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FEATURE AND REVIEW PAPER

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Ecological momentary assessments among patients with cancer: A scoping review

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Abstract

Introduction: Ecological momentary assessment (EMA) is an emerging method to assess an individual's current thoughts, affect, behaviour, physical states and contextual factors as they occur in real-time and in their natural environment. Whereas EMA is frequently used in mental health, little is known about the added value of EMA in oncology research. This review aimed to synthesise methodological information and results of studies that applied EMA among patients with cancer to inform future researchers about the opportunities and challenges.

Methods: We included full-text articles on studies that: (a) were conducted among adult cancer patients; and (b) examined cancer and treatment-related experiences by EMA. Information from selected studies was synthesised: study designs, EMA data collection methods, response-related results and main findings.

Results: Twelve studies were included, which all applied an observational design. The EMA data collection methods varied considerably and the reporting of response-related results were poor. Nevertheless, EMA was found feasible as no systematic patterns of problems were reported and reported response-related results were acceptable. Furthermore, EMA was found useful as it facilitated examination of real-time experiences and behaviour.

Conclusion: Ecological momentary assessment is useful and feasible in oncology research. Future studies would benefit from guidelines for designing and reporting EMA studies.

KEYWORDS
ecological momentary assessment, experience sampling, neoplasms, scoping review

1 | INTRODUCTION

Many patients with cancer can suffer from disease- and treatment-related problems including, among others, reduced physical fitness and function (Jones et al., 2012; Kokkonen et al., 2019), fatigue (Lucia, Earnest, & Perez, 2003), pain (Kokkonen et al., 2019), nausea and vomiting (Kokkonen et al., 2019), anxiety (Le, Yu, Guan, & Zhang, 2018), depression (Le et al., 2018) and impaired health-related quality of life (HRQoL) (Kokkonen et al., 2019). In clinical practice and HRQoL research, retrospective patient-reported outcome measures (PROMs) are frequently used to assess patients' well-being and disease- and treatment-related problems. However, retrospective PROMs ask patients to reflect on their affective and somatic experiences over the past week(s) or month(s), and therefore they reveal an overall evaluation of experiences in the past and not the actual experience in the present.

Capturing real-time experiences related to the disease and treatment requires a different methodology called ecological momentary assessment (EMA) techniques (Moskowitz & Young, 2006). Such techniques involve repeated sampling throughout the day of people's current thoughts, affect, behaviour, physical states and contexts (e.g., where they are, what they are doing, with whom), in their natural (ecological) environment (Shiffman, Stone, & Hufford, 2008). By shedding light on the dynamics of experiences and behaviour in real-time, EMA techniques hold unique promise to gain a better understanding about factors that precipitate or perpetuate disease and treatment-related problems in patients with cancer. As a consequence of the assessments of a patient's current state, EMA is less susceptible to recall bias (Moore, Depp, Wetherell, & Lenze, 2016).

A variety of terms refer to EMA, including experience sampling, ambulatory assessments, event sampling, and structured diary methods (Verhagen, Hasmi, Drukker, van Os, & Delespaul, 2016). Typically, in EMA techniques, patients are asked to complete a brief questionnaire in response to a number of beep prompts throughout a day. Participants are requested to fill out the questionnaire immediately after the beep prompt and to keep a normal day/night routine (Shiffman et al., 2008). Various data collection procedures for EMA exist, ranging from paper-and-pencil to wearable digital devices.

The potential of EMA to successfully capture real-time experiences have long been recognised by mental health researchers (Cho et al., 2017; Hamza & Willoughby, 2015). The following two arbitrary but revealing examples may illustrate the relevance of this technique. First, in patients with anxiety disorders, changes in the variability of symptom levels during the course of psychological treatment were found to be a good predictor of treatment outcome (Walz, Nauta, & Aan Het Rot, 2014). Second, by examining the role of emotions in the development and maintenance of obesity and eating disorders, EMA data revealed that negative affect, rather than hunger, was associated with binge eating (Engel et al., 2016). The potential of EMA has only recently been recognised in oncology research. The emerging number of studies using EMA techniques warrants a scoping review to inform future researchers about the opportunities and challenges of using EMA among patients with cancer.

In the present review, we aim to synthesise methodological information and results of studies that applied EMA techniques addressing disease- and treatment-related problems among patients with cancer, summarising (a) study design characteristics, (b) EMA data collection methods, (c) response-related results and (d) the main findings of the studies.

2 | METHODS

The PRISMA extension for Scoping Reviews (Tricco et al., 2018) guided the writing of the manuscript.

2.1 | Literature search

The databases PubMed (dates of coverage: 1950-January, 2019), EMBASE (1947-present) and PsycINFO (1880-present) were searched. For the development of the search strategy, an information specialist of the Amsterdam University Medical Centers was consulted. Relevant keywords included terms related to the research methodology (e.g., ecological momentary assessment, experience sampling, ambulatory assessment, event sampling and structured diary methodology) and terms related to the participants (e.g., cancer, neoplasm and tumour). The full search strategy is presented in File S1. In addition, studies were identified from reference lists of relevant studies retrieved from the primary search.

2.2 | Eligibility criteria

Studies were included if they: (a) were performed in adult (≥18 years) patients with cancer before, during and/or after primary cancer treatment; (b) examined cancer and treatment-related experiences by "active" EMA techniques, with which self-reported data were collected. "Active" EMA requires participants to consciously provide information, for example by rating their current mood or level of fatigue in response to a question that is prompted on their electronic device; (c) included more than one assessment per day; (d) lasted longer than 24 hr; and (e) original full-text was available in English. Studies were excluded if they (a) reported on ecological momentary interventions (EMI), which extends the methodology of repeated within-environment prompting into the domain of clinical intervention (Versluis, Verkuil, Spinhoven, van der Ploeg, & Brosschot, 2016); or (b) reported on "passive" EMA techniques only, that is, collecting observational data through wearables without active involvement of participants (e.g., heart rate and physical activity monitors or voice recordings).

2.3 | Selection process

Screening of all three databases was performed in two phases. First, titles and abstracts of identified articles were screened to exclude

non-eligible articles by two independent reviewers (CK and LB). Second, full-texts of the remaining articles were screened for eligibility by both reviewers. Disagreement between the two reviewers was resolved by discussion. When necessary, a member of the research team (MS) was available for consultation.

2.4 | Data extraction

From each study, data were extracted in four categories. The first category, *study design characteristics* included information on the overall study aim, sample characteristics (i.e., sample size, age, gender, tumour type, timing in relation to cancer treatment, stage of disease, comparison groups and country of investigation) and outcome measures. The second category, *EMA data collection methods* included information on system characteristics (i.e., type of device, the application name and operation system, if applicable) and EMA schedule characteristics, which refer to monitoring periods (i.e., number of data collection periods), monitoring duration (i.e., number of days that a monitoring period lasted), data sampling method (i.e., (a) signal-contingent sampling with a random scheme in which beep

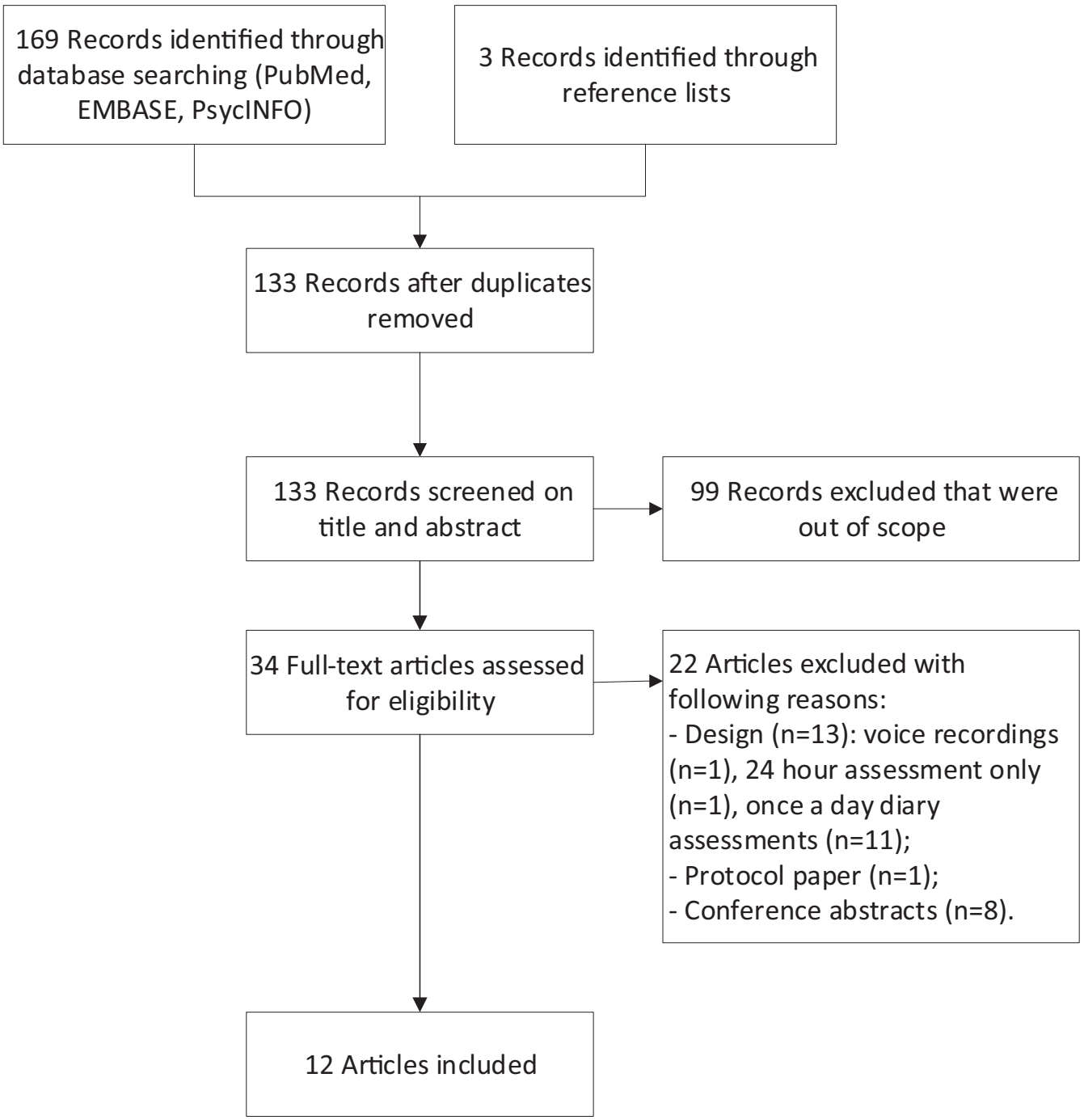

FIGURE 1 Flow chart of literature search and study inclusion. *n*, number

TABLE 1 Characteristics of the included studies (n = 12)

	Study design characteristics			EMA data collection methods			
Author	Research aim	Sample characteristics	Outcome measures	System characteristics	EMA schedule characteristics	Response-related results	Main findings
Badr et al. (2006) (Badr et al., 2006)	To examine diurnal pattern of mood and its associations with fatigue and pain in two independent samples of cancer patients	Sub-study 1 • Sample size: 23 • Tumour type: breast cancer • Comparison: n.a. • Age, mean (*SD*) years: 56,7 (10) • Gender, *n* (%) female: 23 (100%) • Stage of disease: local and advanced • Timing: after treatment • Country: USA Sub-study 2 • Sample size: 33 • Tumour type: ovarian cancer • Comparison: n.a. • Age, mean (*SD*) years: 58,3 (11) • Gender, *n* (%) female: 33 (100%) • Stage of disease: local and advanced • Timing: during treatment • Country: USA	• Primary: mood • Secondary: fatigue, nausea and pain	• Device: personal palm computer • Application name: n.a. • Operation system: not specified	• Monitoring periods: 1 • Duration: 7 days • Data sampling: signal-contingent, random • Prompt frequency: 4 per day • Prompt interval: approximately 3 hr	• Participation rate: not specified • Latency: not specified • Attrition: not specified • Missing data: breast cancer: 31%, ovarian cancer: 14% • Incentive: not specified	Patients with breast cancer who reported greater fatigue and pain levels, reported significant more negative moods. Patients with ovarian cancer who reported greater fatigue, pain and nausea also reported significant more negative moods. Diurnal analyses showed that happy-sad, active-passive and peppy-tired moods were significantly negatively associated with fatigue at each of the four daily assessment times in both samples
Basen 2013 (Basen-Engquist et al., 2013)	To examine the association of social cognitive theory variables with exercise duration in patients with cancer	• Sample size: 100 • Tumour type: endometrial cancer • Comparison: n.a. • Age, mean (*SD*) years: 57,0 (11) • Gender, *n* (%) female: 100 (100%) • Stage of disease: local and advanced • Timing: after treatment • Country: USA	• Primary: exercise duration • Secondary: perceived self-efficacy and outcome expectations	• Device: personal palm computer (Hewlett-Packard iPAQ RX1950) • Application name: n.a. • Operation system: Microsoft Windows Mobile 5.0 Premium	• Monitoring periods: 3 • Duration: 12 days • Data sampling: signal-contingent, fixed and event-contingent • Prompt frequency: 2 per day • Prompt interval: n.a. (set times)	• Participation rate: 30% • Latency: not specified • Attrition: 1% • Missing data: approx. 25% • Incentive: 5–30 dollars	Morning perceived self-efficacy was significantly associated with exercise minutes. Morning positive and negative outcome expectations were not significantly associated with exercise minutes. Exercise perceived self-efficacy predicted exercise at the next time point
Curran 2004 (Curran et al., 2004)	To examine the levels of fatigue, diurnal pattern of fatigue and its associations with pain, mood, activity and sleep in patients with cancer and control groups	• Sample size: 74 • Tumour type: breast cancer (*n* = 25) • Comparison: healthy controls (*n* = 25) and benign breast problems (*n* = 24) • Age, mean (*SD*) years: P: 48,2 (9); HC: 48,1 (9); PC: 49,1 (9) • Gender, *n* (%) female: 74 (100), all groups • Stage of disease: local • Timing: after treatment • Country: USA	• Primary: fatigue • Secondary: pain, mood, activity, sleep	• Device: paper diary • Application name: n.a. • Operation system: n.a.	• Monitoring periods: 1 • Duration: 5 days • Data sampling: signal-contingent, fixed • Prompt frequency: 4 per day • Prompt interval: n.a. (set times)	• Participation rate: not specified • Latency: n.a. • Attrition: not specified • Missing data: less than 1% • Incentive: 50 dollars	Fatigue levels in patients with breast cancer can continue to be elevated long after completion of adjuvant therapy. While patients with breast cancer reported higher levels of fatigue relative to benign breast disease and healthy control groups, no group differences were found in mood, activity type or level, sleep duration or diurnal pattern of fatigue. The relationship between fatigue reports and concurrent reports of pain and mood were similar in all three study groups
Glaus, 1993 (Glaus, 1993)	To examine the levels of fatigue, diurnal pattern of fatigue and its associations with symptom distress and coping in patients with cancer and control groups	• Sample size: 62 • Tumour type: cancer survivors, various types (*n* = 20) • Comparison: healthy controls (*n* = 30) and hospitalised patients with inflammatory gastrointestinal disease (*n* = 12) • Age, mean (*SD*) years: P 54,4 (15); HC: 50,2 (18); PC: 32,6 (10) • Gender, *n* (%) female: P: 13 (33); HC: 5 (13); PC: 21 (54) • Stage of disease: not specified • Timing: during treatment • Country: Switzerland	• Primary: fatigue • Secondary: symptom distress scale, coping with fatigue	• Device: paper diary • Application name: n.a. • Operation system: n.a.	• Monitoring periods: 1 • Duration: 7 days • Data sampling: signal-contingent, fixed • Prompt frequency: 4 per day • Prompt interval: n.a. (set times)	• Participation rate: not specified • Latency: n.a. • Attrition: not specified • Missing data: not specified • Incentive: not specified	Healthy individuals experienced higher peak levels of fatigue than patients with cancer, but the mean of the total fatigue experienced was higher in patients with cancer. Fatigue presented itself as normal part of living in healthy individuals and as refractory distress in patients with cancer. The impact of fatigue was found to be more negative in patients with cancer than in the other two study groups

(Continues)

TABLE 1 (Continued)

Author	Study design characteristics			EMA data collection methods		Response-related results	Main findings
	Research aim	Sample characteristics	Outcome measures	System characteristics	EMA schedule characteristics		
Hachizuka et al. (2010) (Hachizuka et al., 2010)	To evaluate the feasibility of ecological momentary assessments to collect self-reported cancer and treatment-related symptoms in terms of response rates and user-friendliness	• Sample size: 15 • Tumour type: adult patients with advanced cancer who receive palliative care • Comparison: n.a. • Age, mean (*SD*) years: 67,1 (9) • Gender, *n* (%) female: 3 (20) • Stage of disease: end of life • Timing: during treatment • Country: Japan	• Primary: cancer and treatment-related symptoms including fatigue, pain, nausea, anxiety, depression and drowsiness • Secondary: n.a.	• Device: personal palm computer, Sharp • Application name: n.a. • Operation system: not specified	• Monitoring periods: 1 • Duration: 7 days • Data sampling: signal-contingent, fixed and random and event-contingent • Prompt frequency: 3–5 per day • Prompt interval: 4 hr	• Participation rate: not specified • Latency: n.a. • Attrition: not specified • Missing data: 10%–20% • Incentive: not specified	Using computerised ecological momentary assessments to collect self-reported data on cancer and treatment-related symptoms was found feasible. The overall response rates were 90% to the sound of the alarm and 80% after taking rescue medication. The user-friendliness of the device was rated 8.8 on a scale of 0 (worst) to 10 (best)
Hacker et al. (2006) (Hacker et al., 2006)	To examine the diurnal patterns of fatigue and physical activity	• Sample size: 20 • Tumour type: adult patients with cancer who were elected to undergo hematopoietic stem cell transplantation • Comparison: n.a. • Age, mean (range) years: 48,7 (23–64) • Gender, *n* (%) female: 11 (55) • Stage of disease: local and advanced • Timing: during treatment • Country: USA	• Primary: fatigue and physical activity • Secondary: n.a.	• Device: Actiwatchscore, Phillips. • Application name: n.a. • Operation system: not specified	• Monitoring periods: 2 • Duration: 5 days • Data sampling: signal-contingent, fixed • Prompt frequency: 3 per day • Prompt interval: n.a. (set times)	• Participation rate: not specified • Latency: n.a. • Attrition: not specified • Missing data: 15%–23% • Incentive: not specified	Fatigue significantly increased and physical activity significantly decreased following hematopoietic stem cell transplantation
Hacker 2007 (Hacker & Ferrans, 2007)	To evaluate the feasibility of ecological momentary assessments to collect self-reported fatigue data before and after hematopoietic stem cell transplantation in terms of response rates	• Sample size: 20 • Tumour type: adult patients with cancer who were elected to undergo hematopoietic stem cell transplantation • Comparison: n.a. • Age, mean (range) years: 48,7 (23–64) • Gender, *n* (%) female: 11 (55) • Stage of disease: local and advanced • Timing: during treatment • Country: USA	• Primary: fatigue • Secondary: n.a.	• Device: Actiwatchscore, Phillips. • Application name: n.a. • Operation system: not specified	• Monitoring periods: 2 • Duration: 3 days • Data sampling: signal-contingent, fixed • Prompt frequency: 3 per day • Prompt interval: n.a. (set times)	• Participation rate: not specified • Latency: n.a. • Attrition: not specified • Missing data: 5%–20% • Incentive: not specified	Using computerised ecological momentary assessments to collect self-report fatigue data in acutely ill patients with cancer was found feasible. The overall response rates for the 3 days before hematopoietic stem cell transplantation were 95%, 88% and 82%, and after hematopoietic stem cell transplantation were 80%, 90% and 86%
Hacker 2017 (Hacker et al., 2017)	To examine the diurnal patterns and relationships between fatigue and physical activity in patients with cancer and a control group	• Sample size: 50 • Tumour type: adult patients with cancer who were treated with hematopoietic stem cell transplantation with persistent fatigue (*n* = 25) • Comparison: healthy controls (*n* = 25) • Age, mean (*SD*) years: P: 53,4 (12); HC: 52,3 (12) • Gender, *n* (%) female: 11 (44), both P and HC • Stage of disease: not specified • Timing: after treatment • Country: USA	• Primary: fatigue and physical activity • Secondary: n.a.	• Device: Actiwatchscore, Phillips. • Application name: n.a. • Operation system: not specified	• Monitoring periods: 1 • Duration: 7 days • Data sampling: signal-contingent, fixed • Prompt frequency: 5 per day • Prompt interval: n.a. (set times)	• Participation rate: not specified • Latency: n.a. • Attrition: not specified • Missing data: 20% • Incentive: not specified	An inverse relationship was found between fatigue and physical activity. No significant differences in the diurnal patterns of fatigue and physical activity were found between both study groups

(Continues)

TABLE 1 (Continued)

Author	Study design characteristics			EMA data collection methods		Response-related results	Main findings
	Research aim	Sample characteristics	Outcome measures	System characteristics	EMA schedule characteristics		
Langer 2018 (Langer et al., 2018)	To examine intra- and inter-personal associations between communication and relationship satisfaction among patients with cancer and their spouses	• Sample size: 107 couples • Tumour type: breast or colorectal cancer, and their spouses • Comparison: n.a • Age, mean (*SD*) years: P: 50,6 (12); S: 50,9 (13) • Gender, *n* (%) female: P: 69 (65); S: 40 (37) • Stage of disease: local and advanced • Timing: during and after treatment • Country: USA	• Primary: communication and relationship satisfaction • Secondary: support, criticism	• Device: smartphone • Application name: not specified (lifedatacorp.com system) • Operation system: iOS and Android	• Monitoring periods: 1 • Duration: 14 days • Data sampling: signal-contingent, fixed • Prompt frequency: 2 per day • Prompt interval: n.a. (set times)	• Participation rate: approx. 28% • Latency: not specified • Attrition: 4% • Missing data: approx. 11% • Incentive: 75 dollar gift card	Expressing one's feelings was not associated with relationship satisfaction. Not expressing one's feelings was associated with lower relationship satisfaction for both patients and spouses. Giving and receiving support were associated with one's own higher relationship satisfaction for both patients and spouses. Conversely, criticising one's partner and feeling criticised were associated with lower relationship satisfaction
Ratcliff 2015 (Ratcliff et al., 2014)	To examine the association of sleep before and during a chemotherapy cycle with symptoms and mood during that chemotherapy cycle	• Sample size: 21 • Tumour type: breast cancer • Comparison: n.a. • Age, mean (*SD*) years: 54,7 (10) • Gender, *n* (%) female: 21 (100) • Stage of disease: local and advanced • Timing: during treatment • Country: USA	• Primary: sleep • Secondary: mood, symptoms (i.e., nausea, fatigue, numbness, difficulty thinking)	• Device: personal palm computer • Application name: n.a. • Operation system: not specified	• Monitoring periods: 1 • Duration: approx. 3 weeks • Data sampling: signal-contingent, random • Prompt frequency: 4 per day • Prompt interval: 4 hr	• Participation rate: not specified • Latency: not specified • Attrition: not specified • Missing data: not specified • Incentive: not specified	Disturbed sleep prior to chemotherapy was associated with more fatigue and more negative anxious and drowsy mood throughout the 3-week chemotherapy cycle. Good sleep prior to chemotherapy buffered anxiety in the first days following chemotherapy
Shiyko 2018 (Shiyko et al., 2018)	To examine lung cancer patients' natural capacity to exhibit mindfulness during 2 weeks of recovery	• Sample size: 59 • Tumour type: lung • Comparison: n.a. • Age, mean (*SD*) years: 66,1 (8) • Gender, *n* (%) female: 36 (61) • Stage of disease: local • Timing: after treatment • Country: USA	• Primary: mindfulness state • Secondary: n.a.	• Device: personal palm computer • Application name: n.a. • Operation system: not specified	• Monitoring periods: 1 • Duration: 14 days • Prompting strategy: signal-contingent, random • Prompt frequency: 2 per day • Prompt interval: 6–8 hr	• Participation rate: 81% • Latency: not specified • Attrition: 25% • Missing data: 39% • Incentive: not specified	The overall level of mindfulness was very low, with most patients reporting being not at all or a little mindful
Stephenson 2018 (Stephenson et al., 2018)	To examine the between-person and within-person associations between pain and analgesics use in patients with cancer	• Sample size: 53 • Tumour type: breast cancer • Comparison: n.a. • Age, mean (*SD*) years: 49,4 (11) • Gender, *n* (%) female: 53 (100) • Stage of disease: advanced • Timing: after treatment • Country: USA	• Primary: pain and pain medication use • Secondary: n.a	• Device: personal palm computer • Application name: n.a. • Operation system: not specified	• Monitoring periods: 1 • Duration: 14 days • Prompting strategy: signal-contingent, random • Prompt frequency: 6 per day • Prompt interval: 2 hr	• Participation rate: 63% • Latency: not specified • Attrition: not specified • Missing data: not specified • Incentive: not specified	The likelihood of taking medication was found to depend on patients' average pain levels and on whether their pain was better or worse than usual at the time

Abbreviation(s): HC, healthy controls; P, patients with cancer; PC, patients with other problems/disease, S, spouse;.

prompts are randomised throughout the day, (b) signal-contingent sampling with a fixed scheme in which beep prompts are set for certain intervals that are not random or (c) event-contingent sampling, in which momentary assessments are recorded whenever a specific event occurred, instead of a beep prompt), prompt frequency per day and prompt interval (i.e., time between each beep prompt). The third category, *response-related results* included participation rate, latency (i.e., time between a beep prompt and the response, if applicable), attrition rate (i.e., the number of participants who dropped out of the study for any reason), missing data (i.e., unanswered and/or unprompted surveys), and incentives. The fourth category encompassed the *main findings* of the studies. Data extraction was conducted by CK, and the extraction forms were verified by two members of the research team (LB and MO) accordingly.

3 | RESULTS

The electronically database search yielded 172 records. After screening titles and abstracts, 34 potentially relevant articles were retrieved in full-text. Twelve studies met the inclusion criteria. Figure 1 presents the flow chart of literature search and study inclusion, and Table 1 summarises the methodological information and the results of the included studies (Badr, Basen-Engquist, Carmack Taylor, & de Moor, 2006; Basen-Engquist et al., 2013; Curran, Beacham, & Andrykowski, 2004; Glaus, 1993; Hachizuka et al., 2010; Hacker & Ferrans, 2007; Hacker et al., 2006; Hacker, Kim, Park, & Peters, 2017; Langer et al., 2018; Ratcliff, Lam, Arun, Valero, & Cohen, 2014; Shiyko, Siembor, Greene, Smyth, & Burkhalter, 2018; Stephenson, DeLongis, Bruel, & Badr, 2018).

3.1 | Study design characteristics

3.1.1 | Study aims

Seven studies (Badr et al., 2006; Basen-Engquist et al., 2013; Hacker et al., 2006; Langer et al., 2018; Ratcliff et al., 2014; Shiyko et al., 2018; Stephenson et al., 2018) aimed to examine the associations of thoughts, affect, behaviour, physical states or contextual factors with the primary outcome measure of interest (e.g., sleep or pain), in single cohorts of patients with cancer. Three other studies (Curran et al., 2004; Glaus, 1993; Hacker et al., 2017) compared diurnal patterns of the primary outcome measure fatigue between patients with cancer and a control group and examined associations of thoughts, affect, behaviour, physical states or contextual factors with fatigue. Two studies (Hachizuka et al., 2010; Hacker & Ferrans, 2007) aimed to examine the feasibility of EMA among patients with cancer.

3.1.2 | Sample characteristics

The mean number of participants per study was 53 (range 15–107). Three studies (Curran et al., 2004; Ratcliff et al., 2014; Stephenson et al., 2018) included patients with breast cancer, one study (Badr et al., 2006) included reports on a sub-study on patients with breast cancer and a sub-study on patients with ovarian cancer, three studies (Hacker & Ferrans, 2007; Hacker et al., 2006, 2017) included patients with haematologic malignancies, three studies (Glaus, 1993; Hachizuka et al., 2010; Langer et al., 2018) included a mixed group of patients with cancer, and the remaining studies included patients with lung (Shiyko et al., 2018) or endometrial (Basen-Engquist et al., 2013) cancer. Five studies evaluated symptoms during primary treatment (Glaus, 1993; Hachizuka et al., 2010; Hacker & Ferrans, 2007; Hacker et al., 2006; Ratcliff et al., 2014), five studies (Basen-Engquist et al., 2013; Curran et al., 2004; Hacker et al., 2017; Shiyko et al., 2018; Stephenson et al., 2018) after primary cancer treatment, and two study (Badr et al., 2006; Langer et al., 2018) during and after primary cancer treatment. All studies were conducted in the United States, except for two studies that were conducted in Switzerland (Glaus, 1993) and Japan (Hachizuka et al., 2010).

3.1.3 | Outcome measures

Five studies (Curran et al., 2004; Glaus, 1993; Hacker & Ferrans, 2007; Hacker et al., 2006, 2017) included EMA questions on fatigue as primary outcome, the remaining seven studies included EMA questions on sleep (Ratcliff et al., 2014), exercise duration (Basen-Engquist et al., 2013), communication and relationship satisfaction (Langer et al., 2018), mindfulness state (Shiyko et al., 2018), pain (Stephenson et al., 2018), mood (Badr et al., 2006) and cancer- and treatment-related symptoms (Hachizuka et al., 2010) as primary outcome respectively. Furthermore, five studies (Hachizuka et al., 2010; Hacker & Ferrans, 2007; Hacker et al., 2017; Shiyko et al., 2018; Stephenson et al., 2018) focused specifically on their primary outcome and no other EMA questions were included, whereas seven studies (Badr et al., 2006; Basen-Engquist et al., 2013; Curran et al., 2004; Glaus, 1993; Hacker et al., 2006; Langer et al., 2018; Ratcliff et al., 2014) included EMA questions on secondary outcomes among which perceived self-efficacy, outcome expectations, pain, nausea, mood, physical activity, sleep, symptom distress, coping with fatigue, quality of life, life satisfaction, support and criticism.

3.2 | EMA data collection methods

3.2.1 | System characteristics

Ten studies (Badr et al., 2006; Basen-Engquist et al., 2013; Hachizuka et al., 2010; Hacker & Ferrans, 2007; Hacker et al., 2006, 2017; Langer et al., 2018; Ratcliff et al., 2014; Shiyko et al., 2018; Stephenson et al., 2018) incorporated electronic devices for their momentary assessments and two studies (Curran et al., 2004; Glaus, 1993) used paper diaries. The most commonly used electronic device was a palm computer (6 out of 10 studies) (Badr et al., 2006; Basen-Engquist et al., 2013; Hachizuka et al., 2010; Ratcliff et al., 2014; Shiyko et al., 2018; Stephenson et al., 2018), which was provided to the participants for the duration of the studies. Other

electronic devices included Actiwatches (three studies: Hacker & Ferrans, 2007; Hacker et al., 2006, 2017), provided by the study, and participants' personal smartphones (Langer et al., 2018). Additional information about the electronic devices was limited as application names and operation systems remained unspecified. Only one study reported a Microsoft Windows operating system (Basen-Engquist et al., 2013), and another study used an EMA application that could be downloaded from Android and iOS (Langer et al., 2018).

3.2.2 | EMA schedule characteristics

Nine studies (Badr et al., 2006; Curran et al., 2004; Glaus, 1993; Hachizuka et al., 2010; Hacker et al., 2017; Langer et al., 2018; Ratcliff et al., 2014; Shiyko et al., 2018; Stephenson et al., 2018) monitored participants during one period of data collection, and three studies (Basen-Engquist et al., 2013; Hacker & Ferrans, 2007; Hacker et al., 2006) incorporated two or three monitoring periods. The number of days that a monitoring period lasted were as follows: 3 days (one study) (Hacker & Ferrans, 2007), 5 days (two studies) (Curran et al., 2004; Hacker et al., 2006), 7 days (four studies) (Badr et al., 2006; Glaus, 1993; Hachizuka et al., 2010; Hacker et al., 2017), 12 days (one study) (Basen-Engquist et al., 2013), 14 days (three studies) (Langer et al., 2018; Shiyko et al., 2018; Stephenson et al., 2018) and approximately 21 days (one study) (Ratcliff et al., 2014). Seven (Basen-Engquist et al., 2013; Curran et al., 2004; Glaus, 1993; Hacker & Ferrans, 2007; Hacker et al., 2017; Langer et al., 2018) out of twelve studies applied a signal-contingent data sampling method with a fixed scheme in which beep prompts were set for certain time intervals that participants knew in advance. One (Basen-Engquist et al., 2013) of these seven studies added an event-contingent sampling, requesting the participants to self-initiate momentary assessments after physical exercise. Furthermore, four studies (Badr et al., 2006; Ratcliff et al., 2014; Shiyko et al., 2018; Stephenson et al., 2018) applied a signal-contingent data sampling method with a random scheme in which beep prompts were set at random times throughout the day that was unknown to the participant. Finally, one study (Hachizuka et al., 2010) combined all three data sampling methods in their study design (i.e., signal-contingent data sampling with a fixed and random scheme and an event-contingent data sampling method). In all studies, participants were prompted to complete the EMA questionnaire between two and four times per day, irrespective of the length of the monitoring period. Finally, the five studies (Badr et al., 2006; Hachizuka et al., 2010; Ratcliff et al., 2014; Shiyko et al., 2018; Stephenson et al., 2018) that applied a random sampling scheme scheduled either 2, 3, 4 or 6–8 hr between the beep prompts.

3.3 | Response-related results

Information about participation rates was reported in four studies (Basen-Engquist et al., 2013; Langer et al., 2018; Shiyko et al., 2018; Stephenson et al., 2018) ranging from 28% to 81%. None of the studies reported latency periods. Three studies (Basen-Engquist et al., 2013; Langer et al., 2018; Shiyko et al., 2018) reported attrition rates ranging from 1% to 25%. Information about missing data was reported in eight studies and varied between 1% to 39% (Badr et al., 2006; Basen-Engquist et al., 2013; Curran et al., 2004; Hacker & Ferrans, 2007; Hacker et al., 2006, 2017; Langer et al., 2018; Shiyko et al., 2018). Incentives to optimise response-related results were provided in three American studies (Basen-Engquist et al., 2013; Curran et al., 2004; Langer et al., 2018) and consisted of a monitory reward or gift card with the value of 5–75 US dollar.

3.4 | Main findings

3.4.1 | Fatigue

One study (Hacker et al., 2006) used EMA techniques to compare the patterns of fatigue and physical activity in patients with cancer and found that patients with cancer reported increased levels of fatigue and decreased physical activity following cancer treatment. Furthermore, three studies (Curran et al., 2004; Glaus, 1993; Hacker et al., 2017) gathered EMA data to gain a better understanding of diurnal patterns of fatigue among patients with cancer compared to one or more control groups including people without cancer. All three studies reported higher levels of fatigue among patients with cancer compared to the control groups, while mood, pain, sleep, activity levels or diurnal patterns of fatigue did not differ between the study groups. Furthermore, Hacker et al. reported (Hacker et al., 2017) an inverse relationship between fatigue and physical activity level for both patients with cancer and healthy individuals.

3.4.2 | Other outcomes

One study (Badr et al., 2006) collected EMA data to examine diurnal pattern of mood and its associations with fatigue and pain and found that patients with cancer who reported greater fatigue and pain levels, reported significant more negative moods. One study (Basen-Engquist et al., 2013) collected EMA data to identify correlates of physical activity among patients with cancer and found a significant association of higher morning perceived self-efficacy with higher physical activity. Another study (Ratcliff et al., 2014) used EMA techniques to identify correlates of sleep among patients with cancer and found that disturbed sleep prior to chemotherapy was associated with more fatigue and more negative and anxious mood throughout the subsequent chemotherapy cycle. Conversely, good sleep prior to chemotherapy was associated with less anxiety in the first days following chemotherapy (Ratcliff et al., 2014). Furthermore, one study used EMA techniques to examine associations between pain and analgesics use in patients with cancer (Stephenson et al., 2018) and showed that medication use was associated with a patients' average pain level and that the pain was either better or worse than usual at the time. That is, patients with a relatively low level of pain appeared to take pain medication in response to an increase in pain, whereas patients with a relatively high level of pain did not take more pain medication in response to

an increase in pain. Another study (Shiyko et al., 2018) used EMA techniques to examine post-surgery mindfulness among patients with cancer and concluded that levels of mindfulness were very low. One study (Langer et al., 2018) gathered EMA data to examine associations between communication and relationship satisfaction among patients with cancer and their spouses. This study found that expressing one's feelings were not associated with relationship satisfaction, whereas, not expressing one's feelings was associated with lower relationship satisfaction for both patients and spouses. In addition, giving and receiving support were associated with one's own higher relationship satisfaction for both patients and spouses.

3.4.3 | Feasibility

Finally, two studies aimed to evaluate the feasibility of EMA techniques. One study (Hacker & Ferrans, 2007) collected self-reported fatigue EMA data among patients with cancer in terms of response rates and reported that most participants (80%–95%) were able to provide real-time fatigue data before and after cancer treatment. A second study (Hachizuka et al., 2010) collected self-reported EMA data on cancer and treatment-related symptoms in terms of response rates and also reported that most participants (80%–90%) were able to provide real-time EMA data.

4 | DISCUSSION

In this paper, we synthesised methodological information and the results of studies that applied EMA techniques to assess disease- and treatment-related problems among patients with cancer to inform future researchers about the opportunities and challenges. This review showed that research on EMA techniques among patients with cancer is relatively scarce. In total, twelve relatively small studies met the eligibility criteria. The included studies employed observational study designs, varied considerably in EMA data collection methods and the reporting of response-related results was poor. Nevertheless, the findings of this review showed that EMA techniques are feasible as no systematic patterns of problems or complaints were reported across studies and the reported response-related results were acceptable. Furthermore, the findings of this review showed that EMA techniques are useful as they facilitate the examination of real-time emotions and behaviour on disease and treatment-related problems, including fatigue (Curran et al., 2004; Glaus, 1993; Hacker & Ferrans, 2007; Hacker et al., 2017), sleep (Ratcliff et al., 2014), pain (Stephenson et al., 2018) and exercise (Basen-Engquist et al., 2013).

To the best of our knowledge, this is the first scoping review providing a comprehensive overview of studies applying EMA techniques among patients with cancer. Some limitations merit attention. First, due to a wide variety in terminology to describe EMA techniques, we cannot rule out that some relevant studies might have been missed. Second, the search strategy was limited to articles in English, and, as a result, we might have missed articles published in other languages limiting our international scope. However, since EMA techniques have been relatively recently introduced and were originally developed in the US, we believe the risk of language bias to be low. Third, the large heterogeneity in EMA data collection methods hindered cross-study comparisons (e.g., comparisons on EMA schedule characteristics).

An important challenge for future EMA studies lies in improving the reproducibility, comparability and interpretation of study results. The findings of this review highlighted poor reporting, especially on response-related results. Information on participation, latency, attrition, compliance and missing data is of utmost importance for the interpretation of the validity and generalisability of EMA study results. Therefore, future studies need to adopt best-practice guidelines for designing and reporting EMA studies. Several checklists for EMA studies are available from previous work in mental health research for example Checklist for Reporting EMA Studies (CREMAS) by Liao, Skelton, Dunton, and Bruening (2016) and could serve as best-practice guidelines. In addition, attempts are made to handle missing data in EMA study designs by shared-parameter mixed models to deal with the intermittent nature of the missing EMA prompts (Cursio, Mermelstein, & Hedeker, 2018).

Furthermore, in principle, EMA techniques aim to observe participants' real-time experiences and behaviour in their natural environment and social contexts (Shiffman et al., 2008). Therefore, EMA questions need to be sensitive to momentary fluctuations of experiences (Shiffman et al., 2008). What experiences need to be included and how the questions need to be phrased are challenges warranting further research. Perhaps, Delphi studies among EMA researchers may contribute to consensus-building and generate standardisation in the design of EMA questions. Moreover, we would like to emphasise that other psychometric properties of the EMA questions, particularly construct and criterion validity, need to be examined thoroughly (Dubad, Winsper, Meyer, Livanou, & Marwaha, 2017).

The findings of this review showed a shift in EMA data collection devices emerging over time: from paper diaries (Curran et al., 2004; Glaus, 1993) in earlier studies, via palm computers (Basen-Engquist et al., 2013; Ratcliff et al., 2014; Shiyko et al., 2018; Stephenson et al., 2018) to smartphones (Langer et al., 2018) in more recent studies. To date, palm computers were the most frequently used data collection device among patients with cancer, but at present, a variety of (online) EMA smartphone applications are available too (May, Junghaenel, Ono, Stone, & Schneider, 2018; Moore, Swendsen, & Depp, 2017). Therefore, a practical opportunity for oncology research lies in examining the feasibility and added value of smartphone applications in EMA study designs.

Lastly, although findings from this review indicate that EMA can be a promising method in oncology research, it has not yet been used in its full potential. More specifically, the current studies have explored the opportunities of repeated data sampling during the day among patients with cancer, and they have assessed associations between various symptoms throughout the day and over time. However, the additional potential of EMA lies in the improved understanding of symptoms by linking people's current thoughts, affect,

behaviour and physical states with concurrent contexts (e.g., where they are, what they are doing, with whom), in their natural (ecological) environment and should receive further attention. Another opportunity for future EMA studies is to evaluate the added value of EMA techniques in intervention research employing a randomised clinical trial design. For instance, EMA techniques could be used to evaluate the effectiveness of an exercise intervention to improve physical activity and mood. In addition, EMA itself could serve as a clinical intervention (Versluis et al., 2016) involving feedback based on real-time EMA monitoring in everyday life (i.e., EMI). For example, future studies could explore whether EMA-derived feedback on personalised patterns of emotions and behaviours may contribute to improved coping with disease- and treatment-related problems such as fatigue.

In conclusion, EMA techniques were found to be feasible and useful in oncology research and hold unique promise to gain a better understanding of patients' quality of life and disease- and treatment-related problems by linking people's current thoughts, affect, behaviour and physical states with concurrent contexts (e.g., where they are, what they are doing, with whom), in their natural (ecological) environment. Future studies would benefit from guidelines for designing and reporting EMA studies to improve reproducibility, comparability and interpretation of results. In addition, future studies could explore the feasibility and added value of EMA smartphone applications, as well as the potential of EMA techniques in clinical oncology trials.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTION

All authors have made substantial contributions to the conception and design of the study. CK drafted, and IV, MO, MS and LB critically revised the manuscript. All authors read and approved the final manuscript.

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REFERENCES

Badr, H., Basen-Engquist, K., Carmack Taylor, C. L., & de Moor, C. (2006). Mood states associated with transitory physical symptoms among breast and ovarian cancer survivors. *Journal of Behavioral Medicine*, *29*(5), 461–475. https://doi.org/10.1007/s10865-006-9052-9

Basen-Engquist, K., Carmack, C. L., Li, Y., Brown, J., Jhingran, A., Hughes, D. C., … Waters, A. (2013). Social-cognitive theory predictors of exercise behavior in endometrial cancer survivors. *Health Psychology*, *32*(11), 1137–1148. https://doi.org/10.1037/a0031712

Cho, H., Gonzalez, R., Lavaysse, L. M., Pence, S., Fulford, D., & Gard, D. E. (2017). Do people with schizophrenia experience more negative emotion and less positive emotion in their daily lives? A meta-analysis of experience sampling studies. *Schizophrenia Research*, *183*, 49–55. https://doi.org/10.1016/j.schres.2016.11.016

Curran, S. L., Beacham, A. O., & Andrykowski, M. A. (2004). Ecological momentary assessment of fatigue following breast cancer treatment. *Journal of Behavioral Medicine*, *27*(5), 425–444. https://doi.org/10.1023/B:JOBM.0000047608.03692.0c

Cursio, J. F., Mermelstein, R. J., & Hedeker, D. (2018). Latent trait shared-parameter mixed models for missing ecological momentary assessment data. *Statistics in Medicine*, *38*(4), 660–673.

Dubad, M., Winsper, C., Meyer, C., Livanou, M., & Marwaha, S. (2017). A systematic review of the psychometric properties, usability and clinical impacts of mobile mood-monitoring applications in young people. *Psychological Medicine*, *48*, 1–21.

Engel, S. G., Crosby, R. D., Thomas, G., Bond, D., Lavender, J. M., Mason, T., … Wonderlich, S. A. (2016). Ecological momentary assessment in eating disorder and obesity research: A review of the recent literature. *Current Psychiatry Reports*, *18*(4), 37. https://doi.org/10.1007/s11920-016-0672-7

Glaus, A. (1993). Assessment of fatigue in cancer and non-cancer patients and in healthy individuals. *Supportive Care in Cancer*, *1*(6), 305–315. https://doi.org/10.1007/BF00364968

Hachizuka, M., Yoshiuchi, K., Yamamoto, Y., Iwase, S., Nakagawa, K., Kawagoe, K., & Akabayashi, A. (2010). Development of a personal digital assistant (PDA) system to collect symptom information from home hospice patients. *Journal of Palliative Medicine*, *13*(6), 647–651. https://doi.org/10.1089/jpm.2009.0350

Hacker, E. D., & Ferrans, C. E. (2007). Ecological momentary assessment of fatigue in patients receiving intensive cancer therapy. *Journal of Pain and Symptom Management*, *33*(3), 267–275. https://doi.org/10.1016/j.jpainsymman.2006.08.007

Hacker, E. D., Ferrans, C., Verlen, E., Ravandi, F., van Besien, K., Gelms, J., & Dieterle, N. (2006). Fatigue and physical activity in patients undergoing hematopoietic stem cell transplant. *Oncology Nursing Forum*, *33*(3), 614–624. https://doi.org/10.1188/06.ONF.614-624

Hacker, E. D., Kim, I., Park, C., & Peters, T. (2017). Real-time fatigue and free-living physical activity in hematopoietic stem cell transplantation cancer survivors and healthy controls: A preliminary examination of the temporal, dynamic relationship. *Cancer Nursing*, *40*(4), 259–268. https://doi.org/10.1097/NCC.0000000000000459

Hamza, C. A., & Willoughby, T. (2015). Nonsuicidal self-injury and affect regulation: Recent findings from experimental and ecological momentary assessment studies and future directions. *Journal of Clinical Psychology*, *71*(6), 561–574. https://doi.org/10.1002/jclp.22174

Jones, L. W., Courneya, K. S., Mackey, J. R., Muss, H. B., Pituskin, E. N., Scott, J. M., … Haykowsky, M. (2012). Cardiopulmonary function and age-related decline across the breast cancer survivorship continuum. *Journal of Clinical Oncology*, *30*(20), 2530–2537. https://doi.org/10.1200/JCO.2011.39.9014

Kokkonen, K., Tasmuth, T., Lehto, J. T., Kautiainen, H., Elme, A., Jääskeläinen, A.-S., & Saarto, T. (2019). Cancer patients' symptom burden and health-related quality of life (HRQoL) at Tertiary

Cancer Center from 2006 to 2013: A cross-sectional study. *Anticancer Research*, *39*(1), 271–277. https://doi.org/10.21873/anticanres.13107

Langer, S. L., Romano, J. M., Todd, M., Strauman, T. J., Keefe, F. J., Syrjala, K. L., … Porter, L. S. (2018). Links between communication and relationship satisfaction among patients with cancer and their spouses: Results of a fourteen-day smartphone-based ecological momentary assessment study. *Frontiers in Psychology*, *9*, 1843. https://doi.org/10.3389/fpsyg.2018.01843

Le, L., Yu, L., Guan, C., & Zhang, X. (2018). Epidemiology, etiology, screening, psychotherapy of malignant tumor patients with secondary depressive disorder. *Current Pharmaceutical Design*, *24*(22), 2591–2596. https://doi.org/10.2174/1381612824666180727125448

Liao, Y., Skelton, K., Dunton, G., & Bruening, M. (2016). A systematic review of methods and procedures used in ecological momentary assessments of diet and physical activity research in youth: An adapted STROBE Checklist for Reporting EMA Studies (CREMAS). *Journal of Medical Internet Research*, *18*(6), e151. https://doi.org/10.2196/jmir.4954

Lucia, A., Earnest, C., & Perez, M. (2003). Cancer-related fatigue: Can exercise physiology assist oncologists? *Lancet Oncology*, *4*(10), 616–625. https://doi.org/10.1016/S1470-2045(03)01221-X

May, M., Junghaenel, D. U., Ono, M., Stone, A. A., & Schneider, S. (2018). Ecological momentary assessment methodology in chronic pain research: A systematic review. *Journal of Pain*, *19*(7), 699–716. https://doi.org/10.1016/j.jpain.2018.01.006

Moore, R. C., Depp, C. A., Wetherell, J. L., & Lenze, E. J. (2016). Ecological momentary assessment versus standard assessment instruments for measuring mindfulness, depressed mood, and anxiety among older adults. *Journal of Psychiatric Research*, *75*, 116–123. https://doi.org/10.1016/j.jpsychires.2016.01.011

Moore, R. C., Swendsen, J., & Depp, C. A. (2017). Applications for self-administered mobile cognitive assessments in clinical research: A systematic review. *International Journal of Methods in Psychiatric Research*. https://doi.org/10.1002/mpr.1562

Moskowitz, D. S., & Young, S. N. (2006). Ecological momentary assessment: What it is and why it is a method of the future in clinical psychopharmacology. *Journal of Psychiatry and Neuroscience*, *31*(1), 13–20.

Ratcliff, C. G., Lam, C. Y., Arun, B., Valero, V., & Cohen, L. (2014). Ecological momentary assessment of sleep, symptoms, and mood during chemotherapy for breast cancer. *Psycho-Oncology*, *23*(11), 1220–1228. https://doi.org/10.1002/pon.3525

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology*, *4*, 1–32. https://doi.org/10.1146/annurev.clinpsy.3.022806.091415

Shiyko, M. P., Siembor, B., Greene, P. B., Smyth, J., & Burkhalter, J. E. (2018). Intra-individual study of mindfulness: Ecological momentary perspective in post-surgical lung cancer patients. *Journal of Behavioral Medicine*, *42*, 102–110.

Stephenson, E., DeLongis, A., Bruel, B., & Badr, H. (2018). Outpatient pain medication use: An electronic daily diary study in metastatic breast cancer. *Journal of Pain and Symptom Management*, *55*(4), 1131–1137. https://doi.org/10.1016/j.jpainsymman.2017.11.032

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., … Straus, S. E. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*, *169*(7), 467–473. https://doi.org/10.7326/M18-0850

Verhagen, S. J., Hasmi, L., Drukker, M., van Os, J., & Delespaul, P. A. (2016). Use of the experience sampling method in the context of clinical trials. *Evidence Based Mental Health*, *19*(3), 86–89.

Versluis, A., Verkuil, B., Spinhoven, P., van der Ploeg, M. M., & Brosschot, J. F. (2016). Changing mental health and positive psychological well-being using ecological momentary interventions: A systematic review and meta-analysis. *Journal of Medical Internet Research*, *18*(6), e152. https://doi.org/10.2196/jmir.5642

Walz, L. C., Nauta, M. H., Aan Het Rot, M. (2014). Experience sampling and ecological momentary assessment for studying the daily lives of patients with anxiety disorders: A systematic review. *Journal of Anxiety Disorders*, *28*(8), 925–937. https://doi.org/10.1016/j.janxdis.2014.09.022

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