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Review

Evaluating Tools for Assessing Fear of Cancer Recurrence in Adults for Nursing Practice: A Systematic Review

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ABSTRACT

Objective: To identify, assess and compare internationally validated tools that measure the fear of recurrence in adult survivors of cancer.
Methods: This systematic review was based on the PRISMA reporting guidelines and COSMIN methodology was applied to analyses the psychometric properties and the validation process of the selected assessment tools. The search was conducted on 6 databases: PubMed/Medline, Cochrane Library, CINAHL, Web of Science, Scopus and LILACS, from 2001 to 2023. The descriptors used were: "fear of cancer recurrence," "tools," "validity," "reliability" and "cancer survivors." Studies focused on the design, validation or cultural adaptation of fear of cancer recurrence tools in adult cancer patients were selected. The COSMIN checklist was used to compare the tools measurement properties, including the following dimensions: conceptual suitability, applicability and psychometric features, and also to assess the methodological quality and the risk of bias of the different studies.
Results: 18 studies have been included. Three validated tools were identified for measuring fear of cancer recurrence in adults: CARS, FCRI and FCR7, which were also adapted in various languages. Although there are differences in the validation process, most of the tools were validated with acceptable psychometric properties and with a suitable cultural adaptation.
Conclusions: The 3 main tools identified are valid to measure fear for cancer recurrence although vary on their level of development, being FCR4/7 the most recent and consistent 1. Despite the availability of these tools, there is a lack of validated instruments in Spanish-speaking contexts. Regular use of these tools in Nursing practice would contribute to early detect fear of cancer recurrence and to effectively manage it, improving the quality of life of cancer patients. Recently, shorter versions have arisen to facilitate its applicability.
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Cancer is 1 of the main public health issues facing developed nations and is 1 of the most common causes of morbidity and mortality, affecting an increasing number of people.

Survival rates vary by cancer type as well as being influenced by stage of detection, diagnosis and treatment. According to the World Cancer Research Fund International,[1] the most prevalent types of cancer with the highest survival rates are: breast cancer, with a 5-year age-standardized survival rate over 85%; prostate cancer nearly to 90% in Europe and close to 98% in US; and colorectal cancer (men and women combined) around 59% in Europe and 65% in US. Cancer

Abbreviations: CARS, Concerns About Recurrence Scale; CFA, Confirmatory Factor Analysis; COSMIN, Consensus-based Standards for the Selection of Health Measurement Instruments; EFA, Exploratory Factor Analysis; FCR, Fear of Cancer Recurrence; FCRI, Fear of Cancer Recurrence Inventory; FCR4/FCR7, Fear of Cancer Recurrence Questionnaire in versions of 4 and 7 items; GRADE, Grading of Recommendations, Assessment, Development, and Evaluation; ICC, Intraclass Correlation Coefficient; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; PROM, Patient-Reported Outcome Measures; PROSPERO, International Prospective Register of Systematic Reviews

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Layperson Summary

What We Investigated and Why

We carried out a study to identify and compare internationally validated questionnaires designed to measure the fear of cancer recurrence in adult cancer survivors. The fear of recurrence in cancer survivors has gained increasing importance in recent years due to its impact on their quality of life. It is essential for nurses to use adequate systems to assess this problem and address it at an early stage in clinical practice.

How We Conducted Our Research

We carried out a review of studies published in the scientific literature between 2001 and 2023. We used search terms such as "fear of cancer recurrence," "tools," and "validity" to identify relevant research. We selected studies focused on designing, validating, or culturally adapting questionnaires for evaluating this fear in adult cancer patients. Additionally, we assessed the quality of the studies and any potential methodological biases.

What We Found

We identified 3 main questionnaires and 15 adapted versions in different languages that are useful for measuring fear of cancer recurrence but there is a lack of questionnaires in Spanish. These tools are valuable references for future adaptations to the context of oncology care in Spanish speaking countries.

What It Means

Having validated questionnaires is essential to detect and thoroughly assess fear of cancer recurrence in cancer survivors in a timely manner. Their early use in clinical practice can significantly improve patients' quality of life by enabling prompt and effective interventions.

patients' survival in Spain is similar to other European countries. It is estimated to have doubled in the last 40 years and is likely to continue to increase, albeit slowly, in the coming years.[2,3]

The increase in cancer survival rates means that oncology patients now experience different emotional needs in the medium term, especially once the treatment stage has finished.

Recent research has shown that fear of cancer recurrence (FCR), described by Lebel et al.[4] as "fear or worry that the cancer could return in the same place or progress to another part of the body," is 1 of the most common complaints cited by oncology patients. Despite being a problem of increasing magnitude, there seems to be a lack of consensus on the definition that complicates the identification and approach of FCR.

According to the results of the systematic review conducted by Simard et al.[5] in 2013, there are few studies addressing the prevalence and severity of FCR, due to the lack of a validated measurement tool to establish and assess levels of FCR severity. Despite this, the results showed that around 49% of survivors expressed a moderate-high level of FCR and an average of 7% expressed a severe level of FCR.

Studies reviewed in recent years show that fear of cancer recurrence (FCR) is a constant concern for cancer survivors with varying prevalence according to age, gender, cancer type and other clinical and socio-demographic factors. Overall, most studies show a high level of the FCR. In a Nova Scotia cancer population-based registry study published in 2025,[6] 38% of respondents (n = 823) reported FCR. In terms of age, younger respondents (aged 18-54 years) reported higher levels of FCR (66.1%), compared to respondents aged 75+ years who reported lower levels (24.4%). Regarding tumour type, the study conducted by Patel et al.[7] in 2024 in 115 adolescent and young women with breast and gynaecological cancer, 84% reported FCR and at a severe level 34% of the participants. In another recent study carried out in New Jersey and California in 389 oral and oropharyngeal survivors, 40% reported elevated global FCR.[8] The prevalence of FCR can also vary in relation to the treatments received as indicated in the work carried out by Han et al.[9] in 225 Chinese women after cancer surgery and chemotherapy treatment, where a high level of FCR was reported in more than 64%. Moreover, Stafford et al.[10] in 2023 analyzed FCR in a sample of 400 women with breast cancer in Australia and found lower levels of FCR among those patients who did not undergo adjuvant radiotherapy compared to those who did receive this treatment as well as surgery.

From the clinical perspective, it is necessary to acknowledge that some forms of FCR are considered normal and functional in cancer survivors, leading to responses of appropriate self-protection, such as remaining alert to possible signs of recurrence and adherence to therapeutic regimens.[11] However, maintaining a state of concern is not always enough for such patients, and when FCR increases, unwanted effects, such as functional deterioration, psychological symptoms, loss of concentration, reduced quality of life, and a propensity for depression, as well as greater recourse to health services, medication and frequent self-examination, can occur, with subsequent increases in health care assistance costs.[12,13] It is estimated that between 30% and 70% of people with FCR display a chronic concern that negatively affects their daily routine and quality of life.[14]

Fears and concerns related to cancer prognosis and a cure are present from the moment of diagnosis and continue throughout the entire treatment, transforming into a fear of recurrence in the monitoring stage. Severe FCR, also known as clinical FCR, does not spontaneously improve over time; in fact, it can worsen[5]; it is characterized by the misinterpretation of physical symptoms, the belief that the symptoms represent a recurrence, an exaggerated perception of threat, the constant search for peace of mind and an avoidance of situations that remind patients of their illness or treatment.

Despite the high clinical prevalence of FCR, the negative effect on the well-being of patients and their subsequent recourse to healthcare services, the majority of countries do not dedicate specific resources for a therapeutic approach to this problem. Clinicians recognize that FCR is a common problem in clinical practice but do not know how to manage it; it is seemingly impossible in most cases to establish measures for prevention, detection or early treatment or to dedicate specialist services for its evaluation and treatment once identified in the phases of severe FCR.[15]

Although FCR is identified in the scientific literature as a common problem with important negative consequences,[16] part of the difficulty in identifying cases is that few tools are available to evaluate oncology patients´FCR.

In the last decades there has been a significant growth of FCR assessment tools, with translated and short versions that need to be systematically evaluated to provide adequate criteria for their application in the different context, especially considering their psychometric properties to ensure the validity and quality of the data obtained.

The results of 2 recent systematic reviews highlight the importance of developing preventive approaches to early detection of FCR[17] as well as the need to design basic interventions to address the onset of mild to moderate symptoms and thus prevent progression to advanced levels.[18] For this reason, it is very important to have valid and reliable tools to assess levels of fear, which are also applicable in clinical practice and can be routinely integrated. There are interventions carried out by specialist breast cancer nurses[19] consisting of a single brief structured telephone intervention to target the antecedents of FCR. These specialist nurses highlight the perceived challenge regarding the measurement of FCR and the feasibility of the

intervention on their practice due to their workload and limited time, being essential to use adequate instruments to screen those patients at high risk of developing FCR. For these reasons, a systematic review of existing tools for measuring FCR is needed to provide enough information to allow nurses to identify and select the most appropriate instrument to assess FCR.

Therefore, this systematic review aimed to identify, assess and compare the existing validated tools to measure fear of cancer recurrence in adults considered "long survivors."

Methods

Study Design

A systematic review was carried out under the guidance of the COSMIN methodology of the PROMs systematic review[20-22] and reported in accordance with the PRISMA statement.[23,24] This study is registered with PROSPERO, n°CRD42021168705. Two reviewers, both of whom are experts in the design and validation of questionnaires and with clinical experience in oncology, performed the search and extraction of data.

Eligibility Criteria

Studies focused on the design, validation or cultural adaptation of fear of cancer recurrence tools in adult cancer patients were selected. The inclusion criteria were as follows: design, validation and/or cultural adaptation of the measurement tools; studies focused on the evaluation of fear of cancer recurrence; adult population; and no linguistic restrictions. Studies on children or relatives of patients with cancer and questionnaires designed to measure fear of contracting cancer in nononcological populations were excluded.

Information Sources

The bibliographical search covered the January 2001-January 2023 time frame, and the databases consulted were PubMed/Medline, the Cochrane Library, CINALH, Web of Science, Scopus and LILACS.

Search Strategy

The search equation design considered specific descriptors related to the methodology: ("tools," "evaluation tools," "validity," "reliability"); patient profile ("cancer patient," "cancer survivors") and the study object ("fear of recurrence," "fear of cancer recurrence") (Table 1).

Selection Process

The results were evaluated by 2 reviewers separately to identify eligible articles and to compare and agree on the results of the search. After the specific search strategy was applied to each database, the records were imported into Mendeley software, and duplicates were removed. The titles and abstracts were subsequently examined according to the inclusion and exclusion criteria, leading to the elimination of non relevant articles. Later, the full texts of the studies were extracted, and a final selection was made, excluding publications focused specifically on the application of tools rather than on the design and validation of the tools.

Data Extraction

The studies were grouped by name of the measurement tool, including the translated and culturally adapted versions, and were also organized chronologically by researchers in an Excel file. Data extraction and analysis were carried out by 2 independent reviewers (CDP and RCB, experts in oncology and research). Both reviewers applied common criteria and resolved any discrepancies identified in the search by further discussion to reach a consensus.

Assessment of Methodological Quality

Two authors independently assessed the methodological quality of the included studies via the COSMIN Risk of Bias checklist,[20] which focuses on the evaluation of the design and validation processes of health measurement instruments according to the following dimensions: PROM development, content validity, structural validity, internal consistency, cross-cultural validity/measurement invariance, reliability, measurement error, criterion validity, and hypothesis testing for construct validity and responsiveness.

Different systems have been used to assess these dimensions according to the recommendations of specific COSMIN tools:

1) Content validity: The COSMIN 10 criteria for good content validity[22] were used to evaluate instrument content validity, which can be rated as sufficient (+), insufficient (-), inconsistent (±) or indeterminate (?).
2) The psychometric properties of the instruments (structural validity, internal consistency, cross-cultural validity/measurement

Table 1
Search Strategy of Database Search

Database	Search equation	Filters	Limits
PubMed/Medline	#1 ((((validity) AND (tools)) AND (cancer patient)) OR (cancer survivors)) AND (fear of recurrence) #2 ((((validity) AND (tools)) AND (cancer patient)) OR (cancer survivors)) AND (fear of recurrence) NOT pediatrics #3 ((((validity) AND (tools)) AND (cancer patient)) OR (cancer survivors)) AND (fear of recurrence) NOT pediatrics NOT interventions #4 (((((((validity and reliability[MeSH Terms]) OR (tool[MeSH Terms])) OR (scale[MeSH Terms])) OR (instruments[MeSH Terms])) OR (questionnaire[MeSH Terms])) AND (fear of recurrence)) AND (cancer patients)) OR (cancer survivors) #5 ((((((((((validity and reliability[MeSH Terms]) OR (tool[MeSH Terms])) OR (scale[MeSH Terms])) OR (instruments [MeSH Terms])) OR (questionnaire[MeSH Terms])) AND (fear of recurrence)) AND (cancer patients)) OR (cancer survivors))) NOT (pediatric[Title/Abstract])) NOT (interventions[Title/Abstract])	01 January 2001-01 January 2023	No
Cochrane Library	#1 ((validity) AND tools) AND fear of cancer recurrence #2 ((((validity) AND reliability) AND tools) AND fear of recurrence) AND cancer survivors	January 2001-January 2023	No
CINAHL	#1 "fear of cancer recurrence" AND (validation or validity or validation studies) AND (tools or instruments)		No
Web of Science	#1 "fear of cancer recurrence" (Topic) and validity (Topic) and reliability (Topic) and tools (Topic) #2 (validity) AND (tools) AND "fear of recurrence" AND "cancer patients" OR "cancer survivors"	2001-2023	No
Scopus	#1 "fear of cancer recurrence" AND validity AND tools #2 validity AND reliability AND tools OR scale OR questionnaire AND "fear of recurrence" AND "cancer patients" OR oncology	2001-2023	No
LILACS	#1 (validity) AND (reliability) AND (tools) AND (fear of cancer recurrence)	2001-2023	No

invariance, reliability, measurement error, criterion validity, hypothesis testing for construct validity and responsiveness) were assessed via the COSMIN good measurement property criteria[10] and rated as sufficient (+), insufficient (-) or indeterminate (?).

In both cases, disagreements were resolved by discussion with the third author.

Grading the Quality of Evidence

The authors used the modified Grading, Recommendations, Assessment, Development and Evaluation (GRADE) system to independently rate the quality of evidence.[21] GRADE specifies 4 levels of quality evidence (high, moderate, low and very low), depending on 4 factors: bias risk, inconsistency, indirectness and imprecision. The instruments were classified into 3 recommendations according to the COSMIN methodology. If the content validity of the instrument was sufficient and at least the internal consistency was sufficient, the level of recommendation was "highly recommended"; if the measurement properties of the instrument were sufficient, the level of recommendation was "recommended"; otherwise, the recommendation was "not recommended."

Effect Measures

The study results were synthesized and presented according to the COSMIN guidelines in relation to the standards for measuring the validity and reliability of the tools The statistical data and psychometric tests used in each selected study were extracted and analyzed. For the assessment of reliability, internal consistency was considered via Cronbach's alpha as well as correlation tests and other measures, such as the homogeneity test and exploratory and confirmatory factor analysis, to assess construct and criterion validity.

Synthesis Methods

To synthesize the most relevant information, a data dump grid was used that included the following information tools, items and dimensions: process/sample, internal consistency value, and test-retest value.

A narrative synthesis was carried out to compare the metric characteristics of each tool, and its ability to measure the fear of cancer recurrence was assessed. Different translated versions were described and analyzed to identify their applicability to different contexts and clinical processes. The data from the validation studies are summarized in a table for easy comparison. The synthesis results are described according to the COSMIN tool.

Results

Study Selection

The initial search identified 1426 articles from which 376 duplicated papers were excluded. From the 1050 obtained results, after the titles and abstracts were examined, 26 articles were excluded because they did not match the target population, and 852 studies focused on tool application in practice, not including the design or validation process. This selection process yielded 168 publications, and after the full texts were retrieved and checked, 150 articles were excluded. Finally, 18 articles meeting the eligibility criteria were selected (Fig. 1).

Three main tools were identified, and subsequent versions of these original tools were culturally adapted for other languages and, in some cases, further developed to produce shorter versions. A summary of the development of the different tools in chronological order is shown in Fig. 2.

Study Characteristics and Description of the Tools

- **CONCERNS ABOUT RECURRENCE SCALE (CARS)**

This tool was designed and validated in English[25] and was the first tool produced to address the nature of the fear of recurrence.

- Conceptual suitability

The development of this tool was undertaken by clinicians and women affected by breast cancer. It is composed of 30 items structured around 2 major dimensions, the first of which aims to evaluate general FCR and contains 4 items: frequency, degree of concern, consistency and intensity of fears, measured on a scale of 1 (not at all) to 6 (a lot). The second part focuses on the fear of recurrence in relation to 4 dimensions regarding preoccupation for health (11 items), femininity (7 items), functioning of roles (6 items) and death (2 items), on a scale of 0 (not at all) to 4 (extremely).

- Applicability

This tool was applied exclusively to women affected by breast cancer. The initial design was piloted with 16 cancer survivors via a semi structured interview followed by an evaluation of the classification of each item to check for the degree of understanding and interpretation of each element.

- Metric properties

This original version was validated in the USA on a sample of 169 female cancer survivors and had high internal consistency (Cronbach's $\alpha = 0.87$). As a measure of convergent validity, the CARS tool is correlated with the Impact of Events Scale to assess the degree of suffering caused by breast cancer and with the Mental Health Inventory to assess psychological anguish and mental well-being.

Dutch Version of the Concerns About Recurrence Scale (CARS-DLV)

The original version of the CARS was adapted and back-translated into Dutch in 2008 for a sample of 136 female breast cancer patients.[26] The exploratory factor analysis of this version revealed a structure that differed slightly from the original structure, with 4 items that measured general fear; this analysis was limited to 24 items that measured specific aspects of fear. This version had high internal consistency (Cronbach's $\alpha = 0.94$ for the general items and 0.88-0.94 for the 4 dimensions of the second dimension). In addition, a test-retest of 50 participants yielded a mean interval of 22 days ($r = 0.78$). The validity of the construct was supported by significant correlations with the Hospital Anxiety and Depression Scale, Dutch language version, Pain Catastrophizing Scale and Quality of Life scores.

Japanese Version of the Concerns About Recurrence Scale (CARS-J)

The version adapted for use in Japanese was created in 2014 and was validated in a sample of 375 women affected by breast cancer,[27] following a process of cultural and linguistic adaptation and back translation. Factor analysis revealed a version that differed in the grouping of the 26 items of the dimensions in the original CARS version. All the internal consistency coefficients for both the general scale and the subscales were above 0.85 (Cronbach's $\alpha = 0.86$-0.94). This version was compared with the Hospital Anxiety and Depression

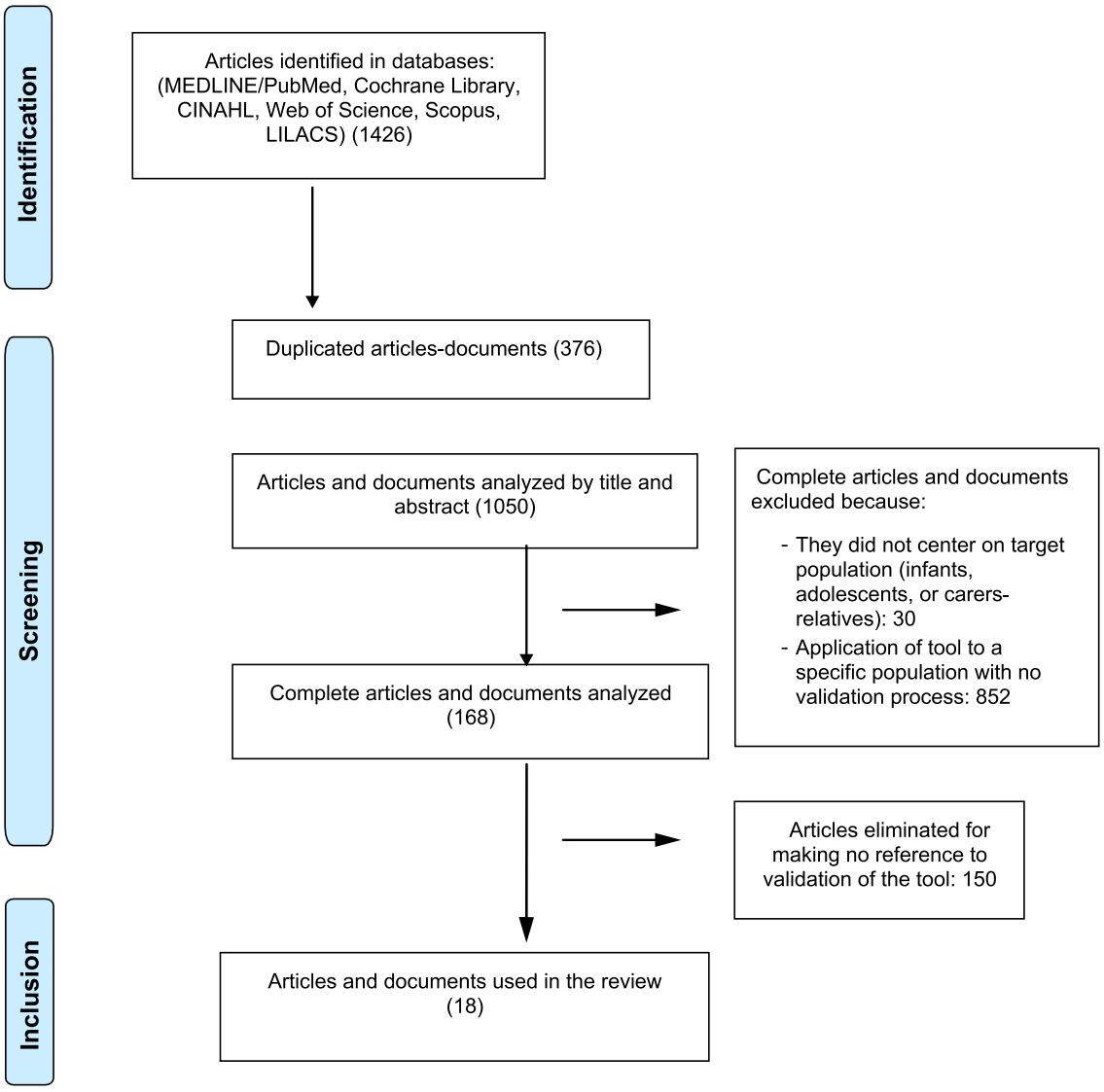

FIG. 1. PRISMA flow diagram.

Scale and revealed significant correlations; discriminant validity was studied to determine the capacity of each dimension to discover changes between subgroups.

- **FEAR OF CANCER RECURRENCE INVENTORY (FCRI)**

The FCRI is the tool most widely developed for construction, and it has been validated in most languages. It was designed and developed in French.[28] Initial validation was tested on a sample of 600 oncological patients diagnosed with breast, lung, prostate or colorectal cancer in the last 10 years.

- Conceptual suitability

The tool's initial content was developed by 6 experts in psycho-oncology who reviewed the literature to compile relevant information and then constructed the first draft. The FCRI comprises 42 items that assess 7 dimensions associated with FCR. Each item is assessed on a scale from 0 (not at all or never) to 4 (all the time or a lot), with the highest scores being indicators of high levels of FCR.

- Applicability

The initial Franco-Canadian version was piloted with 10 oncological patients via interviews to assess their understanding of the questions and the time needed to complete the survey, resulting in amendments and adjustments to improve the questionnaire.

- Metric properties

This tool obtained a high level of internal consistency (Cronbach $\alpha = 0.95$) and a strong correlation ($r = 0.89$) between the 2 deliveries of the survey to 287 patients at 1-month intervals, which confirmed the reliability of the tool's test-retest reliability. This tool is correlated with the Concerns About Recurrence Scale, Fear of Recurrence Questionnaire, Illness Worry Scale, Impact of Event Scale and Hospital Anxiety and Depression Scale, achieving particularly strong associations to CARS and Fear of Recurrence Questionnaire total scores. Additionally, discriminant validity was assessed, and a higher total FCRI score was associated with younger patients and with female patients.

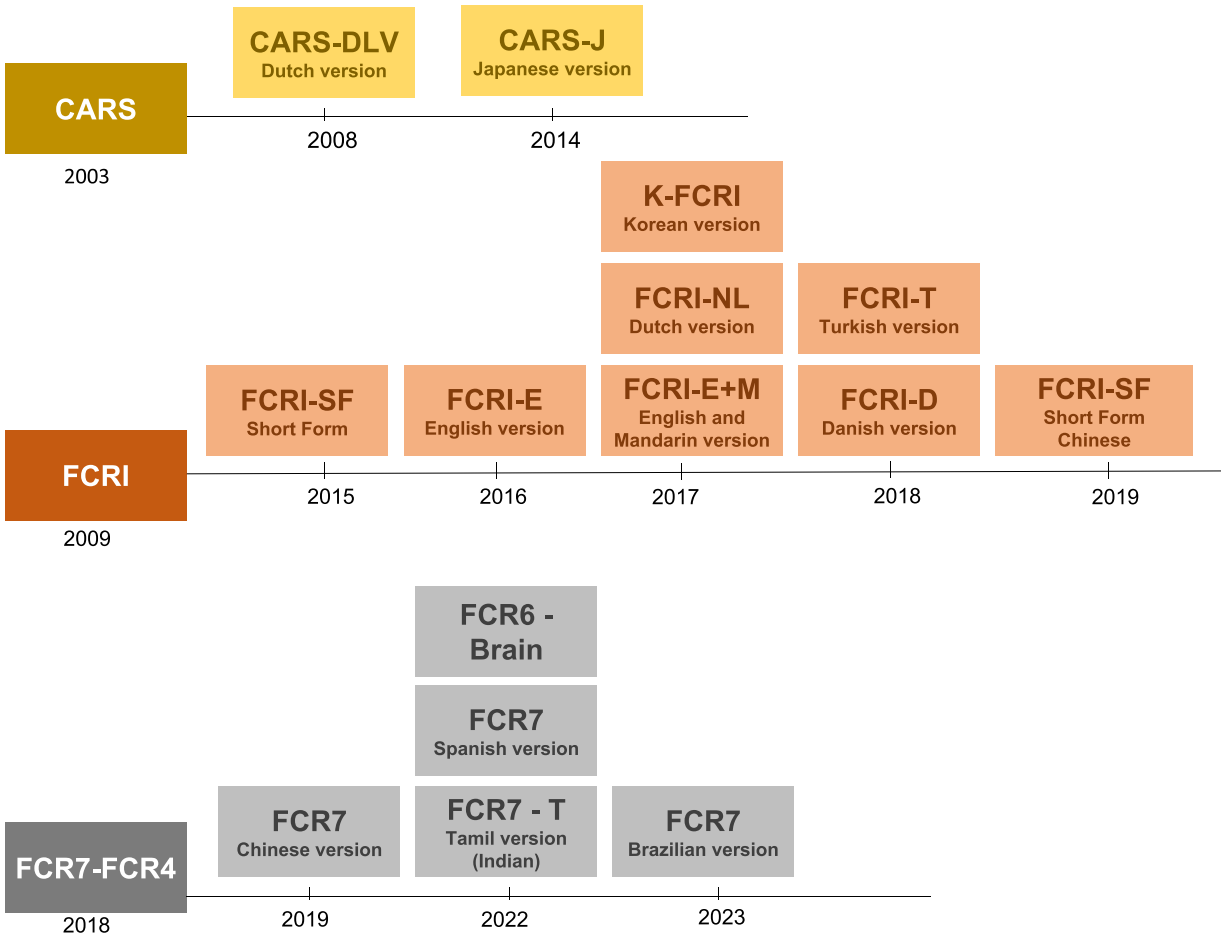

FIG. 2. Summary of FCR tools development.

Short Form of the Fear of Cancer Recurrence Inventory (FCRI-SF)

The abbreviated version of the FCRI[29] is composed of 9 items corresponding to the "severity" dimension of the original scale. The tools were validated in a sample of 60 people and scored high internal consistency (Cronbach $\alpha = 0.89$) and good time stability (r = 0.80) in the 2 deliveries of the survey, which were made 1 month apart. The results revealed a cut-off point greater than or equal to 13 points, indicating optimum rates of sensitivity and specificity for detecting clinical levels of FCR. Convergent validity correlated well with other FCRI dimensions and the Hospital Anxiety and Depression Scale.

English Version of the Fear of Cancer Recurrence Inventory (FCRI-E)

The original FCRI was adapted and validated transculturally to English[30] via standardized translation and back translation processes and was tested on 42 bilingual patients. It consists of 42 items and retains the primary scale structure. Exploratory factor analysis supported the design structure of the 7 dimensions.

The validity of the scale showed high internal consistency (Cronbach's $\alpha = 0.96$) in a sample of 350 patients. Time stability was tested in 2 deliveries of the survey of 135 participants at 30-day intervals, with a high correlation value (r = 0.88). The validity of the construct was confirmed by the correlation of the total scores with the FCRI dimensions, with moderate correlations with the Functional Evaluation of Cancer Therapy-General survey.

Discriminant validity was attained by examining correlations between the total FCRI score and clinical and demographic characteristics.

English and Mandarin Versions of the Fear of Cancer Recurrence Inventory (FCRI-E+M)

The 2017 English and Mandarin versions of the FCRI were adapted, translated and back-translated for Asian populations.[31] A confirmatory factor analysis was performed, and the original FCRI structure was replicated, with the tool consisting of 42 items and 7 dimensions. In a sample of 331 participants, both versions showed highly satisfactory internal consistency (Cronbach's $\alpha = 0.95$-0.96). The test-retest reliability was carried out with 259 participants, and strong correlations (r = 0.83-0.92) were obtained between the 2 time points around a 14-day interval.

The total score of this scale correlated strongly with the Fear of Progression Questionnaire and the Hospital Anxiety and Depression Scale.

Dutch Version of the Fear of Cancer Recurrence Inventory (FCRI-NL)

The Dutch version was published by Van Helmondt et al.[32] following standardized translation/back translation methods, is composed of 42 items grouped in 7 dimensions, and maintains the original FCRI structure. It was administered to a sample of 255 participants who had survived cancer and presented an acceptable level of reliability with good internal consistency (Cronbach $\alpha = 0.93$); there was a high correlation (r = 0.84) between the 2 survey sessions undertaken with 213 patients, which indicated adequate reliability. Convergent validity was confirmed by strong associations with the profile of mood state-Dutch questionnaire (shortened version), the Agoraphobic Cognition Questionnaire-Dutch version and the State Trait Anxiety Inventory (STAI)-Dutch version.

Korean Version of the Fear of Cancer Recurrence Inventory (K-FCRI)

This version (K-FCRI) was created by Shin et al.[33] and applies the translation/back translation process to the English version to produce the Korean form. The confirmatory factor analysis supported the original structure of the 7 dimensions with 42 items. The metric properties were validated in a sample of 444 patients and yielded good internal consistency (Cronbach's $\alpha = 0.85$). To calculate the test-retest reliability of the K-FCRI, it was administered to 62 patients on 2 occasions at a mean interval of 206 days ($r = 0.90$). The correlations between the total score of the Korean version and the category of anxiety reported in the Hospital Anxiety and Depression Scale were significant. There was also a positive correlation with the Korean version of the Fear of Progression Questionnaire.

Danish Version of the Fear of Cancer Recurrence Inventory (FCRI-D)

The Danish version was produced for a population of patients with colorectal cancer.[34] The translation/back translation process was applied to create the Danish version, and the original FCRI structure was retained, with 7 dimensions and 42 items. This version presented high internal consistency (Cronbach $\alpha = 0.95$), and 2 measures were taken from 49 participants at an interval of 14 days ($r = 0.84$). Convergent validity was demonstrated by a positive moderate correlation between the total FCRI score and the Penn State Worry Questionnaire.

Turkish Version of the Fear of Cancer Recurrence Inventory (FCRI-T)

This version appeared in 2018 for the Turkish-speaking population[35] following the standardized translation/back translation process. The number of dimensions in this scale was reduced to 5, from the 7 in the original FCRI version, and the structure consisted of 24 items. The survey was given to 219 cancer patients in the follow-up phase and showed high internal consistency (Cronbach's $\alpha = 0.94$). The validity of the construct was significantly correlated with the FCRI dimensions; the Patient Health Questionnaire-Somatic, Anxiety and Depressive Symptoms and the Impact of Events Scale-Revised.

Short Form of the Fear of Cancer Recurrence Inventory in Chinese Breast Cancer Survivors (FCRI-SF-Ch)

Interest in a shorter, more efficient instrument to measure the construct led to the development of the 9-item FCRI-SF, which corresponded to the "severity" dimension of the original FCRI validated in 2015.[29] This version was adapted and translated/back translated in 2019 to detect clinical levels of FCR in breast cancer survivors in China.[36]

The metric properties were determined for a sample of 207 women and showed a high internal consistency coefficient (Cronbach's $\alpha = 0.96$). The FCRI-SF includes high-sensitivity cut-off points that situate the clinical FCR at 12 points or higher. It is correlated with the Hospital Anxiety and Depression Scale.

- **FEAR OF CANCER RECURRENCE QUESTIONNAIRE (FCR4-FCR7)**

This tool was developed by the University of St Andrews (Scotland) to assess the fear of recurrence in cancer patients.[37]

- Conceptual suitability

It is based on a set of items extracted from publications and scales to directly assess FCR.

Its shortened version (FCR-4) consists of 4 questions designed to assess anxiety, worry and fear of cancer recurrence (strong feelings coupled with return of the disease) (Q1 to Q4). The longer version (FCR-7) contains 3 new elements, 2 concerning cognitive processing (Q5 to Q7) and 1 referring to behavioral response (Q6). The items are scored on a scale of 1 (not at all) to 5 (all the time). The exploratory factor analyses revealed that both scales have a unidimensional structure.

- Applicability

One of the problems identified by patients when they responded to the items in the questionnaire was the repetitive nature of the words used; thus, the items were edited and rewritten. Individual interviews with participants were held to assess the relationship with the total FCR score.

- Metric properties

The sample consisted of 425 participants, with a response rate of 61%. The instrument was applied to 259 patients affected by colorectal and breast cancer, and it showed high internal consistency (FCR-4: Cronbach's $\alpha = 0.93$; FCR-7: Cronbach's $\alpha = 0.92$). This score was correlated with the Hospital Anxiety and Depression Scale, which revealed that the fear of recurrence was most strongly associated with anxiety and, to a lesser extent, depression.

Chinese Version of the Fear of Cancer Recurrence Questionnaire (FCR7)

A long FCR version of 7 items was produced for Chinese patients[38] following the translation/back translation process, and it retained the same structure as the original scale.

Exploratory factor analysis revealed a single-factor structure and satisfactory loads for most of the items. The metric properties were tested on a sample of 1025 participants in a mixed group of cancer patients. The internal consistency was high (Cronbach's $\alpha = 0.87$), and there was a strong correlation between the 2 measures taken 1 month apart in 285 patients ($r = 0.90$). The validity of the construct was supported by correlations between the total scores of the Chinese FCR-7 and 3 other instruments: the Patient Health Questionnaire, the General Anxiety Disorder Questionnaire and the Fear of Progression Questionnaire-Short Form.

Spanish Version of the Fear of Cancer Recurrence Questionnaire (FCR4/7)

The FCR7 questionnaire was adapted, translated, and back-translated into Spanish in 2022 in a sample of 123 patients diagnosed with nonmetastatic melanoma, maintaining the same number of items as the original scale.[39] The metric properties show a Cronbach's alpha reliability of 0.83 and temporal stability with an intraclass correlation coefficient of 0.8 and 1 dimension. Content and construct validity were analyzed via factor analysis, the Kaiser–Meyer–Olkin sample adequacy test, and Bartlett's test of sphericity. Finally, the intraclass correlation coefficient (ICC) was used to determine temporal stability (test-retest) after the questionnaire was administered to 25 randomly selected participants within 14 to 21 days of the first administration. Compared with the Skin Cancer Index 12, the FCR7 score is higher in patients with a personal or family history of skin cancer or poor quality of life related to cancer.

Tamil (Indian) Version of the Fear of Cancer Recurrence Questionnaire (FCR4/7)

In 2022, the FCR7 scale was validated in the Tamil regional language[40] through a translation and back-translation process in a sample of 106 female breast cancer survivors.

It presented high internal consistency (Cronbach's alpha = 0.96) and an intraclass correlation coefficient value of 0.91. The Functional Assessment of Cancer Therapy-Breast scale and the Impact of Event Scale revised were used to establish relationships.

FCR6-Brain

Braun et al. validated the original FCR7 scale in adult patients with primary brain tumors (n = 165) and their caregivers (n=117).[41] Exploratory factor analysis was performed for both groups and revealed a single factor with 1 item demonstrating poor burden for both patients and caregivers. Removing the item that measures symptoms of hypervigilance (checking for physical signs of the tumor) greatly improved single-factor metrics. The modified scale (FCR6-Brain) demonstrated good convergent validity and high reliability, with an internal consistency (Cronbach's alpha) of 0.91. It was compared with the Patient Health Questionnaire-9 items, the Generalized Anxiety Disorder-7 items and the Death Distress Scale.

Brazilian Version of the Fear of Cancer Recurrence Questionnaire (FCR4/7)

The Portuguese version of the FCR7[42] was performed in Brazil in 200 patients (100 with localized breast cancer and 100 with metastatic cancer). This study involved 3 phases: translation and cultural adaptation of the FCR4/7, validity and reliability testing of the Portuguese version, and examination of patient perceptions of these measures. Descriptive and psychometric analyses were carried out, and high internal consistency was demonstrated via Cronbach's alpha for the short version (FCR4 = 0.879) and the long version (FCR7 = 0.894) of this scale. FCR4, FCR7, and the Fear of Cancer Recurrence Inventory-Short Form were compared. A significant proportion of patients reported moderate to severe FCR. Female sex, younger age, and metastatic cancer were associated with higher FCR levels.

The synthesis of the most relevant information of each tool and the comparative analysis of the validation process according to the COSMIN dimensions are shown in Tables 2 and 3.

Methodological Quality and Level of Evidence of the Included Studies

A summary of the analysis of the methodological quality on the basis of the psychometric properties and level of evidence of the selected tools is shown in Table 3.

All the included tools explored internal consistency, but none included error measurement. Confirmatory factor analysis (CFA) was performed to check structural validity in 7 studies:

- CARS: only the original tool[25] and the Dutch version[26] have exploratory factor analysis (EFA). None of them have CFA.
- FCRI: the original tool[28] included only EFA, but 5 versions performed CFA: English,[30] English and Mandarin,[31] Dutch,[32] Korean[33] and Turkish.[35]
- FCR4-7: original tool[37] and 3 versions: Chinese,[38] Spanish[39] and Brazilian.[42]

With respect to reliability, the methods applied vary across studies and tools. In those cases where the intraclass correlation coefficient (ICC) or kappa measurement indicators are applied, values are above 0.70, which is considered sufficient. The summary is provided as follows:

- CARS: only the Dutch version[26] reports the ICC.
- FCRI: the versions showing the ICC or kappa are short form,[29] English,[30] English and Mandarin,[31] Dutch,[32] Korean[33] and Danish.[34]
- FCR7: Spanish,[39] Tamil[40] and Brazilian[42] versions are instruments that reflect these data.

Overall, the quality assessment of the included studies was adequate, so none of them were excluded, although the original CARS is not recommended, as its quality assessment was inconsistent and the quality of the evidence was low.

None of the main tools have transcultural validation, as the initial studies focused on the original tool development in a specific language, which is coherent with this initial design and validation process. Later versions included short forms and translated versions with cultural adaptations, as specified previously in Table 3.

Discussion

The results of this review show that there has been exponential growth in recent years in terms of the number of tools available to measure FCR and those adapted to various languages and the design of shorter versions. This review also identified evaluation tools that did not follow a process of validation or did not directly measure fear of cancer recurrence; these tools were initially discarded Several surveys were found in the preliminary review stage[43] that assessed fear of cancer and fear of cancer recurrence, ranging from short questionnaires (2-10 items), long questionnaires (more than 10 items) and subscales within other questionnaires. The 3 main instruments identified to measure FCR were initially developed in the previous decade, and 15 adapted versions exist. The contexts in which these scales have been translated culturally are worldwide, with versions available in Europe (the Netherlands, the United Kingdom, Denmark, Turkey, Spain), Asia (China, Japan, South Korea, India), and America (Canada, Brazil). The cultural and linguistic adaptation of tools previously designed shows that FCR is viewed as a significant problem across different countries. The FCRI is now the most widely used instrument, with 8 versions developed in different languages and contexts, outstripping CARS, which, despite being the first tool validated to measure fear of cancer recurrence, has been translated into only Dutch and Japanese and validated in these 2 countries. FCR7 is the most recent edition and is currently in an ongoing process of expanding across the world because it is the shortest and most versatile tool in terms of practical use and has undergone a rigorous process of validation and adaptation.

In terms of metric properties, all the scales comply with reliability criteria, with a Cronbach's alpha above 0.8. The different translated and abbreviated versions retain the properties of the original versions, frequently exceeding the internal consistency and time stability of the original scale. The processes of validation vary in each of the tools reviewed. Among the instruments that have undergone the most thorough validation process, including defining the construct and assessing the metric properties of the scale according to the COSMIN criteria, the FCRI and its various versions stand out, as does the FCR7. On the other hand, instruments such as the original version of the CARS, whose psychometric properties are less than ideal due to their methodological limitations, have evolved positively in their later versions. Despite these drawbacks, CARS is recognized as the first tool to measure fear of cancer recurrence. The only scale that thus far includes a clinical cut-off point is the FCRI subscale of severity, which has a short version with 9 items.[26] The cut-off points identify patients with clinical levels of FCR who require intervention. Initially, a cut-off point of 13 was recommended, but recent research in Australia and Canada has suggested that 22 is more suitable for identifying patients who require specialized psychological support.[44] In terms of legibility and understanding of the items, the Turkish version of the FCRI is interesting because, despite being self-reported, it requires an additional interview with the patient to ensure the correct interpretation of the data. This seems to imply that the wording of the questionnaires is difficult to understand.

Overall, the quality assessment of the included studies was acceptable, although the type of statistical analysis performed was basic and specific and varied slightly. A low level of risk of bias was observed, so no further studies were excluded.

Table 2
Synthesis of the Structure and Psychometric Properties of the Tools for Assessing Fear of Cancer Recurrence

Tools	Autors (year)	Language	Items & dimensions	Type Of cancer/sample	CI value (Cronbach's alpha)	TEST-RETEST VALUE
CARS	Johnson-Vickberg (2003)	English	30 items, 2 dimensions (domains): - General fear of recurrence (4 items) - Nature of the fears (26 items, 4 domains): Concerns about health (11 items) Concerns about loss of femininity (7 items) Concerns about role functioning (6 items) Recurring worries about death (2 items)	Breast cancer 169 women	0.87	Not provided
CARS-DLV	Van de Beuken et al. (2008)	Dutch	30 items Retains original structure	Breast cancer 136 women	0.94	22 days (50 participants) 0.78-0.89
CARS-J	Momino et al. (2014)	Japanese	26 items, 4 dimensions: - Concerns about health and death (13 items) - Concerns about loss of femininity (6 items) - Self-reported concerns (5 items) - Concerns about role functioning (2 items)	Breast cancer 375 women	0.86-0.94	Not provided
FCRI	Simard & Savard (2009)	French	42 items, 7 dimensions: - Triggers (8 items) - Severity (9 items) - Psychological anguish (4 items) - Coping strategies (9 items) - Functional deficits (6 items) - Insight (3 items) - Tranquility (3 items)	Breast, prostate, colorectal and lung cancers 600 participants	0.95	30 days (287 participants) 0.89
FCRI-SF	Simard & Savard (2015)	French	9 items Only the "severity" dimension was retained from the original scale	Breast, prostate, colorectal and lung cancers 60 participants	0.89	30 days 0.80
FCRI-E	Lebel et al. (2016)	English	42 items Retains original structure	Breast, prostate, colorectal and lung cancers 350 participants	0.96	30 days (135 participants) 0.88
FCRI-E+M	Liu et al. (2017)	English and Mandarin	42 items Retains original structure	331 participants	FCRI-E: 0.95 FCRI-M: 0.96	14 days (259 participants) 0.83-0.92
FCRI-NL	Van Helmondt et al. (2017)	Dutch	42 items Retains original structure	255 participants	0.93	14 days (213 participants) 0.84
FCRI-K	Shin et al. (2017)	Korean	42 items Retains original structure	Breast, stomach, colorectal, lung, thyroid cancers, and others 444 participants	0.85	206 days (62 participants) 0.90
FCRI-D	Hovdenak et al. (2018)	Danish	42 items Retains original structure	Colorectal cancer 69 participants	0,95	14 days (49 participants) 0.84
FCRI-T	Eyrenci & Hö (2018)	Turkish	24 items, 5 dimensions: - Triggers (7 items) - Functional deficits (2 items) - Recurrence-related meta-cognitions (4 items) - Coping strategies (5 items) - Quality of life (6 items)	Mixed cancers 219 participants	0.94	Not provided

(*continued on next page*)

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Table 2 (*Continued*)

Tools	Autors (year)	Language	Items & dimensions	Type Of cancer/sample	CI value (Cronbach's alpha)	TEST-RETEST VALUE
FCRI-SF-Ch	Peng et al. (2019)	Chinese	9 items Only the "severity" dimension was retained from the original scale	Breast cancer 207 participants	0.96	Not provided
FCR4-FCR7	Humphris et al. (2018)	English	FCR4: 4 itemsFCR7: 7 items - Fear of recurrence (FCR4) - Cognitive processing (2 items) - Behavioral response (1 items)	Breast and colorectal cancers 259 participants	FCR4: 0.93 FCR7: 0.92	Not provided
FCR7-Ch	Yang et al. (2019)	Chinese	7 items Retains original structure	1025 participants	0.87	30 days (285 participants) 0.90
FCR7- Sp	Iglesias-Puzas et al. (2022)	Spanish	7 items Retains original structure	Non-metastatic melanoma 123 participants	0,83	14-21 days (25 participants)
FCR7- T	Nandakumar et al. (2022)	Tamil (Indian)	7 items Retains original structure	Breast cancer 106 participants	0,864	15 days (32 participants) 0,91
FCR6-Brain	Braun et al. (2022)	English	6 items	Primary Brain Tumor 165 participants Caregivers 117 participants	0,91	Not provided
FCR4/7- B	Bergerot et al. (2023)	Portuguese	7 items Retains original structure	Localized breast cancer 100 participants Metastatic cancer 100 participants	FCR4: 0,879 FCR7: 0,894	Not provided

CARS, Concerns About Recurrence Scale; CARS-DLV, CARS Dutch version; CARS-J, CARS Japanese version; FCRI, Fear of Cancer Recurrence Inventory; FCRI-SF, FCRI Short Form; FCRI-E, FCRI English version; FCRI-E+M, FCRI English and Mandarin version, FCRI-NL, FCRI Dutch version, K-FCRI, FCRI Korean version, FCRI-D, FCRI Danish version; FCRI-T, FCRI Turkish version; FCRI-SF-Ch, FCRI Short Form Chinese; FCR7, Fear of Cancer Recurrence Questionnaire; FCR7-Ch, Fear of Cancer Recurrence Questionnaire Chinese version, FCR7-Sp, Fear of Cancer Recurrence Questionnaire Spanish version; FCR7-T, Fear of Cancer Recurrence Questionnaire Tamil version; FCR6-Brain, Fear of Cancer Recurrence Questionnaire in Primary Brain Tumor; FCR7-B, Fear of Cancer Recurrence Questionnaire Brazilian version.

Table 3
Assessment of Methodological Quality and Grading the Level of Evidence

INSTRUMENTS NAME	Autor (año)	Content validity		Structural validity		Internal consistency		Cross-cultural validity		Reliability		Measurement error		Criterion validity		Hypothesis testing		Responsiveness		Recommended grade
		QM	QE	QM	QE	QM	QE	QM	QE	QM	QE	QM	QE	QM	QE	QM	QE	QM	QE	
CARS	Johnson- Vickberg (2003)	±	Low	-	High	+	High			?	High	?	High	+	Low					Not recommended
CARS-DLV	Van de Beuken et al. (2008)	±	Moderate	?	High	+	High	+	Moderate	+	High	?	High	?	Moderate	+	High	+	High	Recommended
CARS-J	Momino et al. (2014)	±	Moderate	?	High	+	High	+	High	-	Low	?	High	?	Moderate	+	High	+	High	Recommended
FCRI	Simard & Savard (2009)	+	High	?	High	+	High			?	Low	?	High	+	High	+	High	+	High	Very Recommended
FCRI-SF	Simard & Savard (2015)	-	Moderate	?	Low	+	High			+	High	?	High	+	High	+	High	+	High	Recommended
FCRI-E	Lebel et al. (2016)	+	Moderate	+	High	+	High	+	High	+	High	?	High	+	High	+	High	+	High	Very Recommended
FCRI-E+M	Liu et al. (2017)	±	Moderate	+	High	+	High	+	High	+	High	?	High	+	High	+	High	+	High	Recommended
FCRI-NL	Van Helmondt et al. (2017)	±	Moderate	+	High	+	High	+	High	+	High	?	High	+	Moderate	+	High	+	High	Recommended
K-FCRI	Shin et al. (2017)	±	Moderate	+	High	+	High	+	High	+	High	?	High	+	High	+	High	+	High	Recommended
FCRI-D	Hovdenak et al. (2018)	±	Moderate	-	High	+	High	+	High	+	High	?	High	-	High	+	High	+	High	Recommended
FCRI-T	Eyrenci & Hö (2018)	+	Moderate	+	High	+	High	+	Moderate	?	Low	?	High	+	High	+	High	+	High	Recommended
FCRI-SF-Ch	Peng et al. (2019)	±	Moderate	?	Low	+	High	+	Moderate	?	Low	?	High	+	High	?	Moderate	?	Moderate	Recommended
FCR4-FCR7	Humphris et al. (2018)	±	Moderate	?	High	+	High			?	High	?	High	+	High	+	High	+	High	Recommended
FCR7-Ch	Yang et al. (2019)	+	High	?	High	+	High	+	Moderate	?	Low	?	High	+	High	+	Moderate	+	Moderate	Very Recommended
FCR7-Sp	Iglesias- Puzas et al. (2022)	±	Moderate	-	High	+	High	+	Moderate	+	High	?	High	?	High	+	Low	+	Low	Recommended
FCR7-T	Nandakumar et al. (2022)	+	High	?	High	+	High	?	High	+	High	?	High	+	High	+	Low	+	Low	Very Recommended
FCR6-Brain	Braun et al. (2022)	±	Moderate	?	High	+	High			?	High	?	High	+	Moderate	+	High	+	High	Recommended
FCR7-B	Bergerot et al. (2023)	+	Moderate	+	High	+	High	+	High	+	High	?	High	?	Moderate	+	Low	+	Low	Very Recommended

CARS, Concerns About Recurrence Scale; CARS-DLV, CARS Dutch version; CARS-J, CARS Japanese version; FCRI, Fear of Cancer Recurrence Inventory; FCRI-SF, FCRI Short Form; FCRI-E, FCRI English version; FCRI-E+M, FCRI English and Mandarin version, FCRI-NL, FCRI Dutch version, K-FCRI, FCRI Korean version, FCRI-D, FCRI Danish version; FCRI-T, FCRI Turkish version; FCRI-SF-Ch, FCRI Short Form Chinese; FCR7, Fear of Cancer Recurrence Questionnaire; FCR7-Ch, Fear of Cancer Recurrence Questionnaire Chinese version, FCR7-Sp, Fear of Cancer Recurrence Questionnaire Spanish version; FCR7-T, Fear of Cancer Recurrence Questionnaire Tamil version; FCR6-Brain, Fear of Cancer Recurrence Questionnaire in Primary Brain Tumor; FCR7-B, Fear of Cancer Recurrence Questionnaire Brazilian version.
QM: quality methodology; sufficient (+), insufficient (-), inconsistent (±) or indeterminate (?).
QE: quality of evidence; high, moderate, low and very low.

With respect to the Spanish-speaking context, it should be noted that there is a low level of development of specific tools to measure fear of cancer recurrence. Recently, Iglesias-Puzas et al.[39] adapted FCR7 in a group of patients with nonmetastatic melanoma. Despite the fact that this initiative represents an important advance, given the need to have tools validated in Spanish, there are several aspects related to the specificity of the process and the limited scope of the population in which it has been applied, which must be considered. To finalize the process, it would be necessary to apply it in other profiles of cancer patients with a larger sample to guarantee the validity and stability of the tool.

Another point to consider when assessing the pertinence and applicability of a tool is the time needed to complete it, which is defined as the burden. This is increasingly relevant, as questionnaires that are too long can even increase the level of anxiety in a patient who already feels fearful. This is the key to applying these tools to assess FCR in routine healthcare, with the aim of finding instruments that yield the maximum amount of information with the strongest data validity in the briefest time possible. The suitability of each of these tools for use in clinical practice is fundamental for integrating them into healthcare for oncological patients. In this respect, the points to consider are the ease of completion of the questionnaire for consultation; short surveys are better and, if possible, should be self-reported to identify the levels of FCR and to enable a more effective intervention. The 7-item scale (FCR7)[37] is the shortest version for assessing fear of cancer recurrence, and it produces reliable results.

A review of the literature also revealed tools that were unidimensional in design as criteria for assessing FCR.[45] Rudy et al.[46] initially validated a 1-item measure of fear of cancer recurrence, which was further reviewed by Smith et al.,[47] confirming its validity. This type of scale is currently not useful for identifying levels of fear from the start of the process of measuring clinical levels or for carrying out a psychosocial intervention, but it can be used during interventions to determine and describe the contribution of this scale in reference to fear. This is a tool to be considered in future outcomes, as it could be a line of research that continues to advance. Despite the usefulness of these tools, we should be aware that fear of cancer recurrence varies according to the phase of the process that each person is in. The end of primary treatment is when the highest levels of fear occur. In 2018, recommended that FCR evaluations should be made at the end of treatment and then during the follow-up phase when survivors have had time to confront their cancer situation and have less contact with the healthcare system.[48] Continuous evaluation can be a form of monitoring, as fluctuations in FCR are normal, an intervention only being considered in cases of high sustained values of FCR.

Implications for Practice

This review offers a synthesis of the different tools for measuring fear of recurrence at the international level and provides information on the characteristics of each tool as well as the versions adapted and translated into different languages, which can facilitate their use at the clinical level. The clinical relevance of the systematic assessment of the fear of recurrence in oncology patients can contribute to the early identification of this problem and facilitate its approach through specific interventions, thus minimizing its consequences. Knowing the availability of these types of tools could also favor their application by different professionals at a multidisciplinary level.

Strengths and Limitations

Notably, the application of the recommendations of the Consensus-based Standards for the Selection of Health Measurement (COSMIN) has favoured the synthesis of information on the different tools in a clear and organized manner. It has also made it possible to compare the tools' psychometric properties and applicability, as well as

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the evolution of the versions translated and used in different contexts and profiles of oncology patients.

Finally, the limitations of this systematic review are that the lack of validated tools to measure FCR meant that we had to undertake a thorough, intensive search and selection of articles to gather all available information. The difficulty then arose in differentiating the study of FCR with cancer from other non-oncological pathologies, which obliged us to screen carefully all potentially relevant articles. Furthermore, considering the variability of the validation process found in different studies, it would be desirable in future research to homogenize it according to current statistical methods and quality standards. Furthermore, in future studies, it would be helpful to have complementary perspectives from other stakeholders (such as patients, healthcare providers, and experts) to enhance their contribution to the global assessment of each tool and its suitability.

Conclusions

There are 3 main tools internationally available to measure FCR, all with acceptable validation criteria. The first instrument designed was CARS, whose initial validation was limited, although it has been reinforced by adaptation to other languages and is currently available in Dutch and Japanese. However, the most widely used tool is the FCRI, which was translated into 8 languages, with a short version and an adapted short form specific for breast cancer patients. The most recent version is the FCR7-FCR4 version, whose versatility makes it increasingly popular in clinical practice. Despite the spread of these tools worldwide, there is a lower development of validated tools for the Spanish-speaking context, which is necessary to approach FCR in Spain and Latin America. The existence of these validated and adapted tools means that they can be used as part of the integral evaluation of oncological patients and in the design of specific interventions that can improve quality of life and check the advance of FCR to more severe phases.

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Registration and Protocol

The research protocol of this systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO), available at https://www.crd.york.ac.uk/prospero/#recordDetails: number CRD42021168705

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Cristina Díaz-Periánez: Writing – original draft, Visualization, Validation, Project administration, Methodology, Conceptualization. **Rafaela Camacho-Bejarano:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Methodology, Conceptualization. **Susanne Cruickshank:** Writing – review & editing, Visualization, Validation, Supervision, Conceptualization. **Gerry Humphris:** Writing – review & editing, Visualization, Validation, Supervision, Conceptualization. **Eloisa Bayo-Lozano:** Writing – review & editing, Visualization, Validation, Supervision. **Dolores Merino-Navarro:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology.

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