BC patients often perceived RT as burdensome, with concerns about feeling tired and sick because of the treatment. Due to the perceived burden, some patients chose to skip RT altogether, as

Table 2
Codes, subthemes and overarching themes of perceptions.

Code	Subtheme	Overarching theme
Unknown treatment and technology		
Intimidating machine and treatment environment		Understanding and knowledge of RT
Lack of understanding of RT		
Mysterious and invisible Being tired and sick		
Concerning side-effects	Side effects and burden of treatment	
Damage of RT to the body		
Burdensome treatment Humiliating self-exposure to strangers		Perceived quality of life during treatment
Feeling dehumanized, disempowered, vulnerable	Emotions experienced	
Cultural stigmatization		
RT as Technology-focused treatment		
Impact of permanent tattoos Worry about the prognosis		Perceptions about life after RT
Worry about effectiveness of RT		
Effect of changes in treatment plan to survival	Effectiveness of RT and prognosis	
Fear of last fraction		
Discontinuity of care	End of care pathway	
Returning to work		

highlighted in another study [30].

Experienced emotions associated with the RT process. Seen as technology-focused care [31], some patients perceived it as dehumanizing and disempowering. A significant aspect causing mixed feelings was receiving permanent tattoos. On the one hand, patients realized the importance of tattoos in terms of treatment accuracy and minimizing errors; however, they also mark a permanent reminder of having had BC: “I did feel suddenly that there was something permanent happening....it felt like you know we’ll cut this out, I’ll get better and then you’re going to be permanently tattooed”. Several studies highlighted patients’ sense of impersonal approach, losing the dignity of being exposed to strangers [26,28,31,32]. Quote from a participant: “I was laid on the bed obviously naked from waist up, it felt really impersonal...there was nobody having a chat with me at all, it was just business” [32]. Depending on the cultural background, exposing yourself to male staff may be a severely traumatizing experience: “Exposing my breast in front of the doctor was the most traumatic experience for me...I was distressed at having to endure this intense suffering. When my tumor was removed, I was relieved of my physical ailment, but the agony of losing my honor and dignity will stay with me” [26].

Perceptions about life after RT

Effectiveness of RT and prognosis. Studies revealed that patients with BC had hesitations in RT’s effectiveness and prognosis after receiving it [23,26,28,33]. A quote from a participant: “How can radiation on one tiny

part of the body have this overall effect?” [28]. Some patients perceived any changes in the treatment plan, either technically or logistically, to impact their survival [27]. One study found that participants’ beliefs in the prognosis and life after treatment were seen in two significantly controversial categories: 1) once treatment ends, their lives will be problem-free, which was illustrated by quotes such as: “I’ll feel better once the situation changes “or 2) once treatment ends, they will never be healthy again [28]. Worry about the prognosis was also expressed by quote: “I am just worried about what will happen after this therapy. Will I get better or not? I worry that this is the last treatment, and after that, what is next?... they say it is a last treatment... what is next?” [26]. Furthermore, permanent anxiety after the treatment occurred among BC patients, which was associated with the follow-up diagnostic scans and living from one appointment to another, being constantly worried about the results. Secondly, the fear was related to the possible development of additional cancers and/or recurrences of this cancer [28,32].

End of care pathway. BC patients are afraid of the end of RT as the last treatment, leaving them in isolation, without continuous care in a safe hospital environment and the possibility to ask for advice if something happens or is concerning, such as symptoms of side effects [25,26,32,34]. One study also found that patients worry about returning to work and explaining their health status to co-workers in detail as they may not be able to participate in, for example, all the social events [32]. End of treatment may even be a significant source of depression [32]. The impact of cancer may never leave due to visible reminders such as surgical scars; moreover, many suggest it was just beginning, becoming a cancer survivor [25].

Breast cancer patients’ educational expectations of radiotherapy

Educational expectations were found to be reported in 12 studies. These were identified as phrases and expressions that stated patients ‘expectations, needs, interests, or level of assessment regarding the information received. The findings revealed expectations in two main categories: general information about the entire treatment pathway, including RT, and specific disease aspects and treatments. Importantly, the pathway doesn’t conclude with RT; educational expectations include understanding post-treatment processes. Additionally, there was a call for more detailed information on RT and its potential side effects. The analysis identified 12 codes, four sub-themes, and two main themes. (Table 3).

Table 3
Codes, subthemes, and overarching themes of educational expectations.

Code	Subtheme	Overarching theme
Disease		
Support		
Role of RT	Treatment pathway and psychosocial support	
Recurrence		
Prognosis		Comprehensive patient care
Personalized treatment	Personalized aspects of RT	
Individualized approach		
Planning		
Delivery	RT planning, delivery and follow-up	Holistic overview of RT process
After RT		
Side-effects	Side-effects caused by RT	
Damage		

Comprehensive patient care

Treatment pathway and psychosocial support. Several studies revealed that patients with BC expect more information and discussions regarding their disease and the role of RT in general [30,35–37]. Notably, patients who had received combined treatment reported lower levels of information. Moreover, a higher proportion of younger women (<54 years) wanted more information, as well as women treated with chemotherapy before RT [35]. To aid decision-making on RT, patients are expected to be fully informed about the possibility of being cured with RT [38]. Patients also reported not to have received adequate information about cancer recurrence [30]. Moreover, a study that explored decision-making in older age (>70) revealed that most of the participants rated information about chances of survival as well as risks of recurrence with or without RT essential [39]. Furthermore, BC patients also anticipate a deeper understanding of psychosocial support options. This aspect was especially prominent in the younger respondent group [35].

Personalized aspects of treatment. BC patients anticipate receiving more individual information, not just by the general protocols [31]. Regarding the individual aspects influencing treatment and its outcomes, it was found that most of the patients (90 %) wanted to be informed about their individual coronary artery calcifications (CAC) score, detectable on RT treatment planning CT scans, having the opportunity to assess the risks of developing cardiovascular disease after cancer treatment [40]. Another study demonstrated that participants were interested in future predictive radiogenomics tests to evaluate the potential severity of side effects. Although the knowledge would provide them with a sense of empowerment in decision-making, some participants were concerned about information overload, heightened anxiety, and powerlessness in case of the absence of symptom management [41].

Holistic overview of the RT process

RT planning, delivery, and follow-up. In two studies[27,37], patients desired more detailed information about RT planning. They needed further explanation regarding the first planning appointment, the overall planning process, and the specific steps involved, including which parts of the breast will be treated. Additionally, patients expected similar information about the treatment delivery: what to expect during treatment, what the machines would be like, and what would happen during the first session. This aligns with findings from another study [36], where nearly half of the respondents felt they required more information about RT. Furthermore, it was noted across two studies that patients also wanted earlier details about life after treatment, including any subsequent treatments they might need to undergo [27,37].

Side effects caused by RT. Patients consistently expressed a need for more information about the side effects of RT, making it a prominent topic of interest. Nearly half of the sources highlighted this need [23,27,29,38]. Some studies categorized side effects broadly, discussing either general side effects or ongoing issues after treatment [27] or distinguishing between short-term and long-term effects [38]. Other sources offered more detailed expectations [23,29,37], including information about the impact on the skin, heart, and lungs [23,37]potential damage to the immune system, healthy cell tissues, and bones, as well as pain caused by RT and the risk of developing secondary cancers [23]. One study pointed out that the healthcare team inadequately addressed education on skin changes, leading to severe skin changes for some patients [29].

Knowledge gaps of BC patients regarding RT

Knowledge gaps defined as BC patients’ awareness and unmet needs of specific topics regarding RT influencing preparedness for the

treatment or follow-up period were found in 6 studies. Eight codes and three overarching themes were identified. No subthemes emerged from the data. (Table 4).

Lack of preparedness and support

In one study, some patients reported feeling unprepared for treatment, with 24 % expressing that they did not know what to expect. Additionally, half of the patients voiced concerns about unmet needs in emotional health and relationships [32] This lack of awareness was further highlighted by the fact that most were not informed about available psychosocial support initiatives [42].

Unexpected risks and side-effects

One of the studies indicated that nearly half of the respondents were either unaware or only slightly aware of the risks associated with treatment-induced cardiotoxicity [40]. Additionally, most patients did not recognize that those with pre-existing cardiovascular risk factors were at an even greater risk, even though they expressed concern about it. Another study [32] revealed that 36 % of respondents reported unmet informational needs regarding side effects, particularly highlighting the unexpected consequences of radiation dermatitis, which can lead to severe skin damage. Further research identified lymphoedema as a side effect of radiation therapy that many patients were unprepared for [31,34]. Patients noted that they were not adequately informed about breast or trunk lymphoedema, as discussions often focused solely on arm lymphoedema. Symptoms associated with this side effect are commonly rare, leading to responses from healthcare providers suggesting that patients’ concerns might be “all psychological.” This perspective has made it challenging for some women to acknowledge and address their symptoms effectively.

Daily practicalities

In two studies [32,43], participants highlighted unexpected aspects of daily treatment, such as the noise produced by the linear accelerator and the procedure for relocating patients in case of machine malfunctions. Some were caught off guard by the cold temperatures in the treatment room. Additionally, logistical challenges like securing a parking spot, arriving on time, and commuting for treatment during winter presented difficulties that were, at times, more daunting than the radiation treatment itself. Furthermore, some patients noted inadequate information regarding daily nutrition, with concerns such as “I did not want to eat something that could feed my cancer,” reflecting the gap in guidance provided [32].

Discussion and conclusion

Discussion

This study aimed to explore the educational expectations, perceptions, and knowledge gaps among BC patients undergoing RT, providing a foundation for future educational interventions. This investigation

Table 4
Codes, subthemes, and overarching themes of knowledge gaps.

Code	Overarching theme
Preparedness Support Cardiotoxicity Dermatitis	Lack of preparedness and support
Lymphoedema	
	Unexpected risks and side-effects
Practicalities Logistics	
Nutrition	Daily practicalities

uncovered interconnected themes that deepen our understanding of patient needs.

There are consistent themes across studies that highlight gaps in patient education about RT, the emotional and psychological impact of RT, and the perceived burden of treatment. Approximately 60 % of BC patients [22–26] report significant misunderstanding and fear surrounding RT due to its technological complexity, which can lead to anxiety. RT is often seen as mysterious and invisible compared to chemotherapy or surgery, leading to distrust in a treatment that cannot be felt. Side effects during treatment can lower quality of life, with some patients incorrectly connecting these effects to the precision of RT, reflecting a misunderstanding of the treatment. Previous studies [2–6] have supported these concerns, emphasizing the critical role of quality information in shaping patients' trust and perceptions.

Emotions throughout the RT journey significantly impact how patients perceive the treatment. A technology-driven approach, including practices like tattooing, can lead to depersonalisation and heightened anxiety. As highlighted by Moser et al. [44], permanent tattoos serve as painful reminders of the cancer experience, adding to the emotional burden. Misunderstandings about RT's effectiveness also arise from a lack of understanding, weakening trust in the treatment. Prognostic perceptions differ widely; some patients expect life after treatment to be problem-free, while others fear they will never fully recover [23,26,28,33]. Even the conclusion of RT, typically viewed as a milestone, can introduce stress and anxiety, particularly when patients feel isolated after treatment and are anxious about follow-up scans or recurrence [25,26,32,34]. The fear of isolation after treatment completion, along with the unpredictability of side effects, makes this a psychologically challenging period for BC patients. Thus, organized follow-up care is essential, as also emphasized in previous studies [2,45].

A significant portion of BC patients (30–40 %) [22,28,29] feel uninformed about RT's long-term effects, especially side effects and prognosis, leading to unmet psychosocial needs and unpreparedness for post-RT challenges. Gaps exist in education about treatment side effects, recurrence risks, and personalised plans. Two studies [32,43] revealed challenges during radiation, including discomfort from machine noise, cold rooms, and parking issues. Patients found these more stressful than treatment. Concerns about nutrition, particularly foods that might “feed cancer,” underscore a lack of information. The few studies indicating these issues suggest they may not be universal, highlighting the need for consistent focus on both physical and psychological aspects. Improved educational strategies could enhance patient experiences and outcomes, necessitating comprehensive, personalized care with better pre-treatment education and ongoing support.

Cultural differences significantly shape emotional responses and treatment perceptions. In countries with advanced healthcare systems like Sweden, the UK, and Australia, clear communication and emotional support are emphasized, alleviating patient concerns [46–48]. However, the focus on technical details and individual roles can vary, affecting patient engagement with educational information. In contrast, resource-limited countries like Pakistan face challenges in delivering consistent educational interventions, leading to knowledge gaps [49]. These healthcare disparities arise from differences in infrastructure and cultural expectations about patient care, highlighting the need for tailored educational interventions for different populations. In collectivist cultures like Pakistan, family involvement in decisions is crucial, whereas individualistic cultures, such as the USA, prioritize technical details and personal autonomy [50]. Such cultural factors influence patient perception of educational materials and emotional responses.

BC patients seek personalized information, with topics such as individualized cancer risk scores and radiogenomics testing becoming more significant [41]. However, these areas may overwhelm patients with complex data. Healthcare providers must ensure that information is presented alongside support to help patients interpret and benefit from it. Creating culturally sensitive, patient-centered educational

interventions is essential to make information relevant and understandable for patients. Additionally, BC patients want comprehensive details about the initial planning appointment and the first RT fraction, highlighting the need for a structured approach for explanation [27,37]. The importance of visualizing the machines and equipment involved is highlighted in several studies [2,5–7]. Metsälä et al. [2] also emphasize the importance of providing thorough information about the follow-up period. At the same time, Gillan's study [5] stresses the need to educate patients about side effects, particularly those related to nearby critical organs and potential whole-body side effects. Addressing these concerns helps reassure patients about what to expect during RT.

Healthcare professionals must meet the individual needs of BC patients by regularly assessing their informational and emotional requirements throughout the RT process [7]. Duoma et al. [16] emphasize the importance of ongoing discussions due to the complexity of the RT pathway. Tools like questionnaires and interviews help identify knowledge gaps and emotional concerns. Tailored educational interventions and flexible communication enhance personalized care, offering information in formats that suit patient preferences [51]. Follow-up consultations clarify previous information and address new concerns. Integrating psychosocial support into education improves patient experiences. Dinapoli et al. [52] note that psychotherapeutic and supportive methods are effective across various patient groups. Support groups or counselling can alleviate feelings of isolation and anxiety, especially in cultures where emotional expression is limited. Educating patients on emotional coping and the treatment's physical aspects is vital for their well-being and adherence [53]. Additionally, a recent study identifies modesty as a concern for women undergoing RT, influenced by personal and hospital factors, urging interventions to safeguard patients' physical and emotional well-being, including better communication and body image support [54].

This review highlights the need to address both the technical treatment aspects and the cultural healthcare environments affecting patient experiences. In countries with robust healthcare systems like Sweden, the UK, and Australia, patients benefit from educational resources that reduce anxiety related to RT. [46–48] Whereas innovative educational strategies can benefit resource-limited countries like Pakistan. In the USA, private healthcare leads to educational disparities due to insurance, while Canada's public system, despite financial and healthcare provider challenges, supports fair access to essential educational resources. [55]. Culturally sensitive educational methods are vital to enhancing patient engagement and adherence while reducing anxiety.

Limitations

This review provides an overview of educational interventions for BC patients undergoing RT, but limitations exist, such as excluding grey literature, possibly omitting relevant findings. The studies varied in design and sample sizes, affecting synthesis and generalizability. Moderate bias risks in some studies may impact conclusions. Additionally, the review did not differentiate between educational approaches, leaving it unclear whether interventions were adequate. However, it highlights patients' perspectives and key themes for healthcare professionals to address.

While the study offers insights into educational expectations and knowledge gaps, the diversity in methodologies calls for caution in generalizing findings. Future research should standardize the evaluation of educational interventions across healthcare systems. Longitudinal studies tracking patient experiences during treatment and follow-up would yield more robust data on evolving information needs.

Future research should prioritize personalised education that addresses individual needs, including cancer risk scores and psychosocial support, to enhance anxiety management and treatment adherence. Technological solutions, such as apps and virtual consultations, can help bridge knowledge gaps in resource-limited areas. It is essential to recognize cultural differences in education and perceptions of

radiotherapy to develop effective, culturally sensitive interventions. Furthermore, concentrating on long-term care, healthcare systems, and knowledge gaps regarding side effects, radiogenomics, and nutrition can improve patient preparedness and outcomes.

Conclusions

The complexity of RT highlights the necessity for a patient-centered approach that addresses technical, emotional, psychological, and cultural factors. Healthcare professionals must recognize that gaps in patient education stem from the complexity and uncertainty of RT. Providing tailored information is crucial for helping patients understand their treatment, manage anxiety, and build trust. The emotional challenges require adaptable, individualized communication strategies. Professionals should customise educational interventions to meet each patient's needs, ensuring clarity and relevance while fostering trust. This involves thorough explanations of treatment plans, side effects, and follow-up care, along with psychosocial support to alleviate feelings of isolation. Patients also seek personalized information like cancer risk scores and radiogenomics; thus, providers should assist in interpreting this data. Continuous, culturally appropriate education empowers patients, enhances adherence, and improves health outcomes. Advancements in breast cancer care depend on comprehensive, patient-centered practices that respect each patient's perspectives, aiming to empower patients in health management, reduce disparities, and increase satisfaction. Furthermore, innovations like mobile applications and virtual consultations can bridge knowledge gaps, especially in resource-limited settings.

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Data availability

Data will be made available on request.

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