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Systematic Review

Measuring "Scanxiety": A Systematic Review and Symptom Coverage Analysis of Commonly Used Measures

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ABSTRACT

Introduction: "Scanxiety" refers to the anxiety and/or distress that an individual experiences before, during, or after a medical scan (e.g., MRI, ultrasound, CT, etc). Symptoms characterising scanxiety remain poorly defined and are inconsistently measured. This systematic review aimed to synthesise symptoms reported in relation to scanxiety among adult populations, and to evaluate patient reported outcome measures commonly used to measure scanxiety focusing on how well these measures capture its symptoms.

Methods: A best fit framework synthesis approach was applied to explore scanxiety symptoms using the five areas model (emotional, cognitive, behavioural, physiological and environmental domains). Symptoms identified were then mapped against nine measures commonly used to assess scanxiety. The quality of studies included was appraised using the Mixed Methods Appraisal Tool.

Results: Across 23 studies, 159 symptoms were identified in studies exploring experiences of scanxiety. Symptoms were synthesised into 18 conceptual clusters spanning all domains of the five areas model. Existing measures predominantly assessed emotional and physical symptoms, while behavioural and cognitive symptoms were inconsistently represented. Environmental symptoms were not captured by any measure reviewed.

Conclusion: Scanxiety is a multi-dimensional and contextually influenced experience, the symptoms of which are not adequately captured by the assessment tools included in this review. The findings have implications for clinicians working with this group, particularly how best to assess symptoms and identify scanxiety in advance to inform appropriate intervention.

Implications for practice: Assessment of scan-related distress extends beyond emotional and physical symptoms to include behavioural and environmental factors. Developing scanxiety-specific tools grounded in lived experience may improve identification and support across a wider range of imaging contexts.

Introduction

Medical imaging is a cornerstone of modern healthcare, helping to inform early diagnosis, treatment planning, and patient monitoring. In England (UK) alone, 44.3 million imaging requests were reported in 2023 and demand for imaging continues to rise every year.[1] This practice has a significant financial cost, with the NHS reporting in 2017/18 that around £2 billion per annum was spent on imaging services.[2] This places great pressure on resources, making patient engagement and attendance critical for sustaining efficiency, quality, and value for money.

"Scanxiety" is a term first known to have been documented in 2011 by Bruce Feiler in TIME magazine.[3] It refers to the anxiety and/or distress experienced before, during, or after medical imaging procedures.[4] Scan related anxiety can pose a considerable clinical risk as high distress can impair patients' ability to tolerate medical scan-related procedures. This raises the likelihood of suboptimal images because of the patient moving during the

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procedure or early termination of scans requiring follow up appointments, cancellation of procedures and an exacerbation of existing symptoms.[5–7]

Interest in scanxiety has steadily grown, with Bui et al.,[4] in 2021 reporting one of the first broad reviews, which focused on prevalence, severity, contributing factors and interventions of the condition. Overall, 57 eligible articles were identified involving data from over 21,000 people. The authors highlighted the heterogeneity in the presentation of scanxiety and the variability in how it has been assessed. This led to a call for a more uniform approach to evaluating the characterising symptoms. Similarly, Derry-Vick et al.[8] examined scanxiety among people with cancer, noting inconsistent measurement approaches have hindered clear conceptualisation of scanxiety. Finally, Hussain et al.[9] conducted a qualitative systematic review in 2023 exploring experiences of scanxiety in the context of cancer-related imaging. Their findings highlighted the need for greater awareness, education, and support from healthcare professionals regarding scan-related distress. Collectively, these reviews reveal continuing uncertainty around the definition of scanxiety, its symptom profile and how to best to identify and measure symptoms and subsequently support those impacted.

Few validated measures exist that are purposefully designed to assess scanxiety. Among the few that do, most tend to be scan specific, such as the Magnetic Resonance Imaging-Anxiety Questionnaire (MRI-AQ),[10] which asks questions only relevant to those undergoing an MRI. In their scoping review, Bui et al.[4] summarised 81 measurement tools that have been applied for assessing scanxiety; however, most were initially designed for different conditions (e.g., general anxiety disorder, trauma), with item wording in some cases being adapted for imaging settings. Such measures risk failing to capture scan-specific experiences, such as distress in relation to scan-procedure, diagnostic outcomes, and waiting for appointments.

In response to calls for clearer conceptualisation and measurement of scanxiety, the current systematic review aims to identify and synthesise symptoms of scanxiety reported across qualitative, quantitative, and mixed-methods studies. The focus will be inclusive across all imaging techniques and clinical conditions. Unlike previous reviews on the topic, a framework approach will be applied to help systematically identify and categorise symptoms. For this purpose, the five areas model[11] will be used, focusing on the *situation* (environment), *thoughts*, *emotions*, *physical symptoms,* and *behaviours* (and how experiences in each domain may interact). This model is highly relatable to clinical practice as it commonly features in widely cited treatment manuals for psychological interventions (e.g., cognitive behavioural therapy). Following the synthesis, tools which are identified as frequently used to measure scanxiety will be evaluated using a symptom coverage analysis to establish the extent to which these tools capture symptoms of scanxiety. It is expected that the findings will help to inform the selection of measures used in clinical practice.

Methods

Search Strategy

A systematic search was conducted for articles reporting on symptoms of scanxiety across PubMed, Google Scholar, Scopus and EBSCOHost (PsycINFO, CINAHL). Search terms combined key words for scan-related anxiety identified in previous reviews (Scanxiety OR “Scan*associated anxiety” OR “imaging anxiety” OR “Scan Anxiety” OR “scan-related anxiety” NOT Children NOT Adolescents). To avoid a narrow oncology focus, terms from previous reviews were adapted and simplified. No date limiters were applied, and both peer reviewed, and grey literature were included to identify a wide range of symptom descriptions. Full search strategies are provided in the supplementary file.

Inclusion and exclusion criteria were guided by the SPIDER framework[12] (Sample, Phenomenon of Interest, Design, Evaluation, Research type; Table 1.) Backward citation searching was conducted using the Citation Chaser tool.[13] Reference lists of all included papers were screened for additional sources. Covidence software[14] was used to facilitate managing screening and duplicates. After duplicates were removed, titles and abstracts were screened by one author (KB). A random sample comprising 12% of title and abstract records was independently screened by a second reviewer (AH) to enhance reliability. Inter-rater agreement was assessed using Cohen's kappa, demonstrating substantial agreement ($k = 0.69$). Independent review of full texts was performed in duplicate by two authors (KB,CG), with disagreements resolved by a third author (GR). Review papers were excluded from synthesis but retained for backward citation searching.

To select the most appropriate self-reported measures of scanxiety for the symptom coverage analysis, 81 measures summarised by Bui et al.[4] were reviewed. Measures were included in the current review if they were self-reported, available in English and used quantitative response formats (e.g., Likert scales). Measures were excluded if they were based on a single-item, condition-specific (e.g., specific to people with cancer), or an adapted measure without sufficient reporting of its psychometric properties Single-item measures were excluded as, while appropriate for screening or descriptive purposes, they are insufficient for examining construct validity or latent structure, which were conceptually central to the aims of this review. Measures relying solely on open-ended questions or informal visual analogue scales were also excluded. See supplementary file for screening and inclusion decisions.

Data extraction

Data were extracted by a single author (removed for peer review) using a piloted Excel form based on the SPIDER framework,[12] capturing study characteristics, sample, scan context, methodology and symptoms reported. Symptoms could be reported in the results or discussion of papers. Descriptions reported by either participants or authors were extracted.

Quality assessment

Study quality was appraised using the Mixed Methods Appraisal Tool (MMAT).[15] This allows consistent evaluation of qualitative, quantitative, and mixed-method studies within a single framework. Quality ratings were performed independently by two authors (removed for peer review), with initial agreement of 80% (84/105 appraisal decisions; Cohen's kappa = 0.13 indicating ‘slight’). Most disagreements reflected between ‘yes’ and ‘partially met’ ratings rather than direct disagreement between ‘yes’ and ‘no’ judgements. The relatively low kappa should therefore be interpreted cautiously as ratings were highly skewed towards the ‘yes’ category, which can reduce kappa values despite high observed agreement. Conflicts were resolved through discussion, Conflicts were resolved through discussion, following this discussion 11 appraisal decisions were amended. Most amendments reflected changes between adjacent rating categories (e.g. yes to partially met) rather than direct disagreement. Typically, the amendments related to whether the MMAT criteria were explicitly reported or just inferred from the manuscript. A final consensus table was subsequently agreed between reviewers.

Table 1
SPIDER framework[12] with inclusion and exclusion criteria.

	Inclusion criteria	Exclusion criteria
Sample	Adults (18+) who are undergoing or have completed medical scans and report scanxiety symptoms for any medical condition/investigation.	Studies involving children or adolescents.
Phenomenon of interest	Scanxiety – anxiety experienced before, during or after medical imaging procedures.	Studies focused solely on non-scanxiety specific experiences i.e. generalised anxiety disorder, health anxiety, or unrelated mental health conditions.
Design	Quantitative (e.g., cross-sectional, surveys, qualitative (e.g., interviews, focus groups), and mixed-method designs.	–
Evaluation	Studies reporting on symptoms (e.g., emotional, cognitive, physical, behavioural) of scanxiety.	Studies discussing the scanning process without reference to any symptom related response, experience or perception.
Research type	Peer-reviewed journal articles and grey literature.	Not available in the English language. Review papers.

Data analysis

A best-fit framework was conducted, following Carroll et al.,[16] integrating deductive mapping with inductive analysis to accommodate heterogeneous data. As discussed, the 'Five Areas Model'[11] was selected as the priori framework for its clinical relevance, and utility in psychological formulation. Symptom data were extracted from all included papers and deductively coded into the five domains (cognitive, emotional, behavioural, physical and environmental).

To enhance consistency, a second reviewer (removed for peer review) independently coded symptom data from five randomly selected studies (22% of included studies). Substantial overlap was observed between reviewers with minor differences primarily reflecting variation in descriptive detail, coding granularity and domain categorisation rather than substantive disagreement regarding identified symptoms. For instance, imagery-based coping strategies were captured by both reviewers but were described with differing levels of specificity across reviewers.

Verbatim quotes were retained where available, and coding was tracked by source and frequency for transparency. Data not aligning with the predefined domains were inductively grouped into similar codes to ensure comprehensiveness and evaluate the usefulness of the priori framework. Interpretive reduction[16] was used to organise related codes into higher-order conceptual categories (clusters) to support synthesis at the domain level. Symptoms that did not align with a cluster were retained as 'unclustered' codes to preserve completeness.

To evaluate how well existing measures captured the symptom clusters identified in this review, a symptom coverage analysis was conducted. Each measure was reviewed item-by-item and coded whether it assessed each symptom cluster. The mapping of symptoms to measurement items involved interpretive review of symptom wording and conceptual overlap. A second reviewer independently mapped a randomly selected subset of measure and symptom clusters.

Results

Search results

The initial search identified 274 unique articles, of which 12 were eligible. A further 11 were identified through citation chasing, resulting in a final total of 23 included studies (Fig. 1).

Overall, 22 were peer-reviewed journal articles, including two non-empirical sources (a patient authored case study and an opinion article; the remaining study was a doctoral thesis). Studies were conducted across eight countries, most frequently in the UK (n = 8), Australia (n = 5), and the United States (n = 3), with other samples from Europe (n = 5; Netherlands, Germany, Sweden), Canada (n = 1), and Saudi Arabia (n = 1). Sample sizes ranged from 1 to 465, with a total of 1028 participants across 21 studies, with two additional analyses of descriptions on social media, comprising of over 2000 posts.

Twelve studies included oncology populations, while a smaller number explored non-cancer (n = 2) or mixed samples including neurological conditions and healthy participants (n = 3). Six studies did not specify diagnostic status. Additionally, 15 studies focused specifically on MRI scans, and three studies examined experiences related to CT scans. A further five did not explicitly state the scan modality however contextual references such as breast screening, radiation exposure and enclosed environments suggested the likely use of MRI, CT, PET, or mammography scans.

Fifteen studies used qualitative designs, three employed mixed-methods and three were quantitative. Semi-structured interviews were the most common data-collection method (n = 12), followed by self-report questionnaires (n = 5) whereas two analysed social-media content. Mixed-method studies combined questionnaires with interviews, and one quantitative study adopted a randomised controlled design. Overall, methods were appropriate to the research aims, though surveys offered less symptom detail when constrained to predefined response formats.

Thematic (n = 8) and content analyses (n = 4) were among the most approaches employed, with some studies using interpretative phenomenological- (n = 3), grounded theory- (n = 2) or framework-analysis (n = 1). Non-empirical sources were retained for experiential value and to contextualise a broader evidence base but were interpreted cautiously during synthesis. Characteristics of studies are summarised in Table 2.

Although heterogeneity was observed across populations, scan-types, and study designs, formal subgroup analyses were not conducted due to the diversity of included studies. Formal weighting was also not undertaken, as this review did not seek to prioritise symptoms but instead comprehensively identify a range of symptoms from scanxiety experiences. A sensitivity analysis indicated symptom identification was not driven by a small number of studies which can be observed in the supplementary file.

Quality appraisal

Of the 23 studies included, 21 papers were appraised; the two non-empirical papers could not be appraised using the quality appraisal tool selected. Of the appraised studies, 15 were qualitative. Thirteen qualitative studies met all MMAT criteria, indicating good alignment between research aims, data collection and analytic procedures. The remaining two qualitative studies met most MMAT criteria but included a small number of criteria that were partially met or unclear.

In contrast, three studies were quantitative and three employed mixed-methods designs. These more frequently demonstrated methodological uncertainty, most commonly relating to unclear

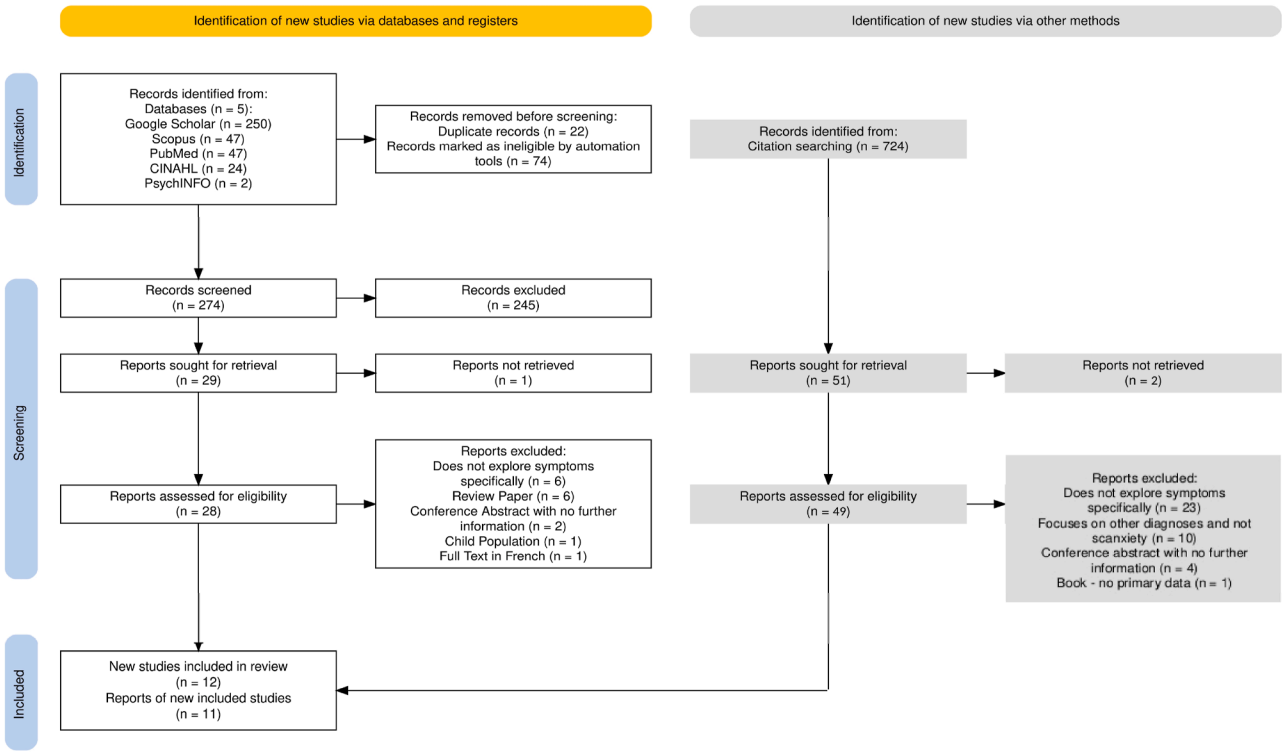

Figure 1. Prisma 2020 Diagram.[17]

sampling strategies, limited reporting of measurement validity, and insufficient integration between qualitative and quantitative components. Full MMAT[15] ratings and key are situated in the supplementary file.

Synthesis

In total, 159 symptoms were coded and categorised within the domains of the five-areas framework. Symptoms clustered into 18 conceptual groupings is illustrated below in Fig. 2 (a full breakdown of conceptual groupings and codes is provided in the supplementary materials).

The framework was expanded inductively to accommodate symptoms that did not cluster neatly but conceptually aligned with broader domains to ensure themes were not shaped disproportionately by individual studies or constrained by pre-existing theory. Visual inspection of the data did not indicate substantial subgroup differences in scan-related symptoms across studies. All clusters were supported by multiple studies across populations, scan types, and methodological designs:

Environment: This encompassed situational triggers and contextual factors associated with scanxiety. Descriptions such as claustrophobic nature of the scan (e.g. "the machine is too confined"[18]), and anxiety related to the scan procedure (e.g., opening of one's eyes mid-scan) were coded here. Three clusters were identified:

Time-related stressors of the scan process included anxiety within the waiting room, the duration of the scan itself, and the period waiting between the scan and results. *Pre-scan procedures* included fears related to cannula insertions, needles and contrast agents. One person described: *"The tech putting in the IV for my contrast missed … I was crying and so distraught. I was so anxious before this happened and now I just wanna go home."*[27]. Additionally, logistical burdens such as scheduling, attending the appointment and financial strain emerged across several studies. *In-scan factors*, included discomfort such as temperatures, darkness, and loud machine noise, as well as restrictive instruments used to minimise movements.

Cognitive: Cognitive responses comprised of three clusters: *Scan-related thoughts* appeared to centre around procedural distress, such as entering scanning environments, worrying the machine would cause harm, claustrophobia related thoughts, and the overall safety of the procedure. *Health-related thoughts* reflected concerns associated with a negative diagnosis, recurrence, results, or disease progression. Recurrence-related concerns appeared specific to oncology focused studies and represented the most notable variation across the dataset. This also included procedural concerns, such as side effects from contrast agents. *Identity and existential thoughts* related to the self, mortality, and the meaning of illness. Thoughts included their life being on hold or pause and worry about the future. One participant expressed, "*Damn, I might only have a few more years to live and I have kids and I'm a single parent.*".[39]

Emotions: This domain encompassed four main clusters: *Anticipatory emotions* reflected emotions related to the lead-up to scans and the unknown nature of the results. Symptoms included anticipation, apprehension and nervousness as well as feeling worried. *Fear-based responses* covered threat and distress, which was common. Participants described feeling a sense of terror, fear and tearfulness. *Agitation* encompassed reported stress, irritability, frustration, and feeling uptight. These responses were often linked to procedural frustrations or a lack of control over the scan process. Participants also described symptoms indicative of *low mood*, which was observed in seven studies. A distinct cluster was made for related experiences including loneliness; feeling isolated, depressed and hateful; as well as powerless. One quote illustrated this well: *Right before [my scans] I get hateful. I do, I get bitchy, I lose sleep ….*[40]

Table 2
Characteristics table.

Author, Year, Country	Sample size	Condition	Scan	Study design	Aims of study	Method
Bellhouse et al., 2020, UK[18]	n = 19	Cancer (lung)	MRI, CT	Mixed methods	1) To explore patient experience of MRI treatment in addition to a CT scan with a focus on anxiety and claustrophobia. 2) How the psychological burden experienced impacted on image quality and scan completion.	Quantitative - questionnaires Qualitative - semi structured interviews with framework-based thematic analysis (TA).
Boele et al., 2023, UK[19]	n = 12	Cancer (primary malignant brain tumour)	MRI, CT	Qualitative	To gain an in-depth understanding of people with PMBT (primary malignant brain tumours) experience and cope with interval MRI scans.	Semi-structured interviews with grounded theory analysis
Buckley et al., 2021, Australia[20]	n = 16	Healthy and Radiology patients	MRI	Mixed methods	To evaluate tolerance and acceptability of horizontal rotation within an MRI scanner. Includes both healthy and previously treated patients.	Quantitative - questionnaires, statistical analysis (Wilcoxon signed-rank test) Qualitative -exit interview - content analysis
Bui et al., 2021b, Australia[21]	n = 16	Cancer	CT	Qualitative	To explore experiences of scans and scanxiety. Identify strategies used by those with advanced cancer.	Semi structured interviews using framework analysis
Bui et al., 2023 Australia[22]	n = 2031	Unstated	Multiple scans	Qualitative (Observational)	To explore how scanxiety is discussed on twitter. To describe the content and demographics of users posting about scanxiety.	Manual search on twitter - inductive thematic analysis.
Custers et al., 2023, The Netherlands[23]	n/a	Cancer (multiple)	MRI, CT	Opinion piece	Letter to editor/opinion piece	–
Evans et al., 2017, UK[24]	n = 51	Cancer (lung)	MRI	Qualitative	To describe the experience and acceptability of whole-body MRI compared with standard scans.	Semi-structured interviews, TA.
Gimson et al., 2021, UK[25]	n = 19	Cancer (multiple)	MRI, CT	Qualitative	Explore anxieties experienced by cancer patients attending investigative imaging or radiotherapy.	Focus groups, inductive TA
Harris et al., 2004 Australia[26]	n = 118	NR	MRI	Quantitative	To evaluate predictors of anxiety and panic symptoms during MRI and if MRI-FFS could predict distress responses more effectively than other surveys.	Self-report surveys at different time points. Regression analysis.
Homewood & Hewis, 2023, Australia[27]	n = 103 Instagram posts	NR	MRI	Qualitative	To explore anxiety and distress shared on Instagram during pre-MRI timeframe. To assess viability of Instagram as a source of experience data. Identify the characteristics of distress pre-MRI.	Content analysis of open Instagram posts during pre-MRI.
Laidlaw & Henwood, 2003[28]	n = 8	Multiple sclerosis (MS)	MRI	Qualitative	Establish overall perception and experience of MRI in MS patients with attention around if sufficient information had been given prior to MRI and how this has been perceived and how this impacted their overall experience.	Unstructured interviews, open thematic analysis used.
Lloyd (2020) Canada[29]	n = 1	Neuromyelitis Optica Spectrum disorder (NMOSD),	MRI	Narrative piece	First person narrative reflection published in peer review journal of one negative and one positive experience.	Narrative Reflection
Mannion et al. (2022), USA[30]	n = 20	Cancer (multiple)	MRI, CT, Ultra-sound	Qualitative	To better understand test related anxiety in patients with cancer, and how to mitigate that anxiety.	Semi structured interviews - code book analysis.
Shanburi et al. (2023) Saudi Arabia[31]	n = 465	NR	MRI	Quantitative	To evaluate MRI associated anxiety among Saudi's general population in the western region of country.	Self-report questionnaire
Shaw et al. (2008), UK[32]	n = 7	Healthy participants	MRI	Qualitative	To explore ethical concerns in neuro-imaging from patient perspectives, and misunderstandings of incidental findings.	Semi-structured interviews before and after MRI, analysed using IPA.
Seibel et al. (2023) Germany[33]	n = 40	Cancer (lung)	CT,X-RAY	Qualitative	To explore experiences among lung cancer survivors and their caregivers, including follow up care (especially on life and psychosocial wellbeing).	Semi-structured interviews. Content analysis done.
Strand et al. (2014) Sweden[34]	n = 12	Cancer (Spine Metastasis)	MRI (Spine)	Qualitative	To explore experience of MRI with metastasis in the spine.	Semi-structured interviews, content analysis.
Thompson et al. (2010) USA[35]	n = 70 (with 30 completing interviews)	Cancer (lymphoma)	CT	Mixed methods	To assess anxiety and the psychological impact of routine surveillance scans in long term survivors of adult aggressive lymphoma.	Self-report surveys and qualitative interviews
Tischler et al. (2009) UK[36]	n = 17	Healthy Participants/ Depression	MRI	Qualitative	Explore and compare experiences of MRI in healthy participants, and participants with depression.	Semi-structured interviews - analysed using TA.

(*continued on next page*)

Table 2 (*continued*)

Author, Year, Country	Sample size	Condition	Scan	Study design	Aims of study	Method
Tornqvist et al. (2006) Sweden[37]	n = 19	NR	MRI	Qualitative	To explore lived experiences of MRI scans and how this relates to support needed.	Phenomenological interviews
Tugwell et al. (2018), UK[38]	n = 74	NR – Head, spine, and cardiac first-time scans.	MRI	Quantitative	To explore if a short video, or phone call can reduce pre-scan anxiety compared to routine prep.	RCT
Van de Wal et al. (2022) Netherlands[39]	n = 25	Cancer (Gastro-intestinal stromal tumours)	CT	Qualitative	To explore the psychological and social life challenges of GIST patients.	Semi-structured interviews, TA used.
Winebrenner (2022), USA[40]	n = 18	Cancer (Pancreatic)	CT	Qualitative	To explore lived experience of scanxiety in pancreatic cancer who have had curative surgery.	Heidegger hermeneutic phenomenology and Manen's six step methodology.

Note: CT = Computed Tomography, MRI = Magnetic Resonance Imaging, NR = Not reported, TA = Thematic Analysis, RCT = Randomised Control Trial, IPA = Interpretative Phenomenological Analysis.

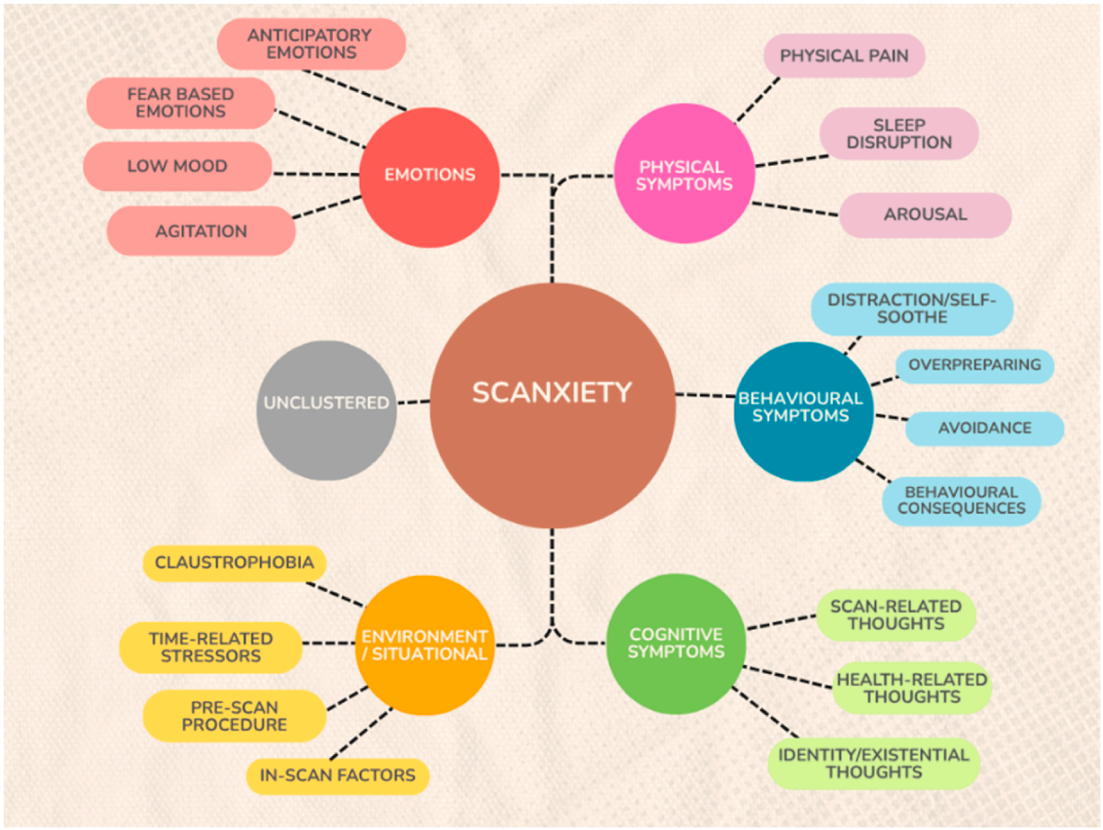

Figure 2. A visual representation of the 5 area domains and their clusters.

Physical: This domain was made up of three primary clusters: *Arousal* symptoms were most frequently reported, which included dizziness, sweating, and hypervigilance of bodily sensations. *Sleep disruption* included symptoms such as insomnia, early waking and restless sleep typically occurring in the days leading up to the scan or awaiting results. Finally, *Physical pain* encompassed symptoms such as stiffness, pain related to body positioning and tension. One participant described, '*My back was uncomfortable … the back of my neck was uncomfortable …*'[24]

Behaviour: Behavioural responses were clustered into four clusters: *Distraction and self-soothing behaviours* to manage the distress included listening to music, engaging in relaxation techniques, reading a book and accepting support from friends and family. *Avoidance behaviours* reported the postponement and avoidance of the scan process and scan-related thoughts. For example, taking care of others to prevent worrying, actively pushing thoughts away and trying to avoid others from discussing the scan process. "*… I probably bury my head in the sand. Sometimes, the less you know the better …*".[22] *Overpreparation,* included paper copies of notes, arriving at appointments early, thinking of worst-case scenarios as a way to prepare for the worst outcome, and seeking information from professionals as a form of seeking reassurance. Finally, *behavioural consequences* such as reduced activity, quick to anger, irritable and teeth grinding were described.[21,22]

Unclustered Symptoms: Nine symptoms did not fit within the established clusters but were retained to capture the full breadth of the scanxiety experience. Examples included tasting metal and isolated behaviours and cognitions such as paranoid thoughts. Symptoms that were ambiguously reported were also coded here to avoid speculative interpretation. These symptoms are presented in Table 3.

Symptom coverage analysis

Nine tools used to assess scanxiety were identified from the Bui et al.'s[4] scoping review for the symptom coverage analysis. To enhance reliability of the mapping process, a second reviewer (AH) independently reviewed a randomly selected subset of the data. This included three measures, and one cluster from each domain, including the unclustered symptom domain. Measures and symptom clusters were selected using a random number generator. Inter-rater agreement for the mapping process was 100%.

The analysis revealed physical and emotional symptoms were the most consistently assessed symptoms across measures. More specifically, anticipatory emotions (e.g., nervousness, anticipation, worry) featured in eight of the ten included measures. Fear and physical symptom clusters such as sleep disruption were also captured frequently. In contrast, behavioural and cognitive symptoms were rarely captured. Interestingly, some of the unclustered symptoms were covered, such as confusion, preoccupation, associating symptoms with cancer, reduced concentration, and irrational and paranoid thoughts.

Every cluster within the environmental domain failed to be covered. This included *Claustrophobia*, which was reported in 11/23 of the included studies reviewed. While all other domains and their respective clusters were represented by at least one tool, coverage was still limited. See Table 3 for more information.

Discussion

The current review used a priori framework to synthesise the evidence documenting self-reported symptoms of scanxiety. A range of symptoms were identified within each framework domain (emotional, cognitive, behavioural, physical, and environmental); however, some symptoms did not fit neatly within the framework but were retained to ensure comprehensiveness. Symptoms were then mapped against a selection of measures previously applied to the assessment of scanxiety through a symptom coverage analysis.[41–49] This revealed that, of the measures selected within this review, most have primarily focused on physical and emotional symptoms of scanxiety, particularly anticipatory emotional responses. In contrast, behavioural symptoms were less frequently examined, and environmental-related symptoms were omitted from all measures examined. None of the nine measures evaluated captured all symptom clusters identified in the present review. Overall, our findings are consistent with previous reviews highlighting heterogeneity and conceptual ambiguity within scanxiety research.[4,8,9]

Environmental features (e.g., noise, temperature, confined spaces, waiting times and procedural elements) emerged as a

Table 3
Symptom Coverage Analysis comparing symptoms and commonly used measures of scanxiety

	HADS -anxiety	STAI -state	STAI -Trait	GHQ 12	SCL-90-R anxiety	PSWQ	IES	HAI	PSS	PROMIS - anxiety
Physical										
Physical pain	✓	✓			✓			✓		✓
Arousal	✓				✓			✓		✓
Sleep disruption				✓	✓		✓	✓		
Emotional										
Anticipatory emotions	✓	✓	✓		✓	✓		✓	✓	✓
Fear based emotions	✓	✓			✓			✓	✓	✓
Agitation	✓				✓				✓	
Low mood			✓	✓						
Behavioural										
Distraction/Self soothe	✓									
Avoidance							✓	✓		
Overpreparation		✓	✓			✓		✓		
Behavioural consequences			✓	✓				✓	✓	
Cognitive										
Scan-related thoughts										
Health-related thoughts								✓		
Identity/Existential	✓			✓		✓		✓	✓	
Environmental										
Claustrophobia										
Time-related stressors										
Pre-scan procedures										
In scanner factors										
Unclustered										
Tearfulness										
Confused		✓								
Pre-occupied			✓			✓	✓			✓
Associating every ache with cancer								✓		
Trying to push call button										
Reduced concentration				✓						✓
Irrational thoughts								✓		
Paranoid thoughts					✓					
Tasting metal										

Note. HADS = Hospital Anxiety and Depression Scale (HADS),[41] STAI = State–Trait Anxiety Inventory[42]; GHQ-12 = 12-item General Health Questionnaire[43]; SCL-90-R = Symptom Checklist-90-Revised[44]; PSWQ = Penn State Worry Questionnaire[45]; IES = Impact of Event Scale[46]; HAI = Health Anxiety Inventory[47]; PSS = Perceived Stress Scale[48]; PROMIS-Anxiety = Patient-Reported Outcomes Measurement Information System (Anxiety).[49] The left axis is clustered by domain (e.g. physical, emotional, behavioural, cognitive, environmental.) Although still related to a respective domain, unclustered symptoms were grouped at the bottom of the graph for ease. ✓ indicates symptom coverage; absence indicates symptom not assessed by measure.

prominent contributor to scanxiety across studies and different types of medical scan procedures, yet are not included in applied measures. These factors were viewed as a possible trigger for scanxiety; exacerbate prior scanxiety levels; or interact with emotional, cognitive, and behavioural responses, such as exposure to visibly distressed patients in the waiting area prior to scanning. Similar environmental stressors have been noted in previous imaging-related research, particularly in relation to MRI tolerance and claustrophobic reactions.[50,51] Since these environment features are often scan-specific and may vary across imaging modalities (such as distinct noise or confinement of an MRI), a notable limitation of the generic anxiety measures evaluated in this review is they naturally lack the specificity required to capture them. This pattern aligns with previous concerns that scanxiety is often assessed using tools developed for broader anxiety constructs, than scan-specific experiences.[4,8]

As identified in the symptom coverage, existing measures demonstrated an uneven focus across symptom domains. This omission may contribute to the under-recognition of scan-related distress and is especially important given the increasing use of scans across medical contexts and the potential cost to public health services when scans are delayed, missed or aborted due to scanxiety. Broader assessment approaches that incorporate these factors could enhance clinical detection and support.

The findings indicate variation in the focus of scanxiety experiences. For some individuals, distress centred on diagnosis uncertainty, prognosis of health or fear of results while for others it related more strongly to sensory or procedural aspects of scanning. Moreover, some symptoms were coded as spanning more than one framework domain. For example, 'difficulty tolerating uncertainty' was described in ways that could reflect cognitive or emotional responses. Whereas 'Worrying', may represent an emotion or a behaviour as both an internal experience and a behavioural process.[52] The heterogeneity and multifaceted nature of scanxiety related symptoms suggest measurement tools that assume a single pathway or patten of scan-related distress may be too simple and fail to capture the range of patient experiences reported across contexts. Instruments that incorporate physical, behavioural and environmental components could improve accuracy and clinical relevance. Clinicians may benefit from combining structured tools with flexible, formulation-based assessments that consider personal history, setting and meaning.

It must be recognised that most measures previously used to evaluate scanxiety identified by Bui et al.[4] were not included, as they did not meet the inclusion criteria. This includes the Magnetic Resonance Imaging Anxiety Questionnaire (MRI-AQ),[10] which was not identified by Bui et al.,[4] However, a visual inspection of its items cross-referenced with symptoms identified here suggests that it primarily assesses emotional and physiological distress, alongside elements of behavioural regulation (e.g. effortful self-control and desire to terminate the scan) and perceived need for support or information. The scale does not explicitly assess cognitive appraisals or external environmental triggers (e.g. scanner noise, physical surroundings) nor does it directly capture claustrophobia. However, it is important to note that certain modality specific instruments have been developed to address these precise environmental demands. For example, the Pre-scan and Post-scan Imaging Distress Questionnaire[53] specifically evaluates MRI-related environmental stressors, capturing features such as the narrowness of the tunnel and noise levels. The existence of such tools highlights the utility of technique specific measures over general anxiety scales, when trying to account for distinct physical environments. Taken together, this suggests that while tools such as the MRI-AQ[10] may be validated and therefore suitable for MRI-specific contexts, existing tools still do not fully capture the multi-dimensional nature of scanxiety identified in this review, supporting the need for refinement or existing measures of more comprehensive assessment tools.

A key strength of this review is the inclusion of diverse study designs, clinical groups and scan contexts. This enables the identification of symptom patterns that were consistent across methodologies. However, variation in reporting quality and the inclusion of non-empirical sources may limit precision. This heterogeneity reflects the developing nature of scanxiety research and the need for continued conceptual refinement. Future research should prioritise the development of scanxiety-specific assessment tools that reflect the full emotional, cognitive, behavioural, physical and environmental diversity of symptoms identified within this review. Further work is also needed to examine scanxiety across diverse cultural, healthcare, and diagnostic contexts. Indeed, the current evidence base remains largely drawn from high income, Western settings, limiting global applicability. Such advances would support more accurate identification of scan-related distress and inform interventions to improve patient experience during medical imaging.

It is a limitation of the current review that it focused on identifying reported symptoms of scanxiety rather than determining the origin or diagnostic specificity of distress. As a result, symptoms such as claustrophobic distress were mapped based on their presence in the literature, without inference regarding whether they reflected a broader specific phobia of enclosed spaces. Additionally, formal subgroup analyses were not conducted, limiting the ability to draw firm conclusions regarding differences across populations, study design and/or scan types. The use of a best-fit framework synthesis,[16] while clinically useful, may have shaped how symptoms were categorised within a priori framework. In addition, variation in study design, reporting quality and symptom detail limited direct comparison across studies, as symptoms were inconsistently defined, variably reported, and often embedded within broader experiential accounts. A small number of non-empirical sources were included to capture experiential perspectives, and were interpreted cautiously within the synthesis, which may influence consistency and comparability of reported symptoms. Additionally, single-item and adapted measures were excluded from the symptom coverage analysis to maintain consistency and comparability across included tools. However, this may limit the applicability of findings to some clinical contexts where brief or modified measures are commonly used in practice. As the review did not seek to weight or rank symptoms, findings are presented at a broad level, which may limit the immediate clinical prioritisation of results. Finally, although search terms were simplified to capture broad descriptions of scan-related anxiety, the term 'scanxiety' only emerged in 2011.[3] This means earlier studies describing similar experiences may not have been identified.

Conclusions

This review demonstrates that scanxiety is a multidimensional experience encompassing physical, cognitive, behavioural, emotional and environmental elements. Existing measures fail to represent all of these domains; while the environmental context, shared idiosyncrasies, and behavioural responses were distinctly under-represented. The findings have implications for clinicians working in all settings in which imaging takes place, albeit many of the included studies came from oncology settings. Future research should prioritise developing valid and reliable measures of scanxiety, with items grounded in the voices of those who experience it. Such tools would enable for greater recognition of scanxiety,

and in turn provide opportunity for management and intervention.

Informed consent

Informed consent for patient information to be published in this article was not obtained as this is a systematic review of already published data.

Ethical approval

Ethical Approval was not sought for the present study as it is a systematic review.

Animal Welfare

Guidelines for humane animal treatment did not apply to the present study because it did not involve animals and is a systematic review of already published data.

Availability of data

A protocol for this systematic review was registered with Open Science Framework. Data for this study may be made available by the author(s) upon reasonable request.

CRediT author Statement

KB: Conceptualisation, Investigation, Methodology, Formal Analysis, Resources, Writing - Original Draft, Writing, Review & Editing, Project Administration, Visualisation. **GL:** Conceptualisation, Methodology, Writing – Review & Editing, Supervision.

GR- Conceptualisation, Methodology, Supervision, Writing – Original Draft Preparation, Review & Editing. **AH**: Formal Analysis, Validation. **CG**: Conceptualisation, Investigation, Methodology, Validation, Writing – Original Draft Preparation, Review & Editing, Supervision.

Generative AI use

During the preparation of this work the author(s) used Google Gemini in order to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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Conflict of interest statement

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.radi.2026.103488.

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