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REVIEW

The relationship between cancer patient's fear of recurrence and radiotherapy: a systematic review and meta-analysis

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Abstract

Objective This review aims to provide an overview of the current knowledge available on the nature and extent of the relationship between external-beam radiotherapy (RT) and fear of cancer recurrence (FoR).

Methods PubMed, MEDLINE, and EMBASE databases were searched to identify relevant studies. Systematic review procedures were followed including a quality assessment. Meta-analysis of suitable studies was conducted.

Results Twenty-five eligible studies were included in the systematic review, and 15 of them were included in further meta-analysis. Meta-analysis of the available data confirmed a weak relationship between RT and FoR (15 studies, 9567 patients, overall r = 0.053, 95% confidence interval, 0.021-0.085, P = .001). Subgroup analysis based on cancer site (breast cancer versus other types of cancer) revealed that the correlation between RT and FoR was statistically significant in "other cancer" group (P < .001) but was nonsignificant in "breast cancer" group (P = .538).

Conclusions While meta-analysis reports a statistically significant association between cancer patient's FoR and the receipt of RT, these results should be interpreted with caution owing to significant variability between studies. Further longitudinal studies should be conducted to address the trajectory of FoR over RT in greater detail.

KEYWORDS

cancer, fear of recurrence, meta-analysis, oncology, radiotherapy

1 | BACKGROUND

Radiotherapy (RT) is a treatment frequently used for cancer patients involving the use of high-energy radiation.[1] Almost a half to two-thirds of cancer patients will have RT as part of their treatment plan (adjuvant treatment), and almost 75% of patients who received RT are treated to cure the cancer, rather than to relieve symptoms such as pain.[2] Radiotherapy is delivered in 2 ways—external to the body by a machine (external-beam RT) or within the body by judicious siting of radioactive material (brachytherapy [BT]). According to the latest data, about 88% of patients received RT, while the remaining 12% of patients received BT.[1,2]

The fear of recurrence (FoR) is common among cancer patients and survivors.[3] Fear of recurrence is considered to persist long after the termination of treatment and into the chronic stage of survivorship.[3] Fear of recurrence is reported by 33% to 96% of cancer patients[4–7] and may predict poorer quality of life outcomes up to 6 years after diagnosis.[8] Cancer patients who suffer from high FoR report negative behavior change (eg, avoidance behavior and excessive personal checking behaviors),[9] increased health service use,[10] inability to plan for the future,[11] and significant psychological distress, such as depression, anxiety, and post-traumatic stress symptoms.[4,12–14]

In recently published studies, a variety of factors were found to be associated with patients' FoR level.[3] Demographic characteristics such as female gender, young age, and a higher level of education have been reported to be related with higher FoR. In addition, studies have shown that white women are more likely to have higher worry levels than African Americans.[15–21] Various treatment characteristics, such as having received a mastectomy or chemotherapy and having more physical symptoms, have been identified as strong predictors of FoR. However, these findings are not always consistent.[16,17,21–23] For example, Mellen et al[24] and Leake et al[22] reported that treatment type (chemotherapy, surgery, or RT) was not related to patient's FoR. Llewellyn et al[8] reported that FoR had no association with any sociodemographic or treatment factors.

To date, although studies have reported that cancer patients may suffer from different psychological problems such as anxiety, depression, and psychological distress, in the course of RT,[25,26] there have been few studies investigating, specifically, the relationship between patient's FoR and RT. A previous systematic review by Simard et al[3] reported a weak to moderate association between treatment type (surgery/chemotherapy/RT) and FoR. However, the result is not entirely convincing as it combines RT and BT. They are different treatment applications, as previously highlighted, and are likely to be perceived by patients with a variety of psychological representations. Therefore, our research team decided to focus deliberately on a specific study of RT and its possible association with FoR and exclude BT. The reason to focus solely on RT, as opposed to, or in combination with BT, is that RT is the most frequent medium of treatment using ionizing radiation, which involves specific units including resource intensive physical and capital environments in the design of clinics and specialist units, while BT is more novel, delivered on a smaller scale and with less public awareness of the procedure. There may be value to the health provider team to learn of patient reaction to their treatment and enable additional avenues of intervention to assist patients through the experience of a common treatment delivery in cancer care.

The aim of this study is to conduct a systematic overview and meta-analysis of FoR-RT–related quantitative studies to test the association between cancer patient's FoR and the receipt of RT. By systematically summarizing current knowledge, an indication of the influence of RT on FoR may be provided.

2 | METHOD

2.1 | Literature search

The study was conducted in accordance with the PRISMA guidelines for a systematic review and meta-analysis.[27] The Ovid MEDLINE, PubMed, and Ovid EMBASE (1974 to May 2016) databases were utilized. The key search terms were as follows: cancer/carcinoma/neoplasm, fear/worry/concern, recurrence/progression/return, and radiation/radiotherapy/radiation therapy. Searching was performed using the OR and AND functions. The detailed search strategy is outlined in supplementary Table S1. The reference lists of identified review articles as well as all included studies were also screened manually for any additional relevant studies. No restrictions were placed on publication date.

2.2 | Inclusion and exclusion criteria

To be included in the review, references had to (*a*) be published in a peer-reviewed journal; (*b*) be written in English; (*c*) include adult patients; (*d*) include patients who had been treated with RT (with/without other treatment type); and (*e*) be quantitative studies and report FoR results. Studies using similar, but not accurate keywords such as "fear of dying," "fear of the worst happening," or "chemoradiotherapy" were excluded. Additionally, studies were excluded if they were case studies, commentaries, reviews, conference abstracts, dissertations, and qualitative studies. Studies were screened for eligibility and codetermined by 2 reviewers (Y.Y. and G.H.).

2.3 | Data extraction and quality assessment

The search identified potential eligible records. After removing duplicate studies, titles and abstracts of search results were reviewed, and unsuitable studies were excluded. Then full papers were obtained and examined, and articles that fulfilled the inclusion criteria for the review were included. For each study, the following information was gathered: first author's name, year of publication, study design, and basic demographic information, such as country where the study was conducted, age, and sample size. In addition, cancer type, measure of FoR, and main findings were noted.

The quality of each included study was assessed using QualSyst criteria (Standard Quality Assessment Criteria for quantitative studies,[28] see Table S2). Items were scored on the specific criteria (yes = 2, partial = 1, and no = 0). A summary score was calculated for each paper and defined as strong (score > 0.80), good (0.70-0.80), adequate (0.50-0.70), or limited (<0.50). Any paper of limited quality was excluded. In case of disagreement about a paper, reviewers (Y.Y. and G.H.) repeated their assessment of the study and in discussion reached consensus.

2.4 | Statistical analysis

On completion of the systematic review, a quantitative meta-analytic approach was applied. The program Comprehensive Meta-analysis was used.[29] The effect size was calculated by applying routines to derive a correlation (*r*) with accompanying 95% confidence intervals (CIs). The effect size was calculated by *r* but not the Hedges *g* because several of the included articles[20,30,31] had very large sample sizes. The corresponding authors of articles with incomplete data were contacted by email to obtain the required data unavailable in the published article. Studies for which the corresponding authors could not be reached were subsequently excluded from the meta-analysis.

Statistical heterogeneity among the articles was reported by the *Q* statistic, a *P* value less than .10 or an I^2 value greater than 50% was considered as substantial heterogeneity.[29] If substantial heterogeneity was observed, the correlation will be calculated according to the random-effects model; otherwise, the results would be calculated based on the fixed-effects model. The selection of the computational model was based on the understanding of the underlying distribution. Under the fixed-effect model, we assumed that the true effect size was the same in all studies, while in the random-effect meta-analysis, we expected the effect size to be similar but not identical across studies. True effect sizes were assumed to be normally distributed under this model.[29]

A subgroup analysis based on the cancer site was performed (breast cancer versus other types of cancer). The percentage of breast cancer patients treated with RT has increased substantially during the past 2 decades.[32] According to the best available evidence, RT would be recommended in 83% (95% CI, 82%-85%) of patients with breast cancer.[33] In the articles included in the meta-analysis, over half of the patients were diagnosed as having breast cancer (5680 of 9567 patients, 59%). Therefore, the subgroups breast vs other cancers were chosen pragmatically, to investigate the potential value of cancer type on the relationship between RT and FoR. In addition, the Rosenthal "fail-safe *N*" procedure was adopted to estimate the number of

negative studies that would be required to overturn the total aggregated result. Funnel plot and the Egger regression intercept test were also performed in this review to assess publication bias.

3 | RESULTS

3.1 | Characteristics of included studies

The search process is shown in Figure S1 . The literature search of 3 databases identified 751 references. Duplicates were excluded revealing 356 titles. Examination of abstracts for appropriateness left 55 articles. After retrieving full texts and further assessment, 25 studies were included in the systematic review. All of them were evaluated using the QualSyst criteria, and none of them had the score of limited quality (see Table 1). However, 10 studies were excluded from further meta-analysis (1 prevalence rate study,[34] 2 longitudinal studies,[35,36] and 1 strong outlier in funnel plot,[37] and 6 did not report specific statistic values[16,22,24,38–40]). Therefore, 15 articles were finally included in the meta-analysis.

The publication dates of the studies included ranged from 1981 to 2016. One article was published in the 1980s and 11 in the 2000s, and the remaining studies were published since 2010. Thirteen studies were conducted in North America, 9 in Europe, and 1 each in Australia, Korea, and China. The cumulative sample size including all studies was 11 129 (ranged from 30 to 2671), and the mean age of cancer patients participating in all studies ranged from 44 to 72 years, with 6 studies not reporting a median or mean age. Regarding the FoR instruments, standardized assessment measures were lacking, and self-reported questionnaires were frequently used (as opposed to standardized interview). The number of scale items ranged from 1 to 42, and only 10 studies reported the validity/reliability of the measurement. Main characteristics and findings of the included publications are presented in Table 2.

3.2 | Systematic review

Twenty-five studies were included in the systematic review, 1 article[34] studied the prevalence rate of FoR after RT in mainland China, 2 longitudinal studies[35,36] measured patient's FoR level over/after RT, and the remaining 22 studies[11,16,19,20,22,24,30,31,37–50] evaluated the impact of RT on patient's FoR. Conflicting evidence was found among these 22 studies. Seven articles[19,20,40,44,46,49,50] suggested that RT was associated with higher FoR. One[30] suggested that patients who had received RT were less likely to experience moderate/high FoR (odds ratio 0.72, CI, 0.55-0.94), while the remaining 14 studies reported that RT and FoR were not systematically associated.[16,22,24,31,37–39,41–43,45,47,48,51]

3.3 | Meta-analysis

The meta-analysis statistics derived from the 15 articles consisted of the following: *P* value (9 articles[11,20,42,43,45–47,49,50]), correlation coefficients (3 articles[19,41,44]), odds ratios (2 articles[30,31]), and means and standard deviations (1 article[48]). Heterogeneity test showed that the *Q* value of this review was 29.46, the *P* value was less than .1, and the I^2 value was greater than 50% (*P* = .009; I^2 = 52.482); therefore, a random-effect model was used. By using random-effect weights, the summary estimate of the correlation was 0.053 with a 95% CI of 0.021 to 0.085. The *Z* value was 3.275, and the *P* value was .001 (2 tailed).

Subgroup analysis showed that cancer type was linked to the degree of association; namely, the "other cancer" group showed a statistically significant correlation between RT and FoR (*P* < .001) while the "breast cancer" group showed a nonsignificant result (*P* = .538, see Figure 1). The correlation value of "other cancer group" (*r* = 0.089) is significantly higher than that of "breast cancer group" (*r* = 0.014, *P* = .001). Additionally, the fail-safe *N* value, which calculates the number of missing studies that would bring the *P* value to less than an α of 1.96, was found to equal 64. In the examination of the funnel plot, 15 studies were noticeably distributed symmetrically about the mean effect size (see Figure S2). The Egger regression intercept test showed no statistically significant *P* value (intercept = 0.448, standard error = 0.61, *T* = 0.74, and *P* = .48); therefore, we assume that no apparent publication bias was found in this review.

4 | DISCUSSION

This is the first systematic review and meta-analysis that explores the association between RT and FoR. Overall meta-analysis indicated that patient's FoR level was statistically significantly associated with the receipt of RT, although the correlation is weak. This result should be interpreted with great caution because even though a positive association is shown, it is questionable if this relationship is clinically significant. A careful inspection of the various studies within this review may signal an understanding of why this relationship, although positive, is not strong.

The collective of breast cancer studies showed a nonsignificant relationship between RT and FoR. One possible reason for this is that Koch's study reported 2671 patients with a negative correlation between RT and FoR. This large-sample study dominated the overall breast cancer group sample size and had therefore a strong influence on the overall subgroup result. In addition, among all the articles, this was the only study that reported RT as a protective factor for cancer patients. Removal of this study resulted in a significant positive association consistent with subgroup result for the other cancer sites.

According to the systematic review, 7 studies demonstrated the positive association of RT receipt with greater FoR. The side effects and symptom burden caused by RT may contribute to this result. Significant side effects are common with RT and contribute to the symptom burden. Previous research revealed that RT-induced side effects are usually chronic and progressive and can be sustained for many years after the end of treatment.[52] Strong evidence was found for an association between residual physical symptoms and elevated FoR.[24] Therefore, it is reasonable to conceive that RT-related symptoms, such as tiredness and skin reaction, might be viewed by patients as a constant reminder of their cancer or be misinterpreted as an indicator of cancer recurrence, which leads to higher FoR score. Also, some patients may believe that the effect of RT may be a risk factor for new malignancies. The results point to the need for patient education

TABLE 1 Quality assessment of included studies

Study	Item 1 Question Describe	Item 2 Study Design	Item 3 Method of Subject	Item 4 Subject Characteristics	Items 5-7 Intervention/ Blinding	Item 8 Outcome/ Measure	Item 9 Sample Size	Item 10 Analytic Methods	Item 11 Estimate of Variance	Item 12 Confounding Control	Item 13 Result Report	Item 14 Conclusion	Quality
Simard	2	2	2	2	N/A	2	2	2	2	1	2	2	Strong
Janz	2	2	2	2	N/A	2	2	2	1	1	2	2	Strong
Hong	2	2	2	1	N/A	2	2	2	2	2	1	2	Strong
Tewari	2	2	2	1	N/A	1	2	2	1	2	2	2	Strong
Van de Wal	2	2	2	2	N/A	2	2	2	1	1	2	2	Strong
Deimling	2	2	2	2	N/A	2	2	2	1	2	2	2	Strong
Liu	2	2	2	2	N/A	2	2	2	1	0	2	2	Strong
Mellon	2	2	2	2	N/A	2	2	2	2	2	1	2	Strong
Sung	2	2	2	2	N/A	2	2	2	2	0	2	2	Strong
Stanton	2	2	2	1	N/A	2	1	2	1	2	1	2	Strong
Hong	2	2	2	1	N/A	2	2	1	2	0	2	2	Strong
Skaali	2	2	2	2	N/A	1	2	2	2	0	2	2	Strong
Bergman	2	2	2	2	N/A	2	2	2	2	2	2	2	Strong
Rogers[49]	2	2	2	2	N/A	2	2	2	1	0	2	2	Strong
Koch	2	2	2	2	N/A	2	2	2	2	0	2	2	Strong
Rogers[43]	2	2	2	2	N/A	2	2	1	0	0	2	2	Good
Perrucci	2	2	2	1	N/A	2	2	2	0	0	2	2	Good
Wiley	2	2	2	2	N/A	2	1	2	1	0	1	2	Good
Ghazali	2	2	2	1	N/A	2	2	2	1	0	1	2	Good
Rabin	2	2	1	1	N/A	2	1	2	2	1	1	2	Good
Mehta	2	2	2	2	N/A	2	2	1	1	0	1	2	Good
Hartl	2	2	2	1	N/A	2	2	2	0	0	2	2	Good
Humphris	2	2	2	1	N/A	1	1	2	1	1	1	2	Good
Leake	2	2	2	2	N/A	1	2	1	0	0	1	2	Adequate
Northouse	2	2	1	2	N/A	2	0	1	0	0	1	2	Adequate

Quality assessment of included studies.

TABLE 2 Characteristics of the 25 included studies

First Author Year, Country	Study Design	Cancer Type	Sample Size Analyzed	Age at Survey Mean (SD)	FoR Instruments	Reliability	Main Findings
Simard, 2009, Canada	Cross-sectional	Breast	N = 600	Breast 59.0 (0.6)	Fear of Cancer Recurrence Inventory 42-item	Cronbach α = 0.95, test-retest *r* = 0.89	A significantly higher FCR was found in cancer patients who had RT (*P* = .005)
		Prostate		Prostate 69.1 (0.5)			
		Lung		Lung 62.0 (1.5)			
		Colorectal		Colorectal 61.6 (1.3)			
Janz, 2011, USA	Cross-sectional	Breast	N = 1837	56.8 (11.4)	Worry about recurrence scale (3 items, range 1-5)	Cronbach α = 0.88	RT was associated with higher FoR (*P* < .001)
Hong, 2010, USA	Longitudinal[a,c]	Prostate	N = 584	Unknown	Kornblith Scale (CaPSURE Questionnaire)	Unknown	Patients who received radiation and/or hormonal therapy experienced greater FoR (OR 2.78, 95% CI, 1.21-6.39)
Rabin, 2004, USA	Longitudinal[a,c]	Breast	N = 69	48.4 (9.3), range 30-73	Study-designed FoR Scale	Cronbach α = 0.84, test-retest *r* = 0.50	RT (received vs did not receive) was unrelated with FoR
Tewari, 2014, USA	Cross-sectional	Breast	N = 392	Unknown	Face-to-face interview (single question)	Unknown	Having had RT was correlated with increased worry about recurrence (*P* = .04)
Deimling, 2006, USA	Cross-sectional	Breast	N = 321	72.3 (7.5)	Cancer-related heath worries scale (4 items)	Cronbach α = 0.84	Having had RT was significantly related to worry of recurrence but was not a significant predictor (*r* = 0.13, *P* < .05)
		Colorectal					
		Prostate					
Mehta, 2003, USA	Longitudinal[b]	Prostate	N = 53	71.6	Fear of Recurrence Scale (5 items)	Unknown	FoR was more severe before RT, improved after RT, but did not change substantially in the 2 years thereafter
Hartl, 2003, Germany	Cross-sectional	Breast	N = 274	60.0 (11.6)	QLQ-C30-V2.0 questionnaire	Unknown	RT had no significant impact on patient's FoR (*P* = .75)
Liu, 2011, USA	Longitudinal[a]	Breast	N = 506	58 (10)	First 4 items from the Concern About Recurrence Scale	Cronbach α = 0.87	RT was unrelated to cancer patient's FoR (*P* = .87)
Humphris, 2003, UK	Cross-sectional	Orofacial	N = 87	58.3 (11.3)	Single item from the Worry of Cancer Scale	Unknown	RT was unrelated to cancer patient's FoR (*r* = −0.08)
Northouse, 1981, USA	Cross-sectional[c]	Breast	N = 30	Range 34-74	Fear of Recurrence Questionnaire (22 items)	72% of the items having correlations above 0.6	RT was not significantly related to cancer patient's FoR
Mellon, 2007, USA	Cross-sectional[c]	Breast	N = 123	65 (6.2), range 52-75	Fear of Recurrence Questionnaire (22 items)	Reliability coefficients = 0.92	RT was not related to cancer survivors or family caregivers' FoR
		Colon					
		Uterine					
		Prostate					
Leake, 2001, Australia	Cross-sectional[c]	Gynecological malignancies	N = 202	Unknown	A single FoR question	Unknown	RT was not related to cancer patient's FoR

(*Continues*)

Rogers, 2010, UK	Cross-sectional	Head and neck	N = 123	Unknown	7-item Fear of Recurrence Questionnaire	Unknown	There was no relationship between RT and cancer patient's FoR (P = .86)
Sung, 2011, Korea	Cross-sectional	Thyroid	N = 357	43.9 (11.3)	FoP-Q	Unknown	Use of postoperative radiation treatment had no significant effect on cancer patient's FoP (P = .414)
Stanton, 2002, USA	Longitudinal[a, c]	Breast	N = 70	52.63 (11.94), range 30-80	6 items from 22-item Fear of Recurrence Questionnaire	Unknown	RT was not significantly related to cancer patient's FoR
Hong, 2015, China	Cross-sectional	Nasopharynx	N = 216	47.81 (10.75)	QLQ-C30-V3.0 questionnaire	Unknown	FoR was a frequent RT-induced psychological distress in China (prevalence rate, 18.52%)
Perrucci, 2015, Italy	Longitudinal[b]	Breast	N = 117	Unknown	3-item FoR Scale	Unknown	FoR was unchanged at a median of 20 and 80 months after partial (P = .483) or whole breast irradiation (P = .417)
Skaali, 2009, Norway	Cross-sectional	Testicular	N = 1336	44.8 (10.1)	Single question of FoR	Unknown	RT was not associated with cancer patient's FoR (P = .85)
Wiley, 2013, USA	Cross-sectional[d]	Choroidal melanoma	N = 98	63.71 (range, 24-88)	The concern of recurrence scale	Cronbach α = 0.68	No difference in concern of recurrence between RT/BT group and enucleation group (Fisher Z = 1.280)
Bergman, 2009, USA	Longitudinal[a]	Prostate	N = 78	63 (8)	The memorial anxiety scale (5 items)	Unknown	RT was not associated with FoR (P = .97), and it did not predict change in FoR from baseline to 12 months (P = .24)
Rogers, 2015, UK	Cross-sectional	Head and neck	N = 513	65 (range, 58-72)	Single-item FoR	Unknown	There was significant association between having had RT with higher FoR (P = .001)
Koch, 2013, Germany	Cross-sectional	Breast	N = 2671	65	FoP-Q-SF	Cronbach α = 0.89	Patient having undergone RT was less likely to experience moderate/high FoR (OR = 0.72 [0.55-0.94])
Ghazali, 2013, UK	Longitudinal[a]	Head and neck	N = 189	62 (12), range 24-87	7-item FoR Questionnaire	Unknown	RT (received vs did not receive) was not associated with FoR level (M [SD]: 19.20 ± 9.40 vs 17.2 ± 8.10)
Van de Wal , 2016, Netherlands	Cross-sectional	Prostate	N = 283	70 (range, 54-89)	Cancer Worry Scale	Cronbach α = 0.88	RT is associated with higher FCR (t = −2.033; P = .043)

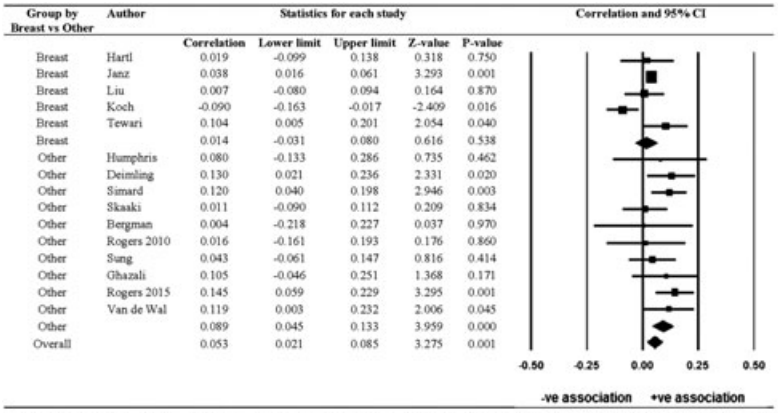
Abbreviations: BT, brachytherapy; FoP, fear or cancer progression; FoR/FCR, fear of cancer recurrence; OR, odds ratio; RT, external-beam radiation treatment; SD, standard deviation.

[a]Longitudinal design but not over the radiation treatment phase.

[b]Longitudinal design over/after the radiation treatment phase.

[c]Articles excluded from the meta-analysis—no specific statistical value.

[d]Article excluded from the meta-analysis—strong outlier in funnel plot.



Random effects meta-analysis of the correlation between RT and FoR, and subgroup analysis by cancer site. The size of the squares indicates the weight of the study. The diamond indicates the summary correlation. Abbreviation: CI: confidence interval.

FIGURE 1 Meta-analysis of the relationship between radiotherapy (RT) and fear of cancer recurrence (FoR)

about common RT side effects, both before and after RT, to provide patients with sufficient knowledge that they wish to receive. The aim of this additional attention to patient RT health literacy is to diminish FoR development.

Another reason may be patients' doubts about the efficacy of RT. Owing to the more conservative nature of RT, patients may feel less confident and hold concern that the tumor/cancer still exists inside their body; thus, patients are more likely to report higher FoR. One study[53] has found out that conservative treatment such as endoscopic therapy for esophageal cancer was associated with higher FoR, which may relate to patients' doubts about whether the cancer has been fully removed. A further reason for RT being interpreted by the patient as linked to FoR may be that they believe they have a more serious form of cancer that requires more intensive treatment. Some patients may regard the extra treatment as a useful and important protection against further disease. However, a proportion may well regard the additional mode of treatment with a sinister interpretation such as the disease is difficult to treat and is persistent, even in small traces.

There are, inevitably, limitations in this review that require consideration. These include the overall study sample's homogeneity (mostly white, old cancer patients), which precludes generalizations to more diverse populations or younger people with cancer, especially Asian. A lack of longitudinal studies over the course of RT is another limitation of this review. Many studies are cross-sectional with follow-up assessment. Further studies should focus attention on the development of FoR and how RT makes an influence on it. Moreover, the lack of standardized validated questionnaires is also an important fact that cannot be ignored. Fear of recurrence was measured using a range of scales among the included articles, and the number of items varied widely. The publication dates of the studies included also varied significantly (ranged from 1981 to 2016). Radiotherapy techniques have improved considerately in the past 15 years; therefore, patients may report different experience/side effects to RT. Last but not least, this review only involved a small number of studies: only 15 articles were included in the meta-analysis. No attempt was made to search for non-English publications or unpublished articles. Hence, we suggest that our research findings must be interpreted with caution.

Interventions in cancer patients may be warranted to alleviate their FoR and other psychological distress during RT. Such interventions could include the offer of counseling and psychotherapy providing adequate treatment-relevant information, and facilitating the support network from both health professionals and families. Cancer survivors who have high levels of FoR should be carefully identified and invited into appropriate psychological programs to assist them and help address overall negative effects on health-related quality of life.

5 | CONCLUSIONS

Although meta-analysis showed a statistically significant association between cancer patient's FoR and the receipt of external-beam radiation treatment, the relationship might not be clinically significant. Further longitudinal studies should be conducted to address the trajectory of FoR over RT in a more detailed way, and standardized validated FoR measurement should be developed and used.

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ETHICS APPROVAL

Ethics not required. This article does not contain any studies with human participants or animals performed by any of the authors.

CONFLICT OF INTEREST

Gerry Humphris has received grant support from Breast Cancer Now. Yuan Yang and Josie Cameron declare that they have no conflict of interest.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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