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Global prevalence and determinant factors of pain, depression, and anxiety among cancer patients: an umbrella review of systematic reviews and meta-analyses

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Abstract

Introduction Depression and anxiety are prevalent psychological disorders that significantly affect physical, emotional, and social well-being, reducing quality of life and increasing medical costs. These issues are especially challenging for cancer survivors, complicating treatment management, affecting adherence, and potentially impacting survival rates. Thus, this umbrella review aimed to evaluate the global prevalence of pain, depression, and anxiety, as well as their determinants among cancer patients.

Method An exhaustive umbrella review was conducted to systematically assess the prevalence and determinants of pain, depression, and anxiety among cancer survivors worldwide by analyzing systematic reviews and meta-analyses. The review involved a thorough search of multiple databases and included studies published in English up to July 2024 that reported on these symptoms. The process involved screening and selecting studies based on specific criteria, assessing the risk of bias using the AMSTAR tool, and analyzing data with statistical methods to determine overall prevalence and identify predictors. This comprehensive approach aimed to provide a detailed understanding of these psychological issues in cancer survivors and guide future research and interventions.

Result The global summary prevalence of depression among cancer survivors was 33.16% (95% CI 27.59–38.74), while anxiety had a prevalence of 30.55% (95% CI 24.04–37.06). Pain prevalence after treatment was 39.77% (95% CI 31.84–47.70). Before treatment, 65.22% (95% CI 62.86–67.57) of cancer patients reported pain, which persisted in 51.34% (95% CI 40.01–62.67) during treatment. The analysis also found that during the COVID-19 pandemic, depression and anxiety rates among cancer patients were at their highest, with prevalences of 43.25% (95% CI 41.25–45.26) and 52.93% (95% CI 50.91–54.96), respectively.

Conclusion The umbrella review found that depression and anxiety prevalence among cancer survivors was 33.16% and 30.55%, respectively, with significantly higher rates during COVID-19 at 43.25% and 52.93%. Key factors contributing to depression included poor social support, advanced cancer stage, and inadequate sleep, while anxiety was significantly linked to advanced cancer stage and poor sleep quality.

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Keywords Cancer, Oncology, Pain, Depression, Anxiety, Cancer survivors, Systematic review, Meta-analysis, Umbrella review

Introduction

Depression, anxiety, and pain are interconnected psychological and physical conditions that collectively affect an individual's overall well-being. These conditions can create a vicious cycle where each amplifies the other, leading to a profound reduction in quality of life [1]. For cancer survivors, the emotional ring of their diagnosis and treatment, attached to persistent psychological stress, can intensify physical pain and make it difficult to manage both mental and physical symptoms. Poor mental health, in turn, affects treatment adherence, increases hospitalizations, and may negatively influence survival outcomes [2]. The COVID-19 pandemic has further worsened these challenges by increasing uncertainty, disrupting care, and developing feelings of isolation and vulnerability, especially among cancer patients, who must now navigate the dual burden of their disease and the pandemic's risks [3].

Pain specifically, physical pain in cancer patients is one of the most prevalent and debilitating symptoms, often resulting from tumor invasion, treatment modalities, or a combination of both. Tumors can exert pressure on nearby tissues, nerves, or organs, leading to nociceptive pain, which is typically described as aching, throbbing, or sharp [4]. Beyond physical dimensions, unrelieved pain can exacerbate emotional distress, fatigue, and a decline in functional capacity, further underscoring the need for integrative palliative care [5].

Depression, a widespread mental health disorder affecting personal and social aspects of life, is recognized as a major public health concern, with approximately 264 million people affected globally, according to the WHO. This condition contributes to various disabilities and increases the overall burden and healthcare costs [6]. Studies show that depression is particularly common among individuals with chronic or terminal illnesses, such as cancer when compared to healthy populations [7]. Around 30–40% of cancer patients experience depression, with a higher prevalence observed in breast cancer patients [8]. The Global Cancer Observatory reported nearly 19.3 million new cancer cases and 10 million cancer-related deaths in 2020. Depression, anxiety, and pain may be interrelated due to the shared pathways of emotional and physical distress, where cancer's physical toll and uncertainty about the future contribute to both psychological and physical suffering. This interplay often amplifies the experience of each symptom, exacerbating the overall burden on patients [9].

Depression and anxiety are commonly observed psychological challenges in cancer patients, often leading to adverse psychophysiological effects, such as physical pain, poorer treatment outcomes, extended hospital stays, and higher mortality rates [10]. Studies suggest that various factors, including age, education, patient-provider relationships, social and financial support, sleep quality, and cancer stage, play a role in the development of these mental health issues. A unifying framework for understanding the relationship between depression, anxiety, and pain in cancer patients points to the shared underlying mechanisms, such as chronic stress, inflammation, and altered neurotransmitter activity, which can worsen both physical symptoms like pain and psychological distress. These interconnected factors create a feedback loop where pain exacerbates emotional distress, and anxiety or depression heightens the perception of pain, making it harder to manage symptoms and achieve favorable treatment outcomes [11, 12].

The global prevalence and determinants of pain, depression, and anxiety among cancer patients are critical focus areas due to their significant impact on quality of life, treatment adherence, and clinical outcomes. These symptoms, often interlinked, exacerbate the disease burden and contribute to poorer prognoses and higher healthcare costs. Conducting an umbrella review on this topic provides a comprehensive synthesis of high-quality evidence, clarifying the associations between these conditions, identifying effective interventions, and addressing research gaps. This approach supports the development of integrated care strategies that holistically address the mental and physical needs of cancer patients, ultimately improving their outcomes. Thus, this umbrella review aimed to evaluate the global prevalence of pain, depression, and anxiety, as well as their determinants among cancer patients.

Research question

- What is the global prevalence of pain, depression, and anxiety among cancer patients as reported in systematic reviews and meta-analyses?
- What are the key demographic, clinical, and psychosocial factors associated with the prevalence of pain, depression, and anxiety among cancer patients?
- Are there regional or cultural differences in the prevalence of pain, depression, and anxiety among cancer patients?

Methods

An exhaustive umbrella review was conducted to systematically and comprehensively examine the prevalence and determinants of pain, depression, and anxiety among cancer survivors worldwide, utilizing systematic reviews and meta-analyses (SRMA) studies [13]. This approach allowed for a comprehensive synthesis of the existing evidence to gain summarized evidence on the outcome of interest.

Search strategy and eligibility criteria

To identify available systematic reviews and meta-analyses (SRMA) on the prevalence of pain, depression, anxiety, and their associated factors among cancer survivors, two authors (AG and MB) conducted a comprehensive electronic search. The search, carried out from July 1 to 15, 2024, included databases such as MEDLINE, EMBASE, CINAHL, PubMed, ScienceDirect, Web of Science, the Cochrane Database of Systematic Reviews, and PROSPERO (International Prospective Register of Systematic Reviews). The search terms, combined using Boolean operators "AND" and "OR," included: "prevalence" OR "magnitude" OR "proportion" OR "percentage" AND "pain" OR "depression" OR "anxiety" AND "cancer patients" OR "cancer survivors" AND "factors" OR "determinant factors" OR "predictors" OR "risk factors" AND "reviews" OR "systematic review" OR "meta-analysis." The target population for this umbrella review was cancer survivors experiencing one or more of the following symptoms: pain, depression, or anxiety. Only SRMA studies published in English up to July 2024 that reported the prevalence of these symptoms were included. Excluded from the review were non-SRMA studies, narrative reviews, editorials, correspondence, abstracts, methodological studies, and literature reviews lacking a defined research focus or search strategy, missing relevant outcomes, or not meeting quality standards.

Screening and selection process

All search results were imported into Endnote X8 for cleaning, sorting, and removing duplicate articles. Two authors (AG and MA) independently screened the titles and abstracts based on the inclusion criteria, generating a preliminary list of articles. Three authors (AG, MB, and MA) then jointly retrieved and screened all full-text articles. Exclusion reasons were documented in the PRISMA flow diagram. One author, AG, extracted data from the included SRMA studies into Microsoft Excel spreadsheets, focusing on the author's name, publication year, cancer type, number of studies in each SRMA, sample size, and outcome variables (prevalence of pain, depression, and anxiety). Determinant factors reported in the SRMA studies were also extracted. The remaining two authors, MB and MA, cross-checked the extracted data. Any disagreements during the screening and selection process of SRMA studies were resolved through consensus.

Data extraction

Two independent reviewers extracted data from eligible systematic reviews and meta-analyses (SRMAs) using a standardized form. Key data items were included: study characteristics (author, year of publication, study population, sample size); outcome measures, specifically the prevalence of pain, depression, and anxiety among cancer patients; and treatment details (pain before and after treatment). Discrepancies in data extraction were resolved through consensus, with a third reviewer consulted if necessary.

Measurement of outcome variables

This umbrella review focuses on three outcome variables: pain, depression, and anxiety. The pain was assessed using various scales, including the visual analog scale (VAS), numerical rating scale (NRS), verbal rating scale (VRS), and a simple pain "yes/no" measure. When pain severity was reported using VAS or NRS, Serlin's rating was applied [14]. For evaluating anxiety and depression in cancer patients, the hospital anxiety and depression scale (HADS) and the patient health questionnaire (PHQ) were utilized [15, 16]. Additionally, this review aimed to identify determinants of anxiety and depression among cancer patients globally.

Risk of bias assessment

The Assessment of Multiple Systematic Reviews (AMSTAR) tool [17] was used to ensure the methodological and evidence quality of each SRMA study included in the review (Table 1).

Data synthesis and heterogeneity assessment

After screening and selecting all eligible SRMA studies, the data were exported to Stata version 17.0 software (Stata Corp, TX, USA) for analysis. Cochran's Q statistic and the I^2 test were used to identify and measure statistical heterogeneity [18]. Due to significant heterogeneity among the included SRMA studies, the Der Simonian-Laird random-effects model was applied to estimate the pooled prevalence of pain, depression, anxiety, and their predictors among cancer survivors worldwide [19]. The use of the random-effects model was due to the high degree of heterogeneity observed among the included studies. The random-effects model assumes that the true effect sizes vary across studies, reflecting the diversity in study populations, methodologies, and settings. Given the substantial heterogeneity, which is often indicative of differences in study characteristics, the random-effects model provides a more appropriate estimate of the overall

Table 1 The methodological quality of the included systematic reviews and meta-analyses was assessed using the AMSTAR criteria to explore the global prevalence and influencing factors of pain, depression, and anxiety among cancer patients

Author and publication year	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Total
Van Den Beuken-Van et al., 2016	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	10
Van den Beuken-van et al., 2007	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	9
Yang YL et al., 2013	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Zamani M et al., 2023	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	9
Walker ZJ et al., 2021	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	10
Mitchell AJ. et al., 2013	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Brunckhorst O et al., 2021	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Watts S et al., 2014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Watts S et al., 2015	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10
Rezagholi P R et al., 2022	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Tao F et al., 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	10
Geremew H et al., 2024	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	8
Kouhestani M et al., 2022	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	10
Pilevarzadeh M et al., 2019	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	10
Tan DJ et al., 2022	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	10
Mejareh ZN et al., 2021	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	9
Javan Biparva A et al., 2023	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	10
Gharaei HA et al., 2019	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Mohammed A et al., 2024	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
HaenenV et al., 2023	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	9
Evenepoel M et al., 2022	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	10
Osmani V et al., 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Yu H et al.,2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Rezaianzadeh A et al., 2019	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	9
Darvishi N et al., 2022	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Ghamari D et al., 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	10

AMSTAR: Assessment of Multiple Systematic Reviews. Q1: A priori design; Q2: Duplicate study selection and data extraction; Q3: Search comprehensiveness; Q4: Inclusion of grey literature; Q5: Included and excluded studies provided; Q6: Characteristics of the included studies provided; Q7: Scientific quality of the primary studies assessed and documented; Q8: Scientific quality of included studies; Q9: Appropriateness of methods used to combine studies' findings; Q10: Likelihood of publication bias was assessed; Q11: Conflict of interest

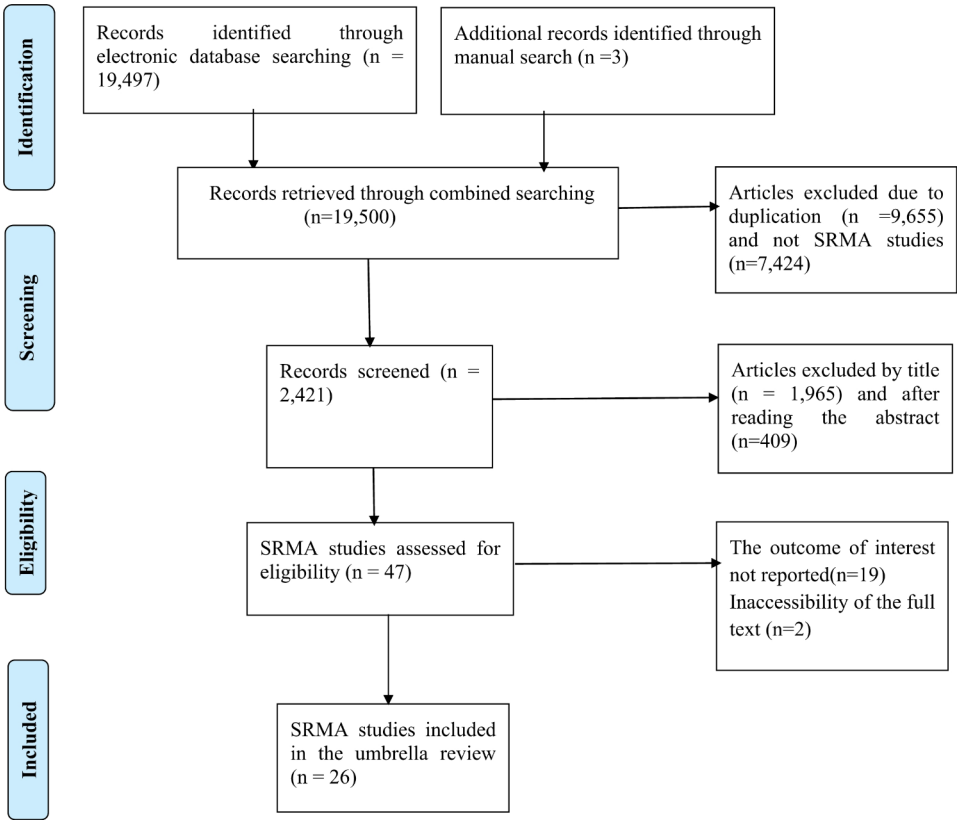

Fig. 1 A PRISMA diagram illustrating the selection process of systematic reviews and meta-analyses reporting the prevalence of pain, depression, and anxiety among cancer survivors globally

effect, as it accounts for both within-study variability and between-study variability. By using this model, we are better able to generalize the findings to a broader population, rather than assuming a single, fixed effect across all studies. This approach ensures that the influence of individual studies on the overall results is appropriately weighted and that the findings remain robust despite the observed heterogeneity. To investigate the source of high heterogeneity, meta-regression was performed using the number of studies in each SRMA and sample size as covariates. Since these covariates did not explain the high heterogeneity, subgroup analysis based on cancer type was conducted. With a minimum of ten studies required to evaluate publication bias, the presence of publication bias was assessed since 26 studies were included in this umbrella review [20]. This assessment was done through visual inspection of funnel plots and Egger's regression tests [21]. When publication bias was detected, a trim and fill analysis was performed to address it. A log odds ratio was used to show the association between dependent variables (depression and anxiety) and their associated factors. A *p*-value of less than 0.05 was considered statistically significant.

Result

Search results on systematic review and meta-analysis studies

Initially, the electronic database searches yielded 19,500 articles from various sources. Of these, 19,455 were subsequently removed for reasons such as duplication, not being SRMA studies, inaccessibility of the full text, and after careful examination of the titles and abstracts. Full-text articles were then retrieved and critically appraised for the remaining 45 SRMA studies. Of these, 19 were excluded because they did not report the outcomes of interest (pain, depression, and anxiety). Finally, 26 SRMA studies were included in the umbrella review (Fig. 1).

Characteristics of included studies

This umbrella review includes 26 SRMA studies: 14 [1, 22–34] reported both the prevalence of depression and anxiety, 8 [6, 7, 35–40] reported only the prevalence of depression, and 4 [41–44] reported the prevalence of pain. Among the studies reporting pain prevalence, 2 reported pain before, during, and after treatment, one reported pain only before treatment, and one reported pain only during treatment. These 26 SRMA studies encompass 1,161 individual studies with a total sample size of 1,288,612 cancer survivors worldwide.

The types of cancer survivors included in this review were general cancer patients [1, 7, 23, 24, 29, 31, 33, 41–44], digestive tract cancer patients [6, 22], breast cancer patients [28, 35–40], prostate cancer patients [25, 26], liver cancer patients [30], ovarian cancer patients [27, 34], and cancer patients during COVID-19 [32]. The studies were conducted from 2007 to 2024, with the number of studies in each SRMA ranging from 9 to 183. Sample sizes ranged from 240 to 655,149. The highest prevalence of depression and anxiety was reported by Yang YL et al. (2013) [1], at 54.9% and 49.7%, respectively. Regarding pain prevalence, the highest prevalence after treatment was reported by Haenen V et al. (2022) [43] at 47%, the highest prevalence before treatment was reported by Van Den Beuken-Van et al. (2016) [41] at 66.4%, and the highest prevalence during treatment was reported by Van den Beuken-van et al. (2007) [42] at 59% (Table 2).

The methodological quality of the included studies

The methodological quality of the included SRMA studies was evaluated using the AMSTAR tool [17, 45]. The AMSTAR tool consists of 11 items that address criteria related to the assessment of methodological rigor. Each item is scored as "yes," "no," "cannot answer," or "not applicable," with a maximum possible score of 11. Scores of 0–4 indicate low quality, 5–8 indicate moderate quality, and 9–11 indicate high quality. The authors conducted the appraisal independently using a standardized form and found that scores ranged from 8 to 11, with a mean score of 10.11 points, indicating an overall high quality of SRMA studies (Table 1).

Table 2 Key features of the systematic reviews and meta-analyses incorporated in this umbrella review aim to examine the global prevalence and contributing factors of pain, depression, and anxiety among cancer patients

Author	Cancer survivors	Number of studies	Sample size	Percentage of pain			Depression (%)	Anxiety (%)
				After treatment	Before treatment	During treatment		
Van Den Beuken-Van et al., 2016	Cancer patients	122	63,533	39.3	66.4	55.0		
Van den Beuken-van et al., 2007	Cancer patients	52	19,985	33.0	64.0	59.0		
Yang YL et al., 2013	Cancer patients	17	3,497				54.9	49.7
Zamani M et al., 2023	Digestive cancer patients	51	1,678				30.2	20.4
Walker ZJ et al., 2021	Cancer patients	40	9,195				21.0	18.0
Mitchell AJ. et al., 2013	Cancer patients	43	51,381				11.6	17.9
Brunckhorst O et al., 2021	Prostate cancer patients	117	655,149				5.8	16.9
Watts S et al., 2014	Prostate cancer patients	27	4,494				17.3	27.0
Watts S et al., 2015	Ovarian cancer patients	24	3,623				25.3	19.1
Rezagholi P R et al., 2022	Brest Cancer patients	22	3,082				50.0	
Tao F et al., 2023	Brest Cancer patients	63	53,513				38.0	38.0
Geremew H et al., 2024	Cancer patients	17	5,592				45.1	42.9
Kouhestani M et al., 2022	Digestive cancer patients	18	4,709				37.0	
Pilevarzadeh M et al., 2019	Brest Cancer patients	72	47,424				32.2	
Tan DJ et al., 2022	Liver Cancer patients	17	64,247				24.0	22.2
Mejareh ZN et al., 2021	Cancer patients	183	182,521				27.0	
Javan Biparva A et al., 2023	Brest Cancer patients	71	2,345				30.2	
Gharaei HA et al., 2019	Brest Cancer patients	18	2,799				46.8	
Mohammed A et al., 2024	Brest Cancer patients	9	2,226				45.6	
HaenenV et al., 2023	Cancer patients	38	73,000	47.0				
Evenepoel M et al., 2022	Cancer patients	12	9,052			40.0		
Osmani V et al., 2023	Cancer patients	68	15,213				24.0	29.0
Yu H et al.,2020	Cancer During COVI-19	9	2,335				43.3	52.9
Rezaianzadeh A et al., 2019	Brest Cancer patients	9	240				44.2	
Darvishi N et al., 2022	Cancer patients	24	3,225				50.1	40.9
Ghamari D et al., 2023	Ovarian cancer patients	18	4,554				27.0	33.0
Summary		**1,161**	**1,288,612**	**3 SRMA**	**2 SRMA**	**3 SRMA**	**22 SRMA**	**14 SRMA**

SRMA: Systematic Review and Meta-Analyses

Umbrella review of systematic review and meta-analysis studies

Prevalence of depression

The overall summary prevalence of depression among cancer survivors worldwide was 33.16% (95% CI 27.59–38.74) (Fig. 2). This suggests that approximately one-third of cancer survivors experience depressive symptoms, highlighting a significant mental health concern within this population. Heterogeneity analysis revealed an I^2 index of 99.7% with a p-value of <0.001, indicating very high heterogeneity. The funnel plot (Fig. 3) revealed an asymmetrical distribution of the included SRMA studies, which raised concerns about potential publication bias. To formally assess this, Egger's test was conducted, yielding a significant result ($p=0.001$), indicating the presence of publication bias in the analysis. This suggests that smaller studies with null or negative results may have been underrepresented in the literature, potentially skewing the overall findings. To address this issue, a Trim and Fill analysis was performed (Fig. 4), which estimates the number of missing studies and adjusts for potential bias. In this analysis, 12 studies were "filled in" to account for the missing data. After adjusting for publication bias, the revised estimate for the prevalence of depression among cancer survivors was 12.03% (95% CI 6.41–17.65). This adjustment provides a more accurate reflection of the true prevalence, considering the potential influence of unpublished or inaccessible studies.

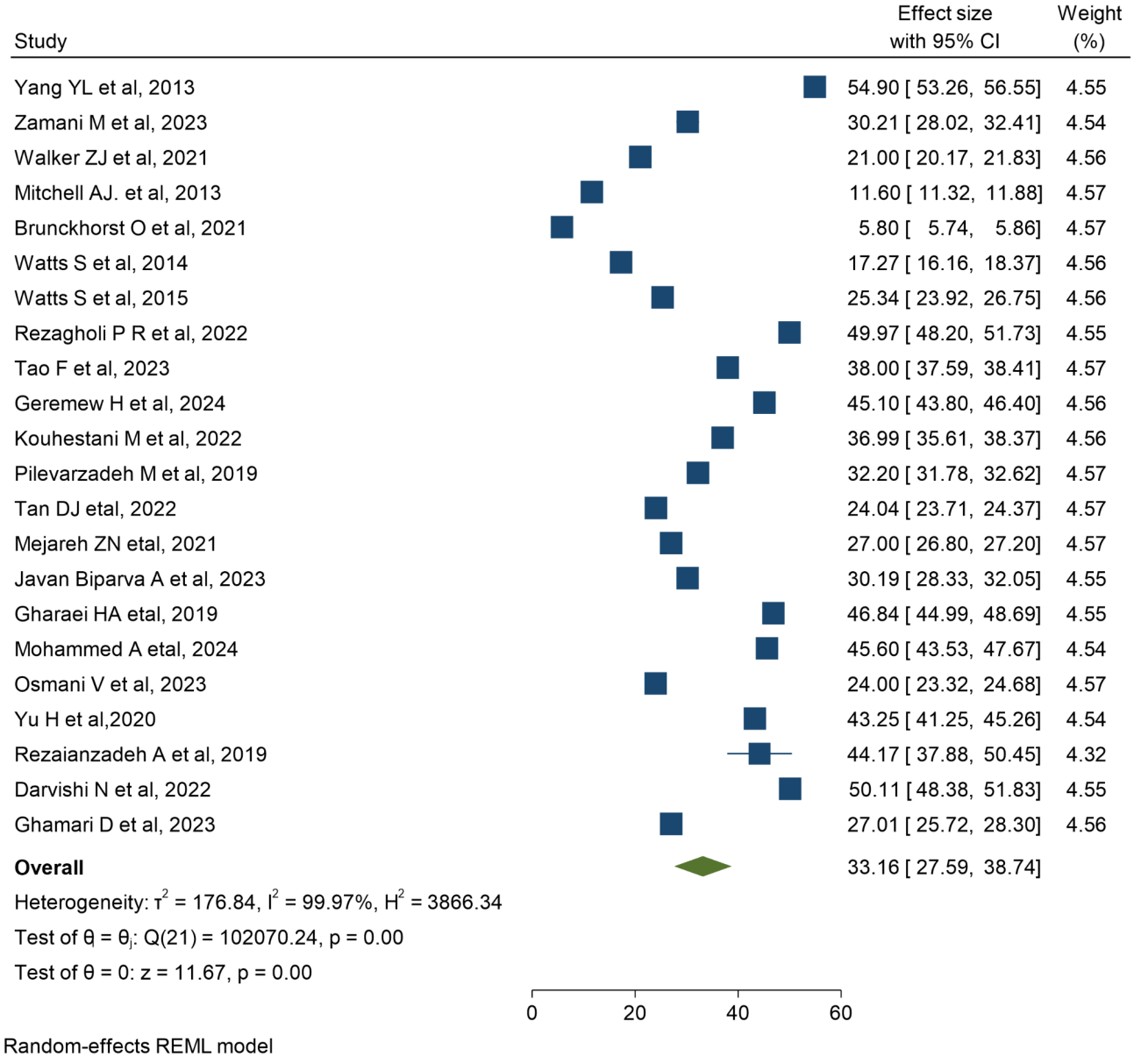

Fig. 2 A forest plot from the umbrella review showing the pooled prevalence of depression among cancer survivors worldwide

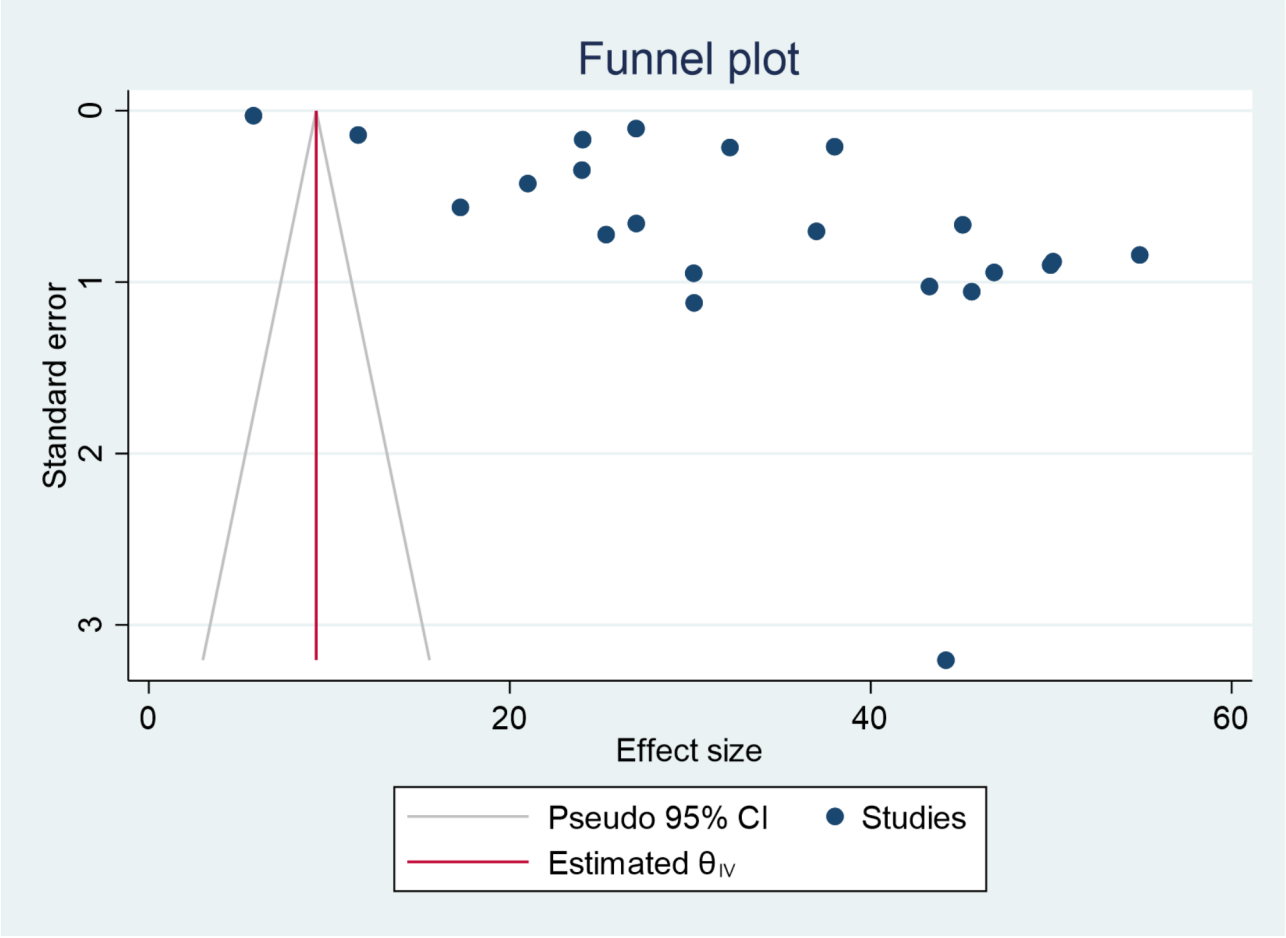

Fig. 3 Funnel plot with 95% confidence interval on the distribution of systematic review and meta-analysis studies on the prevalence of depression among cancer patients included in this umbrella review

Prevalence of anxiety

The overall summary prevalence of anxiety among cancer survivors worldwide was 30.55% (95% CI 24.04–37.06) (Fig. 5), reflecting a widespread psychological burden in this population. The analysis revealed high heterogeneity among the included SRMA studies, with an I^2 index of 99.96% and a *p*-value of < 0.001. The Egger's test was conducted to assess the presence of publication bias, and the results were significant ($p < 0.001$), suggesting that the studies included in the analysis were asymmetrically distributed in the funnel plot. This asymmetry is often indicative of publication bias, where studies with smaller sample sizes or less favorable results may be underreported or unpublished (Fig. 6). To address this potential bias, we performed a Trim and Fill analysis, which estimates the number of missing studies and adjusts the overall effect size by imputing these missing studies. The analysis indicated that eight studies were likely missing from the original set, and after filling these gaps, the total number of studies increased to 22 (Fig. 7). After adjusting for the identified publication bias, the revised prevalence estimate for anxiety among cancer survivors was 17.80% (95% CI 13.18–22.41), which is notably lower than the unadjusted estimate. This adjustment enhances the reliability of the prevalence estimate by accounting for the potential bias introduced by the asymmetrical funnel plot. This process highlights the importance of considering publication bias when interpreting meta-analytic results, particularly in studies where small or non-significant findings may not be fully represented.

Investigations of heterogeneity

This umbrella review found considerable heterogeneity across the included systematic reviews and meta-analyses (SRMAs). To investigate the sources of variability, we performed meta-regression, subgroup analysis, and sensitivity analysis. In the meta-regression, we examined two covariates: the number of studies included in each SRMA and the sample size, focusing on depression and anxiety outcomes. The results showed that neither the number of studies ($p = 0.326$ for depression; $p = 0.194$ for anxiety) nor the sample size ($p = 0.113$ for depression; $p = 0.823$ for

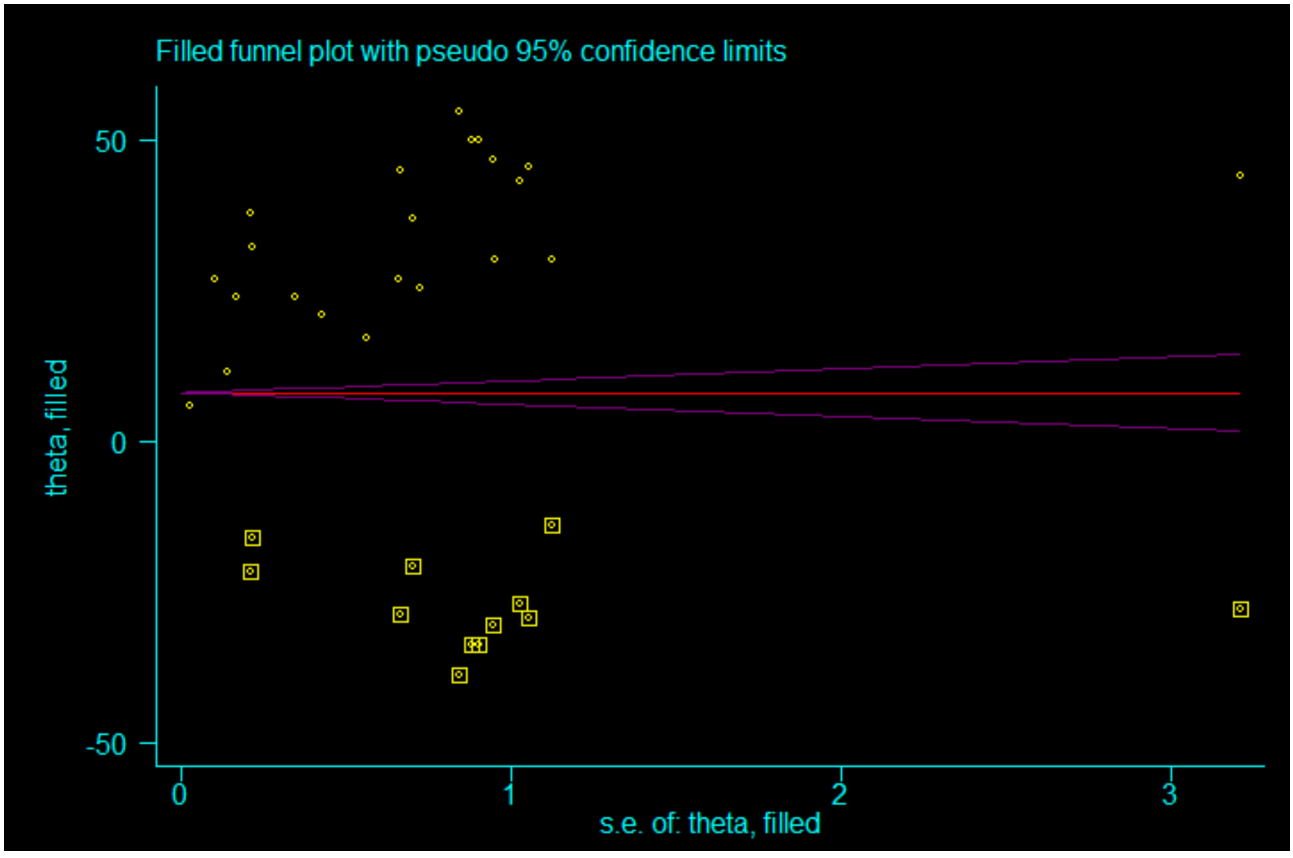

Fig. 4 Filled funnel plot with pseudo 95% confidence interval on the distribution of systematic review and meta-analysis studies on the prevalence of depression among cancer patients included in this umbrella review

anxiety) significantly contributed to the observed heterogeneity. We conducted a subgroup analysis based on cancer survivor type, which revealed that cancer patients during the COVID-19 pandemic experienced the highest prevalences of depression and anxiety, with rates of 43.25% (95% CI 41.25–45.26) and 52.93% (95% CI 50.91–54.96), respectively (Table 3). Additionally, a sensitivity analysis using the random-effects model demonstrated that all individual estimates for depression (95% CI 27.59–38.74) (Fig. 8) and anxiety (95% CI 24.04–37.06) (Fig. 9) remained within the overall confidence intervals, suggesting that no single study had a disproportionate impact on the findings.

Prevalence of pain

This umbrella review explored the global prevalence of pain among cancer survivors, providing a comprehensive analysis of pain levels before, during, and after treatment. The findings revealed that, after treatment, approximately 39.77% (95% CI 31.84–47.70) of cancer survivors continued to experience pain. Before treatment began, nearly two-thirds of cancer patients (65.22%, 95% CI 62.86–67.57) reported experiencing pain. During the treatment phase, about 51.34% (95% CI 40.01–62.67) of survivors still dealt with pain. Overall, the results indicate that cancer treatment tends to reduce the prevalence of pain, although a significant proportion of survivors continue to experience discomfort even after treatment ends. This underscores the need for ongoing pain management strategies throughout the cancer care continuum.

Determinants of depression and anxiety

A report on an SRMA study showed that the odds ratios (ORs) for depression and anxiety in cancer patients compared to those with other diseases were lower than those compared to a normal group. Specifically, for depression, the OR was 6.03 (95% CI 4.23–8.61) compared to 13.58 (95% CI 6.26–29.46) for the normal group; for anxiety, the OR was 4.40 (95% CI 3.05–6.36) compared to 15.47 (95% CI 10.00-23.95) for the normal group [1]. A systematic review and meta-analysis study from Ethiopia identified several determinants of depression and anxiety. Factors significantly associated with depression included poor social support (OR = 2.27, 95% CI: 1.29–3.98), occupational status (OR = 0.59, 95% CI: 0.43–0.82), advanced cancer stage (OR = 2.19, 95% CI: 1.38–3.47), comorbid illness (OR = 1.67, 95% CI: 1.09–2.58), and poor sleep quality (OR = 11.34, 95% CI: 6.47–19.89). For anxiety,

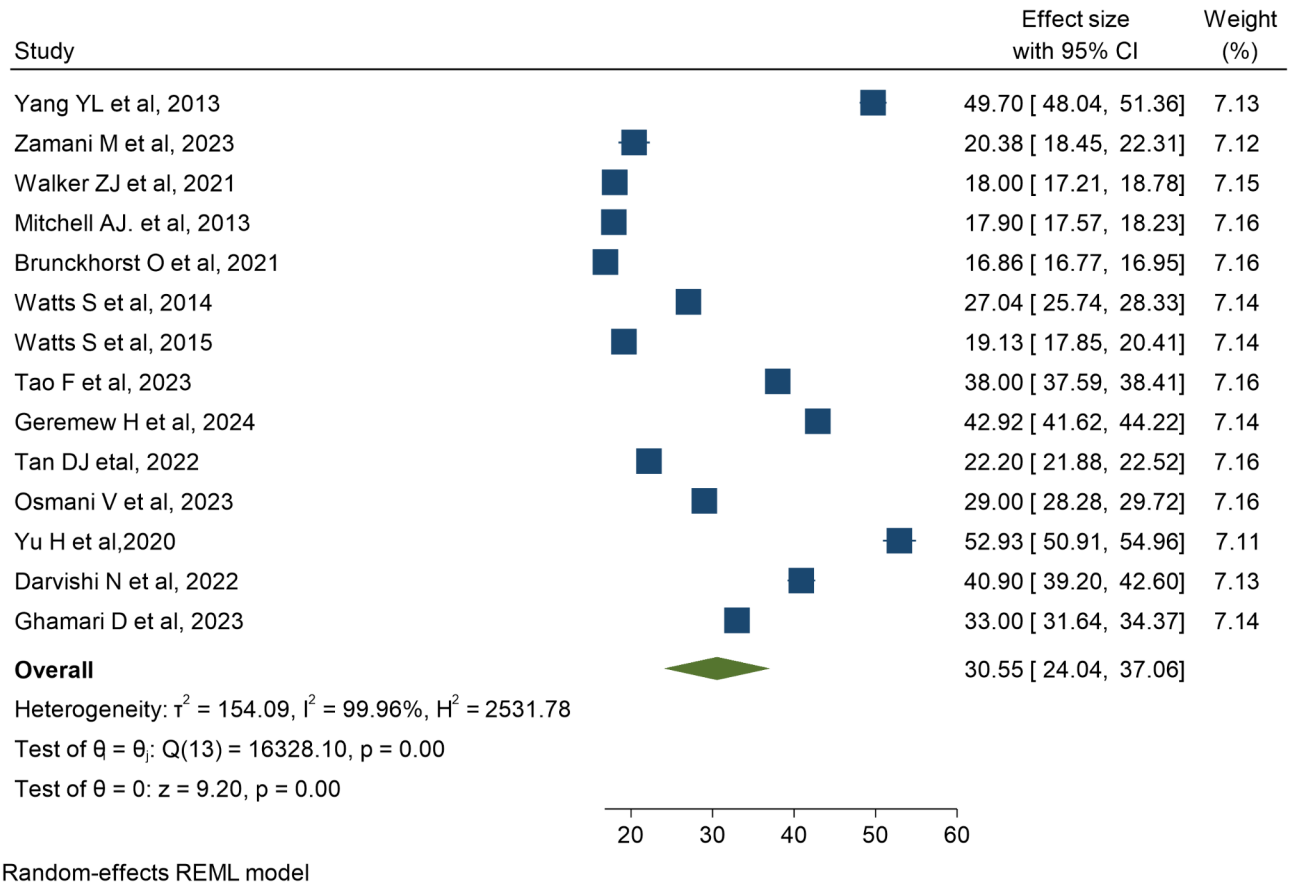

Fig. 5 A forest plot from the umbrella review showing the pooled prevalence of anxiety among cancer survivors worldwide

advanced cancer stage (OR = 1.59, 95% CI: 1.15–2.20) and poor sleep quality (OR = 12.56, 95% CI: 6.41–24.62) were identified as significant factors [29]. Another systematic review and meta-analysis on liver cancer found that alcohol consumption, cirrhosis, and college education were determinants of depression [30]. Additionally, an SRMA identified sociodemographic factors such as age and gender as determinants of depression. Depression prevalence was higher among female cancer patients (31%, 95% CI 26%-36%) compared to males (26%, 95% CI 21%-31%), and depression prevalence among cancer patients was increasing by an average of 0.6% per year [7]. Poor financial support was also found to be a determinant of depression, with an OR of 1.47 (95% CI: 1.02–2.13) [37].

Discussion

This umbrella review summarized the prevalence of pain, depression, and anxiety among cancer survivors, highlighting their impact and identifying key predictors and risk factors. The global prevalence of depression in cancer survivors was found to be 33.16% (95% CI 27.59–38.74), offering insights for enhancing survivor care and interventions. This umbrella review's findings align with global studies but reveal regional and population-based variations. For example, one study reported depression prevalence around 30%, with variations by cancer type and stage, while another found rates as high as 38% in advanced cancer patients, indicating disease progression may worsen mental health. In contrast, a study reported lower rates of 24%, highlighting the impact of healthcare access, social support, and cultural perceptions of mental health [46–48]. The findings underscore the urgent need for targeted mental health interventions that address the specific challenges encountered by distinct cancer populations. While the global prevalence of depression among cancer survivors is estimated at approximately 33%, this figure showed substantial variations due to local factors such as cultural norms, socioeconomic conditions, and differences in healthcare systems [49, 50]. Contributing factors include limited access to mental health services, the societal stigma surrounding mental illness, and the varying psychological impacts of a cancer diagnosis across cultural contexts [51]. To bridge these disparities, tailored interventions must consider these contextual influences, ensuring that mental health support is both accessible and culturally sensitive.

This review revealed that 30.55% (95% CI 24.04–37.06) of cancer survivors experience anxiety, likely driven by

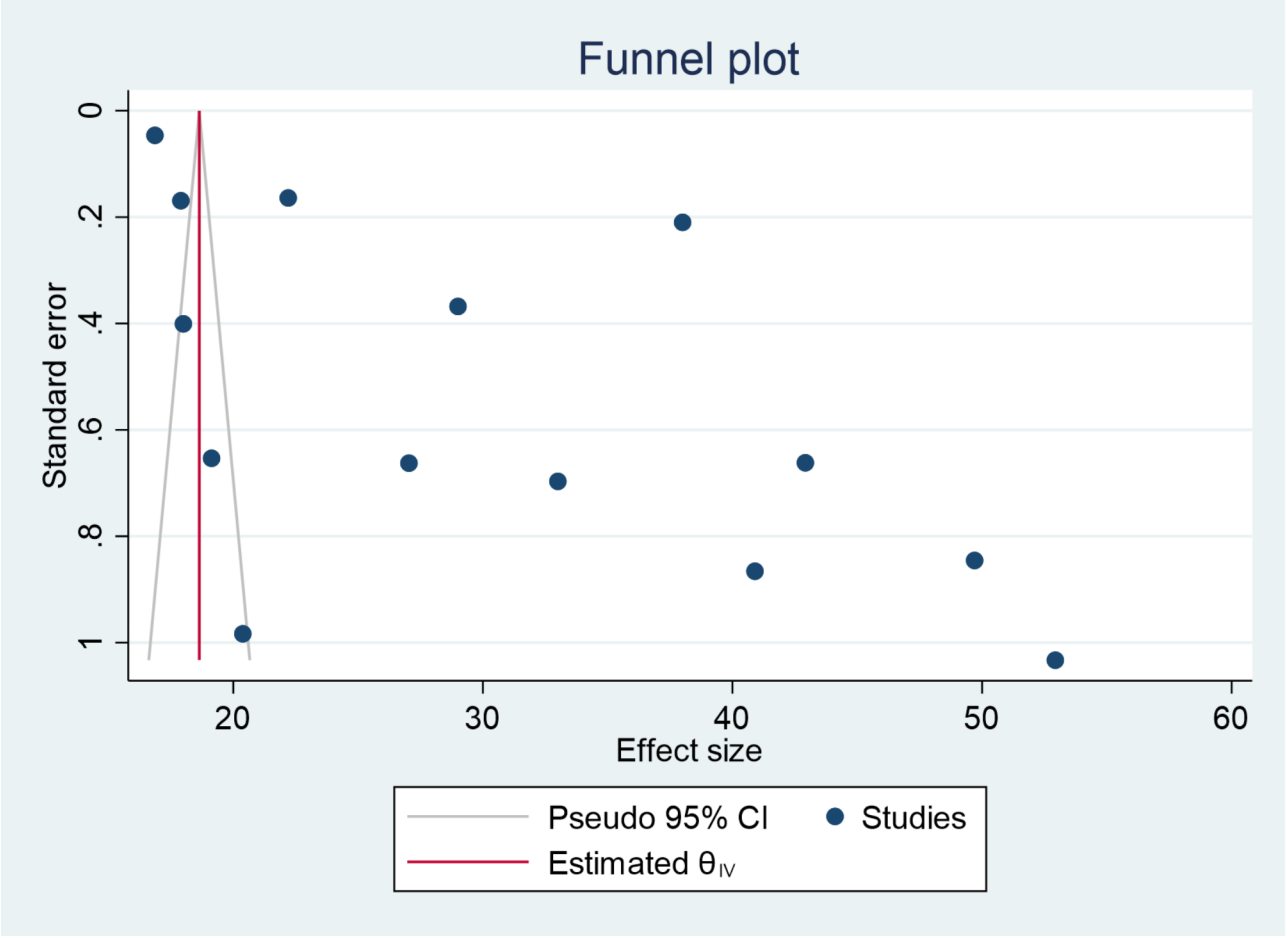

Fig. 6 Funnel plot with 95% confidence interval on the distribution of systematic review and meta-analysis studies on the prevalence of anxiety among cancer patients included in this umbrella review

fears of recurrence, uncertainty about the future, and the psychological impact of treatments. Such anxiety significantly affects the quality of life and hinders recovery, emphasizing the need to integrate mental health support into survivorship care [52, 53]. This finding aligns with other studies reporting significant anxiety prevalence among cancer survivors. For example, some studies estimate anxiety affects around 33% of cancer patients, while others report rates ranging from 20 to 40% depending on cancer type. Conversely, certain research indicates lower rates, averaging about 20%. These discrepancies likely stem from variations in study design, population characteristics, and assessment tools. Overall, while the prevalence in this review is consistent with many findings, it underscores the need for standardized measurement approaches and consideration of contextual factors influencing anxiety rates in this population [46, 48, 54].

Sociocultural and economic factors profoundly impact the mental health outcomes of cancer patients, influencing the prevalence and severity of conditions like depression and anxiety. Cultural beliefs, stigma, and family dynamics shape how patients perceive and manage their diagnosis. In low- and middle-income countries, the stigma surrounding cancer and mental health often deters individuals from seeking psychological support, worsening their emotional distress and leaving these needs unmet [55]. Cultural norms influence reliance on family or community support, which can either ease or heighten isolation and anxiety [56]. Economic factors, including limited healthcare access and financial strain, significantly hinder mental health care in resource-limited settings due to inadequate infrastructure and high costs [57]. The economic burden of cancer treatment can lead to financial toxicity, further compounding psychological distress [58]. In high-income countries, while access to care may be better, socioeconomic disparities persist, with underserved populations experiencing worse mental health outcomes due to barriers like limited insurance coverage or geographic inaccessibility to specialized services [59].

Health system factors also play a crucial role in the prevalence and management of depression and anxiety in

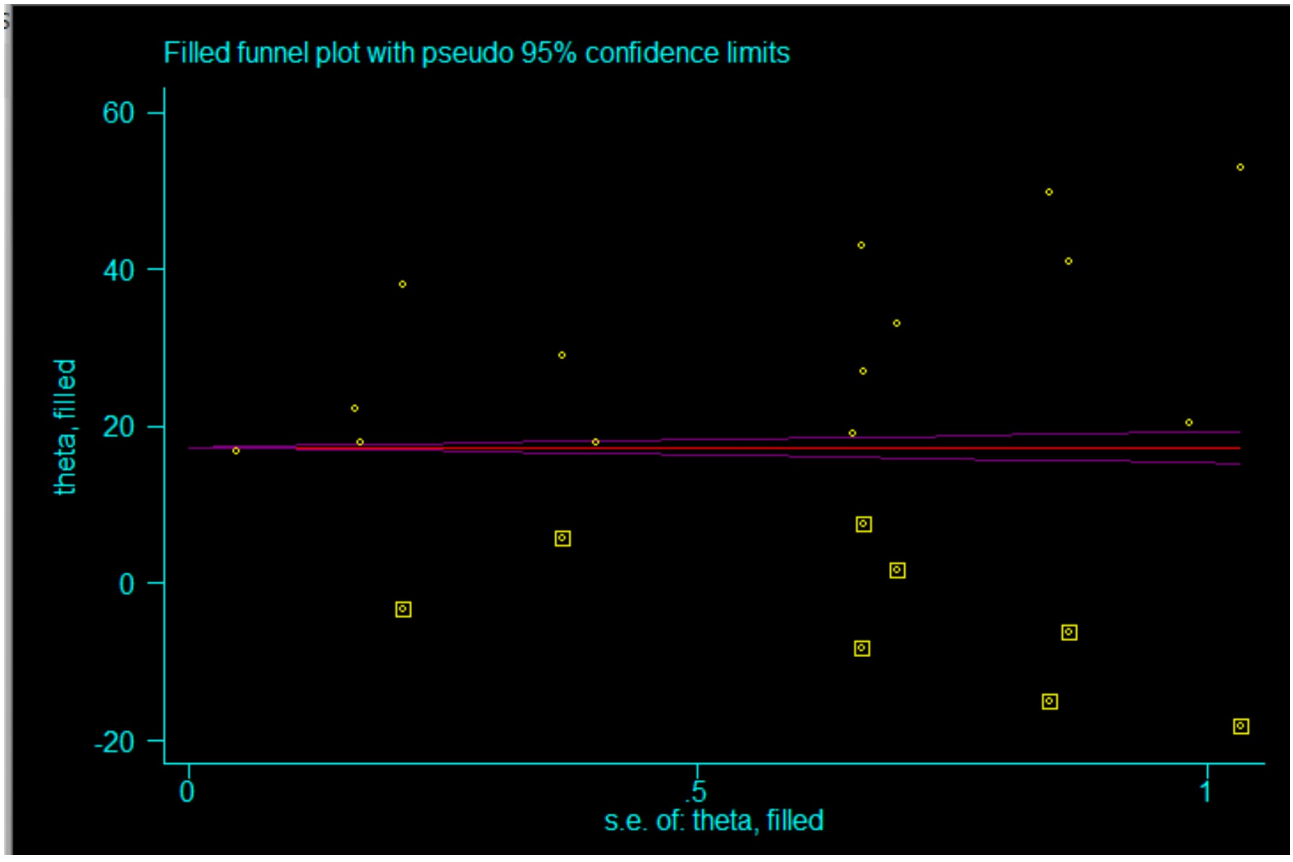

Fig. 7 Filled funnel plot with pseudo 95% confidence interval on the distribution of systematic review and meta-analysis studies on the prevalence of anxiety among cancer patients included in this umbrella review

Table 3 Sub-group analysis by cancer survivor type on the prevalence of depression and anxiety among cancer survivors worldwide

Valuables	Cancer survivors	Prevalence (95%CI)	I^2 (%)	*P*-value
Depression	Brest cancer patients	40.91(35.17–46.65)	99.64	< 0.001
	Cancer patients in general	33.37 (21.14–45.60)	99.98	< 0.001
	Cancer patients during COVID-19	43.25 (41.25–45.26)	0.00	< 0.001
	Digestive tract cancer patients	33.66 (27.02–40.30)	96.19	< 0.001
	Ovarian cancer patients	26.20 (24.56–27.84)	65.80	0.09
	Prostate cancer patients	11.52 (0.28–22.76)	99.76	< 0.001
	Liver cancer patients	24.04 (23.71–24.37)	0.00	< 0.001
Anxiety	Brest cancer patients	38.00 (37.59–38.41)	0.00	< 0.001
	Cancer patients in general	33.05 (22.27–43.84)	99.90	< 0.001
	Cancer patients during COVID-19	52.93 (50.91–54.96)	0.00	< 0.001
	Digestive tract cancer patients	20.38 (18.45–22.31)	0.00	< 0.001
	Ovarian cancer patients	26.06 (12.47–39.66)	99.53	< 0.001
	Prostate cancer patients	21.93 (11.95–31.90)	99.57	< 0.001
	Liver cancer patients	22.20 (21.88–22.52)	0.00	< 0.001

cancer patients. Limited access to mental health services, lack of trained professionals, and inadequate integration of psychological care into oncology settings are major barriers, particularly in resource-poor environments [49, 50]. In some cases, fragmented healthcare delivery leads to delayed or missed identification of mental health conditions, further exacerbating emotional distress [60]. Furthermore, insufficient funding for mental health services and poor coordination between oncology and mental health care teams can prevent cancer patients from receiving comprehensive care [51]. These health system factors highlight the need for system-wide reforms to integrate mental health support into cancer care,

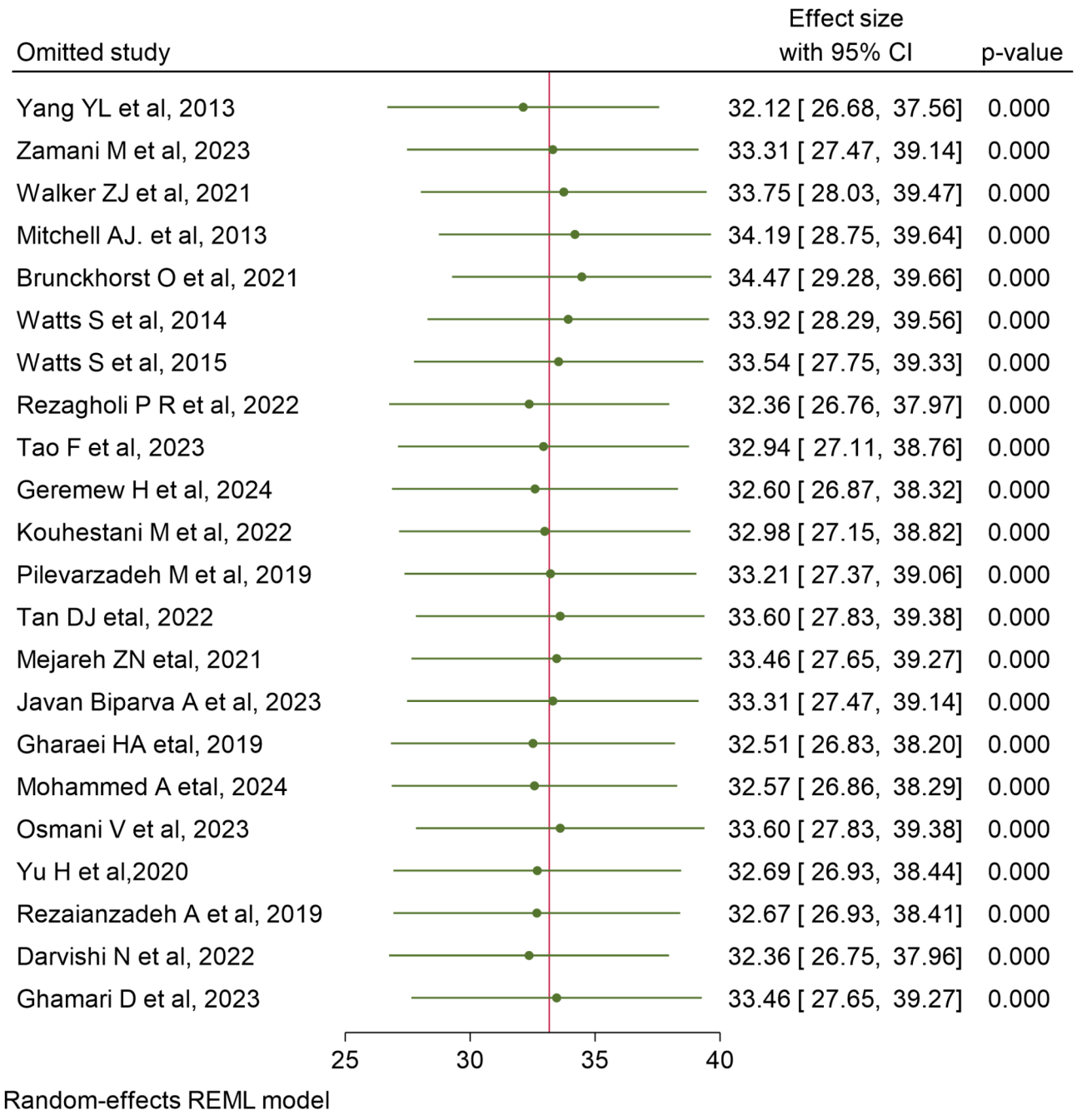

Fig. 8 Sensitivity analysis on the pooled prevalence of depression among cancer survivors worldwide

improving early detection and treatment of anxiety and depression [61].

The summary prevalence of pain post-treatment in cancer patients was 39.77% (95% CI 31.84–47.70), consistent with some studies but differing from others. One study reported a higher prevalence of 50%, while another found rates around 25%. These discrepancies likely stem from variations in cancer type, treatment, follow-up duration, and study methodologies, including sample size and measurement techniques. These findings highlight the need for standardized pain assessment tools and tailored interventions to address the diverse pain experiences of cancer survivors [62, 63].

This review also emphasizes the differences in pain prevalence before, during, and after treatment. Specifically, pain prevalence is lower during and after treatment compared to before treatment. This is because, cancer treatment decreases pain by targeting the tumor and its growth, which often alleviates pressure on surrounding tissues and nerves. Additionally, treatments such as

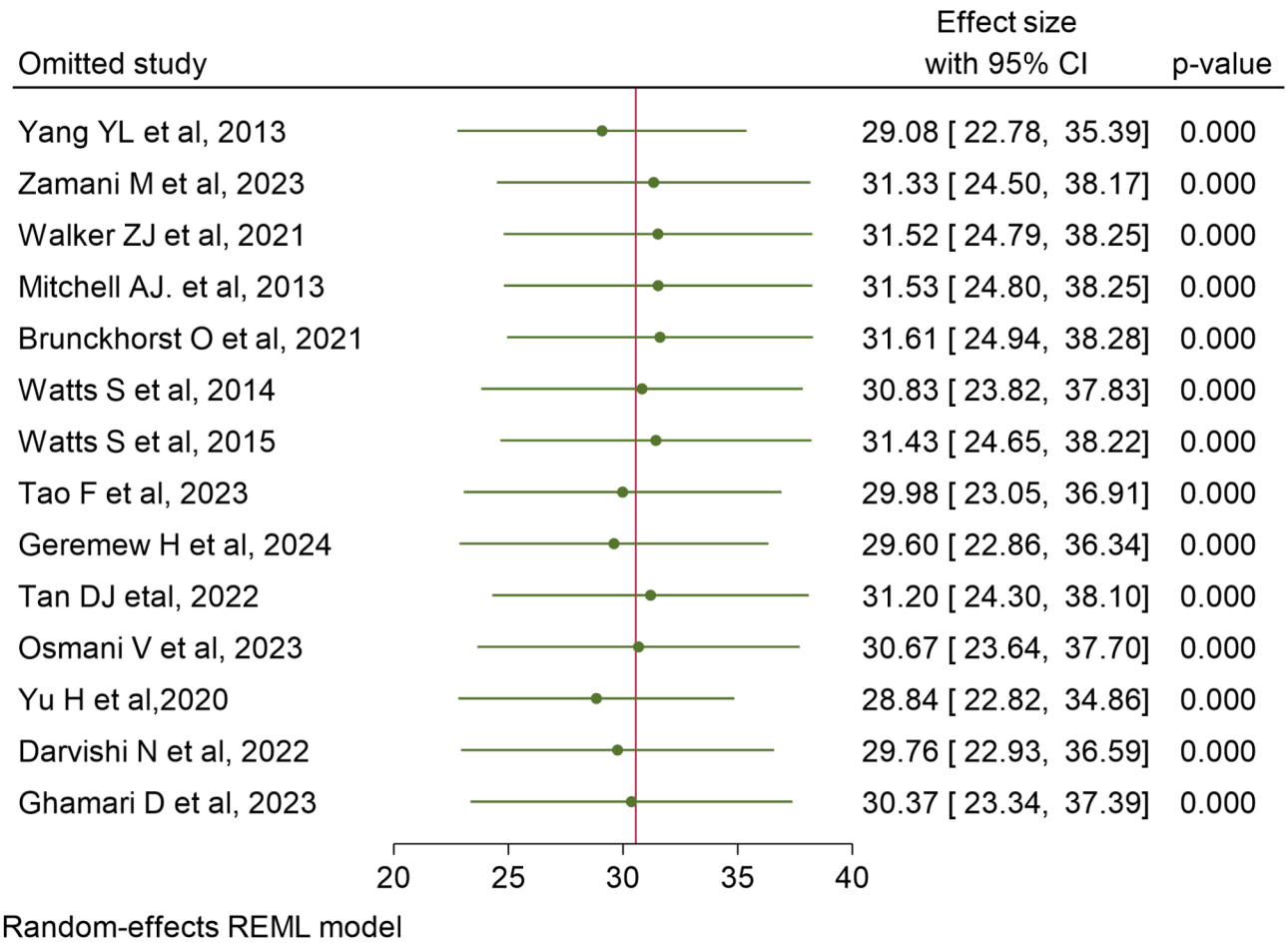

Fig. 9 Sensitivity analysis on the pooled prevalence of anxiety among cancer survivors worldwide

chemotherapy, radiation, and surgery can reduce inflammation and tumor-related symptoms, leading to overall pain relief [64].

This umbrella review highlighted significant heterogeneity, which weakens the reliability of the results. High variability in the studies reduces the validity of pooled outcomes, making it difficult to draw clear conclusions. Subgroup analysis indicated that cancer patients during COVID-19 had the highest rates of depression (43.25%) and anxiety (52.93%). Several factors contributed to this increase, including heightened health risks, disruptions in cancer treatment and follow-up care, social isolation, and the general stress and uncertainty of the pandemic. The added stress of managing both cancer and the pandemic likely worsened their mental health [65, 66].

An SRMA study found that cancer patients had lower odds ratios (ORs) for depression and anxiety compared to those with other diseases. The OR for depression was 6.03, while for anxiety, it was 4.40, compared to 13.58 and 15.47 in the normal group, respectively [1]. This might be because the psychological impact of cancer is less severe compared to other serious diseases. A systematic review and meta-analysis from Ethiopia identified key determinants of depression and anxiety, including poor social support, occupational status, advanced cancer stage, comorbid illness, and poor sleep quality. Advanced cancer stage and poor sleep quality were significant factors for anxiety [29]. Another systematic review and meta-analysis on liver cancer identified alcohol consumption as a determinant of depression [30]. This is because, alcohol consumption increases the risk of liver cancer by causing chronic liver inflammation, cirrhosis, and cancerous changes in liver cells, with its carcinogenic effects and impact on liver function contributing to cancer development over time [67]. Sociodemographic factors like age and gender are significant because they influence the prevalence and experience of depression among cancer patients. Female cancer patients had a higher depression prevalence (31%) compared to males (26%) due to gender-related differences in coping mechanisms and social support, while the increasing trend of 0.6% per year reflects a growing recognition of the psychological impact of cancer over time [7].

Strengths and limitations of the study

The study's strengths encompass minimizing bias risk, performing a comprehensive literature review, employing strong statistical techniques for pooled data analysis, and managing publication bias with trim and fill analysis. A key limitation of this study is the presence of heterogeneity across the included trials, which may arise from differences in patient populations, interventions, or outcome measures, potentially affecting the overall validity of the results. Additionally, the potential for publication bias cannot be ruled out, as studies with negative or inconclusive results may be underrepresented, influencing the strength of the conclusions drawn.

Clinical implication of the study

Studying the global prevalence and determinant factors of pain, depression, and anxiety among cancer survivors has significant clinical implications. It enhances our understanding of the psychological and physical burdens faced by this population, enabling healthcare providers to develop targeted interventions and support systems. By identifying specific risk factors and prevalence rates, clinicians can tailor treatments to address both the mental and physical health needs of survivors, potentially improving their quality of life and overall outcomes. Additionally, this knowledge can inform policy-making, resource allocation, and the creation of comprehensive survivorship care plans that integrate mental health services, pain management, and ongoing monitoring to ensure holistic patient care.

Conclusion

The umbrella review highlighted a global prevalence of depression (33.16%) and anxiety (30.55%) among cancer survivors, with notably higher rates during COVID-19 (43.25% and 52.93%, respectively). Pain was prevalent in 65.22% of patients before treatment, 51.34% during treatment, and 39.77% post-treatment. Key factors contributing to depression included poor social support, advanced cancer stage, comorbidities, alcohol use, inadequate sleep, and financial strain, while anxiety was most strongly associated with advanced cancer and sleep disturbances.

To mitigate these issues, it is crucial to enhance social and financial support, offer targeted psychological and sleep interventions, and tailor care based on cancer stage and sociodemographic factors. A personalized, long-term care plan that integrates mental health counseling, pain management, and ongoing evaluations can help improve emotional well-being and overall quality of life for cancer survivors.

Future research should standardize assessment methods for pain, depression, and anxiety in cancer patients and explore the influence of sociocultural, economic, and healthcare factors to develop tailored interventions.

Abbreviations

AMSTAR	Assessment of multiple systematic reviews
CI	Confidence interval
COVID	Corona virus disease
HADS	Hospital anxiety depression scale
NRS	Numerical rating scale
OR	Odds ratio
PHQ	Patient health questionary
PRISMA	Preferred reporting items for systematic review and meta-analysis
SRMA	Systematic review and meta-analysis
VAS	Variable analogue scale
VRS	Variable rating scale

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Author contributions

AG conceived the study, analyzed the data, and wrote the manuscript. AG, MA, and MB conducted literature search, screening, data extraction, and quality assessment. MB supervised the work and reviewed the work critically. All authors reviewed and approved the final manuscript.

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Data availability

All related data have been presented within the manuscript. The dataset supporting the conclusions of this article is available from the authors on request.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

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Competing interests

The authors declare no competing interests.

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