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Scoping Review of Experience Sampling Methodology Investigations of Posttraumatic Stress Disorder Symptoms

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Posttraumatic stress disorder (PTSD) is a serious mental health condition with a profound impact at both the individual and population levels. In recent years, there has been a surge of interest in studying PTSD using experience sampling methodologies (ESMs), which allow for a nuanced examination of how symptoms are experienced in or near real time, in the natural contexts of individuals' lives. We conducted a scoping review of studies of adults that employed ESM to assess PTSD symptoms. Our primary goals were to characterize the participants of such studies, the key design features of ESM studies of PTSD, and the analytical approaches employed for ESM data of PTSD symptoms. We also examined to what extent the current literature reflects best practices in reporting for ESM/ecological momentary assessment studies. Our findings revealed an active and growing literature, with 136 published articles reflecting 89 unique samples identified. There were some commonalities across studies in population (e.g., U.S.-based participants with unspecified trauma exposure), design (e.g., multiple assessments per day with Likert rating scales under an interval-contingent schedule), and analysis (e.g., representing symptoms as a composite in multilevel modeling). However, studies varied in terms of design characteristics (e.g., study duration, number of assessments per day, and other constructs assessed) and data analytic methods. Papers largely adhered to recent guidelines for reporting on ESM studies, although opportunities for improvement were identified. Results support the use of ESM to investigate the dynamics of PTSD symptoms. We discuss strengths and limitations of the existing literature and suggestions for future research.

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Public Health Significance Statement
Posttraumatic stress disorder (PTSD) is a prevalent and harmful psychological condition. We reviewed studies that use experience sampling methodologies (i.e., querying participants about their experiences in or near real time) to study dynamic experiences of PTSD symptoms. The findings revealed trends in how this method has been used to study PTSD symptoms thus far and highlighted gaps in our knowledge to guide future clinical investigation.

Keywords: PTSD, experience sampling methodology, scoping review, trauma

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Posttraumatic stress disorder (PTSD) is a highly impairing psychiatric condition that impacts approximately 6% of American adults over the course of their lifetimes (Goldstein et al., 2016). Particular subgroups of individuals (e.g., women, veterans) face heightened risk of developing the disorder after exposure to potentially traumatic events (Goldstein et al., 2016; Kilpatrick et al., 2013; Street & Dardis, 2018). The *Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition, Text Revision* (*DSM–5 TR*) defines trauma exposures as those involving actual exposure or threat of death, injury, or sexual violence. It organizes PTSD symptoms according to four clusters: reexperiencing (e.g., intrusive memories, flashbacks), avoidance (i.e., avoidance of both internal and external trauma-related experiences), negative alterations in cognitions and mood (e.g., self-blame for the trauma, strong negative beliefs about the self or others, difficulty experiencing positive emotions), and alterations in arousal and reactivity (e.g., hyperarousal, concentration difficulties, sleep problems). Symptoms must impair functioning and last for at least a month following the trauma.

PTSD is frequently comorbid with other mental health conditions (e.g., depression; Rytwinski et al., 2013) and health risk behaviors (e.g., smoking, alcohol and other substance use, self-directed violence, risky sexual behaviors; Fu et al., 2007; Jacobsen et al., 2001; Mota et al., 2019; Panagioti et al., 2009; Rheingold et al., 2004), and symptoms may be readily impacted (“triggered”) by experiences in the individual’s daily environment. As with other psychiatric conditions, efforts by clinicians and investigators to understand PTSD symptoms have typically relied on tools such as clinical interviews or self-report surveys that ask patients or participants to reflect on experiences over extended periods of time (e.g., past week, past month, one’s lifetime). For example, the Clinician-Administered PTSD Scale for *DSM-5* (CAPS-5; Weathers et al., 2018) is a structured clinical interview that can be used to assess for current or lifetime diagnoses of PTSD, as well as past-week PTSD symptoms. The PTSD Symptom Checklist for *DSM-5* (PCL-5; Bovin et al., 2016) is a widely used self-report measure with versions assessing lifetime, past-month, or past-week symptoms.

Investigations using such approaches and other methods have generated rich knowledge about the nature, course, and impact of PTSD symptoms (Friedman et al., 2016). However, they also reflect inherent limitations associated with retrospective recall bias. For example, Horwitz et al. (2024) recently called for increased understanding of how the “peak-end rule,” in which the most intense or most recent experiences are more readily recalled, may impact reporting of mental health symptoms, including those due to PTSD. Initial work comparing PTSD symptoms reported retrospectively versus in real time suggests this heuristic may be relevant for PTSD (Decker et al., 2021; Kiefer et al., 2024, although see Greene et al., 2022). The depression literature also highlights the potency of negative recall bias associated with this disorder (Urban et al., 2018; Wenze et al., 2012), which is important to note given the high comorbidity between this disorder and PTSD. In addition to recall bias, the focus on symptoms as experienced over longer periods of time may obscure more dynamic changes in PTSD symptoms or the interplay between PTSD symptoms and other relevant constructs (e.g., social experiences, coping strategies, affect).

Experience sampling methodologies (ESMs) represent an alternative approach to gathering information on symptoms and related constructs through “repeated collection of real-time data on subjects’ behavior and experience in their natural environments” (Shiffman et al., 2008). ESM serves as an umbrella term for methods that share characteristics such as querying about experiences or behavior in real time or over relatively recent history, focusing on the natural context (vs. experiences in a clinic or laboratory setting), and gathering information repeatedly over time (Shiffman et al., 2008). Like a collection of time-lapse images, data derived from ESM can provide both rich composites of a phenomenon and insight into nuances of its antecedents and consequences. ESM methods include daily diary studies (Bolger et al., 2003) in which participants are asked to recount experiences from the past day. Experience sampling methods (Hektner et al., 2007; Larson & Csikszentmihalyi, 2014) may involve prompting individuals to report on their experiences at random or pseudorandom times (i.e., signal-contingent design), fixed intervals, such as every 3 hr (i.e., interval-contingent design), having individuals self-initiate an entry, often in response to an urge or behavior (i.e., event-contingent design), or a combination of these approaches (Shiffman et al., 2008). Ambulatory assessments often focus on more frequent or even continuous assessments of physiological experiences (Shiffman et al., 2008). In this review, we use the term ESM to refer to this broad collection of methodologies that facilitate intensive longitudinal data collection.

With the advancement and availability of technology, ESM study methods have grown more sophisticated. For example, early studies often emphasized pen/paper or telephone interactive voice response (IVR) systems and later palm pilots or other portable computing devices. Studies are now frequently employing app-based assessments on individuals’ smartphones, sometimes in combination with wearable technologies. Given the proliferation of studies using ESM, new reporting standards have also emerged

to guide contributions to the ESM literature (Trull & Ebner-Priemer, 2020).

The use of ESM methods to study PTSD has mapped onto these broader trends. For example, one of the earliest published ESM studies of PTSD symptoms asked participants to keep written daily diaries of cognitive intrusions following treatment (Lytle et al., 2002). Another study used IVR systems to assess PTSD symptoms, alcohol craving, and related symptoms among participants in early recovery from alcohol use disorder (Simpson et al., 2005). More recently, investigators have integrated ESM of PTSD symptoms with ambulatory assessments of physiological characteristics (Devignes et al., 2024; Slavish et al., 2023) or used ESM to examine temporal associations of PTSD symptoms with a range of constructs, such as social support (Howe & Dworkin, 2024), reckless or self-destructive behaviors (Messman et al., 2024), exposure to trauma cues (Mojallal et al., 2024), and many more. Additional investigations have used advanced analytical techniques such as network analysis to examine changes in interrelationships among PTSD symptoms over time (Stefanovic et al., 2024) or to examine the concordance of PTSD symptoms reported via ESM with retrospective self-report measures (Decker et al., 2021; Greene et al., 2022; Kiefer et al., 2024; Schuler et al., 2021).

Chun (2016) reviewed the literature published before October 2014 on PTSD symptoms using ESM methods (specifically referred to as experience sampling methodology and daily diary studies in the manuscript). The review encompassed 15 studies, which were categorized according to a focus on total or multiple PTSD symptoms, intrusive symptoms specifically, or broader mood and anxiety symptoms related to PTSD (Chun, 2016). Key elements of methodology and findings were summarized for each study, along with their strengths and limitations. Chun (2016) noted several important takeaways from this review. First, examinations of PTSD symptoms using ESM methods in both pen/paper and digital forms appeared feasible and acceptable among individuals with PTSD and histories of traumatic stress. Second, there was marked variability in study designs across the literature, making direct comparisons of study findings challenging. Despite such variability, the then-nascent ESM literature on PTSD revealed negative impacts of the disorder on daily life in areas such as avoidance and intrusions, negative mood, cognitions, and stress and well-being, as demonstrated by the prevalence and burden of symptoms reported using ESM (Chun, 2016).

Chun (2016) provided a foundational overview of the PTSD ESM literature. However, almost a decade has passed since this effort, and the use of ESM to investigate PTSD and related symptoms has proliferated. We sought to describe how ESM studies of PTSD symptoms have been designed and implemented in the literature, thus providing a "map" for investigators considering ESM studies on this topic. Scoping reviews are well-suited for efforts to "identify and map" evidence in a particular field, including characterizing how research is conducted (Munn et al., 2018). In contrast, systematic reviews are best suited for questions related to the clinical application of research findings (Munn et al., 2018). Given our descriptive aim and focus on study methodology (i.e., vs. endeavoring to synthesize study findings), we conducted a scoping review of studies using ESM to examine PTSD symptoms. We did not meta-analyze our findings for similar reasons, and given the volume of discrete study methodology features that we intended to catalogue. We had three overarching goals for the present article. These built on work by Chun (2016), which focused on summarizing the results of the studies published at that time, along with brief evaluations of their strengths and weaknesses. First, we aimed to catalogue participants in ESM studies of PTSD symptoms by describing the prevalence of key demographic characteristics, geographic origin, trauma types, and so forth across the samples uncovered in the review. Second, we sought to describe the landscape of how ESM studies of PTSD have been structured so far in the literature (e.g., specific form of ESM, duration, type, and frequency of PTSD-related queries in the protocol, other constructs studied). Third, we endeavored to characterize analytical techniques and decisions used in processing the data generated by ESM studies of PTSD. An additional exploratory goal was to assess the degree to which the literature reflected recommended reporting guidelines for ESM studies (Trull & Ebner-Priemer, 2020).

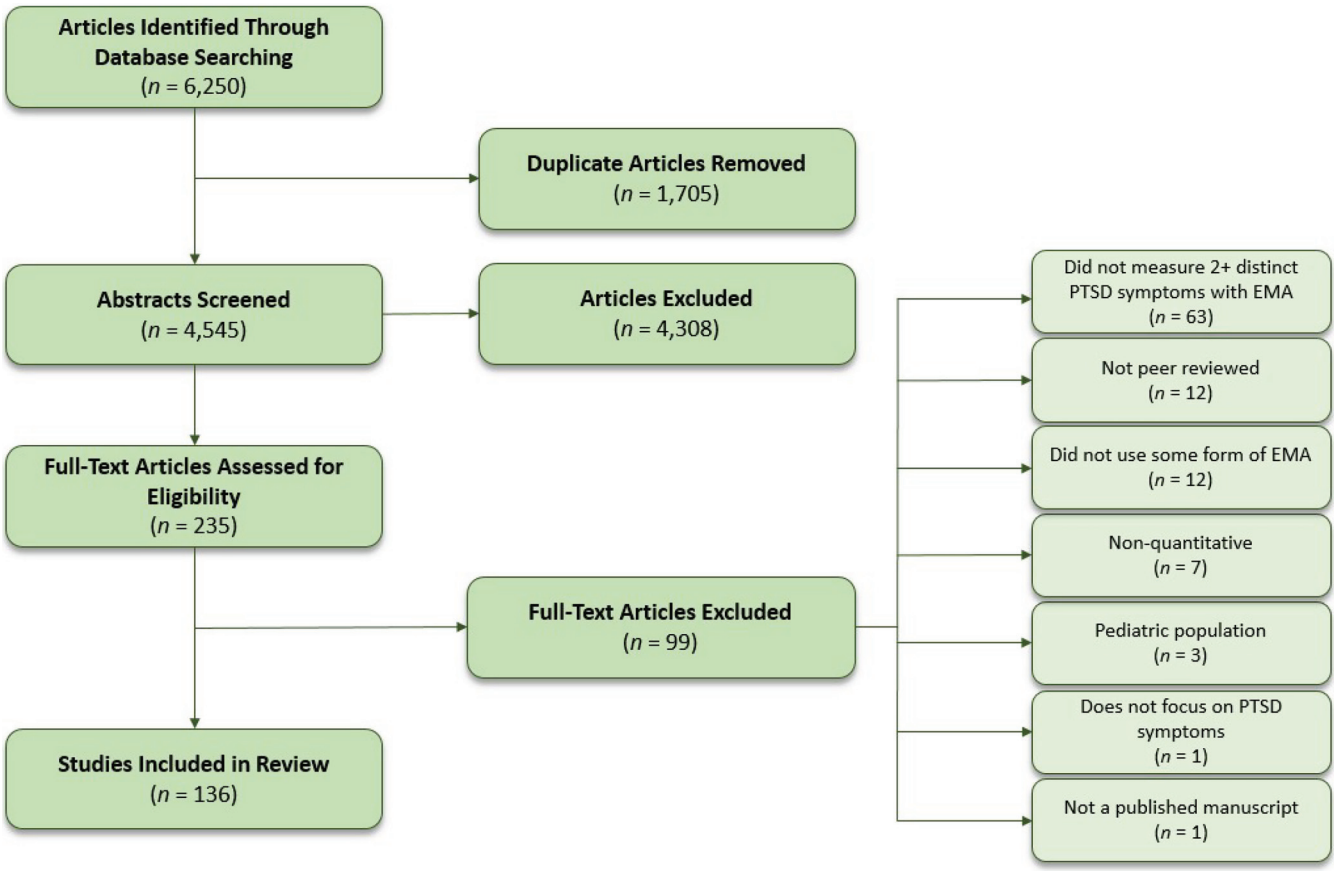
Method

We followed the guidelines by Peters et al. (2015) for the development and implementation of our scoping review; the review itself was not preregistered. We generated candidate search terms, which were applied across five databases: PubMed, PsycInfo, PTSDpubs (maintained by the National Center for PTSD), EMBASE, and Web of Science. See Supplemental Material Table S5 for a list of the final search terms used. The original database searches were implemented in early March 2023 and exported to the Covidence web-based systematic review database. We imposed no date restrictions on the search, as our key questions encompassed study details that were not included in the review by Chun (2016). We also reviewed reference lists of key articles for additional candidate papers. We repeated this search and coding process in April 2024 and August 2025 to capture manuscripts published since the previous search.[1] Our search terms generated 4,545 non-duplicative titles. Two authors independently reviewed all titles and abstracts for possible full-text review (Rachel L. Zelkowitz, Haijing Wu Hallenbeck). Eligible articles had to be published in English, reflect peer-reviewed manuscripts (e.g., publications in the gray literature and conference abstracts were excluded), and document the use of intensive longitudinal methods to assess at least one PTSD symptom. For studies focusing on PTSD symptoms that overlap with multiple mental health conditions (e.g., poor sleep quality, negative affect), we required that the study assess at least one other PTSD symptom to be included in our review. Consistent with the approach by Chun (2016), we excluded articles that only examined analogs of PTSD symptoms (e.g., intrusive memories about laboratory stimuli such as a film). Discrepancies on article inclusion/exclusion were resolved by consensus among the two authors; any outstanding discrepancies were resolved through discussion with members of the larger team. A flowchart of study identification and reasons for exclusion is depicted in Figure 1.

We developed and piloted a coding extraction tool with domains that corresponded to our overarching goals for the review. We

[1] One article identified in the original search (Kanstrup et al., 2021) was no longer detected in the final iteration of the database searches performed in August 2025. We retained the article in the scoping review, as it met the review inclusion criteria.

Figure 1
PRISMA Flow Diagram



Note. PRISMA flow diagram for the scoping review detailing database search results, abstract screening, full-text screening, and reasons for exclusion. PRISMA = preferred reporting items for systematic reviews and meta-analyses; PTSD = posttraumatic stress disorder; ESM = experience sampling methodology. See the online article for the color version of this figure.

collaboratively refined the tool before applying it to the identified articles. For example, for Aim 1, we coded such features as the demographic characteristics of study participants, countries in which the studies took place, key inclusion criteria, and so forth. For Aim 2, we extracted details such as the specific type of ESM applied, duration of the study, and compliance. For Aim 3, we focused on design elements such as how PTSD symptoms were analyzed (e.g., total vs. symptom level) and the analytical models applied. As noted, we did not formally meta-analyze the domains extracted, but we did summarize our findings via descriptive characteristics such as frequencies, mean, and range. Each article was double-coded. A third author resolved discrepancies. Any remaining questions or discrepancies were resolved through discussion with the larger authorship team.

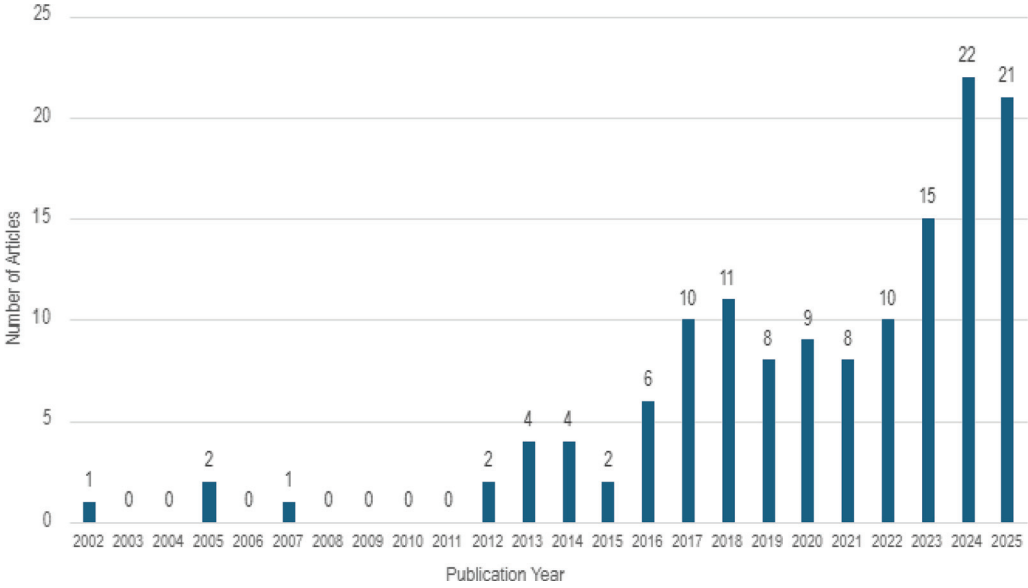
We also coded consistency with the recommended reporting guidelines for ambulatory assessment studies (Trull & Ebner-Priemer, 2020) as a quality assessment. This was an exploratory aim, given that many of the articles were published before the publication of the guidelines themselves. Recommended reporting guidelines were developed to increase replication, transparency, and scientific rigor. Consistent reporting of ESM methodology and analytic procedures is also necessary to combine results across studies in a meaningful way (e.g., meta-analyses). Each study was double-coded according to each of the 12 recommended reporting criteria proposed by Trull and Ebner-Priemer (2020; see Table S4 for a list of criteria) as either absent or present. Discrepancies were resolved by a third coder from the authorship team. We also calculated an overall summary of how many ESM PTSD studies in the review adhered to each criterion (i.e., percentage of studies reporting). As our effort was not a systematic review, the purpose of presenting overall adherence to the recommended reporting guidelines for ambulatory assessment studies was to assess areas of strength and improvement in the ESM PTSD literature rather than to assess the quality or potential for bias of any individual study.

Results

A total of 136 articles published between 2002 and 2025 met study inclusion criteria, most of which were published from 2015 to 2025 (89.7%). See Figure 2 for a chart of articles published by year. These articles reflected 89 unique samples (i.e., a distinct set of participants). In most cases of multiple papers based on the same sample, we used the first published study as the study of

Figure 2

Articles Using Experience Sampling Methodology to Investigate PTSD Symptoms, By Year



Note. PTSD = posttraumatic stress disorder. See the online article for the color version of this figure.

record (and the source of information for that unique sample). However, in the few instances when they presented a larger *N* or provided more complete information about the sample, we designated later papers as the study of record. Participant demographics and inclusion criteria, study design characteristics, ESM features, and analytic methods are presented in Tables S1–S3. Descriptive statistics regarding study participants and study design characteristics (for Goals 1 and 2) are based on total unique samples unless stated otherwise. The denominator for each proportion is specified; not all coded characteristics were relevant or provided for each sample. Descriptive statistics regarding analytical methods and adherence to reporting guidelines (for Goal 3 and our exploratory goal) are based on the total papers published. Denominators for each proportion are similarly specified, as not all coded characteristics were relevant or provided for each publication.

Goal 1: Characterizing Participants in ESM Studies of PTSD

Table S1 presents descriptive characteristics of study participants. The average sample size was 102.3 participants and ranged from 3 to 2,185. Studies were conducted in nine different countries (Australia, China, Germany, Iceland, Israel, Sweden, Switzerland, the United Kingdom, and the United States), the most common being the United States (77.0%, 67/87 samples providing this information). The average percentage of participants who identified as women among studies that provided this information was approximately 59.5%, with 16 samples comprised of only women. Only 11 studies reported other gender identities, including transgender, nonbinary, genderqueer, or other status, with two studies specifically focused on gender-diverse populations. Approximately 2.7% of all sample populations identified as a gender other than cisgender man or woman. Very few studies made a distinction between biological sex and gender, and it is possible that transgender status was underreported.

Mean age of participants ranged from 18.9 to 61.1 years, with the median of these averages being 34.9 years. We coded race/ethnicity for samples based in the United States only, as this was the country most commonly represented among studies, and not all categories for race/ethnicity in the U.S. context applied internationally. The average percentage of participants identifying as White or Caucasian was 61.8% and ranged from 23.9% to 93.3%. On average, 14.6% participants identified as Hispanic or Latinx, ranging from 0% to 73.2%. Nearly half (46.5%, 40/86) of included samples recruited participants from community settings, a third (32.5%, 28/86) from psychiatric settings, 30.2% from medical settings (including emergency departments), 19.8% (17/86) from universities or academic settings, and 12.8% (11/86) from other sources.

Inclusion criteria varied considerably between studies, the most common being unspecified trauma exposure (48.3%, 43/89), followed by Veteran status (18.0%, 16/89). Other criteria included sexual assault (6.7%, 6/89), intimate partner violence (4.5%, 4/89), depression or suicidal ideation (4.5%, 4/89), motor vehicle accident exposure (3.4%, 3/89), natural disaster exposure (Benight et al., 2025; Littleton et al., 2023), World Trade Center first-responders (Dietch et al., 2019; Ringwald et al., 2025), childhood trauma (Priebe et al., 2013), refugee status (Holmes et al., 2017), civilian wartime exposure (Lapid Pickman et al., 2017), and traumatic birth (Horsch et al., 2017). Of all included samples, a majority (74.2%, 66/89) reported that the presence of PTSD was assessed at baseline by one or more measures. For about half of the included studies, this was done using one or more clinical interviews (48.5%, 32/66), most often a form of the CAPS (81.3%, 26/32). The 43.9% (29/66) of papers that identified baseline PTSD with self-report measures typically used one or more

versions of the PCL (75.9%, 22/29). The average percentage of participants meeting full diagnostic criteria for probable PTSD at baseline was 67.8% and ranged from 0% to 100% (median: 68.3%), among the 54 studies that reported a valid percentage. Eighteen studies reported that all participants met full diagnostic criteria for probable PTSD at baseline.

Goal 2: Describe Key Design Characteristics of ESM Studies of PTSD

Methodological features of ESM PTSD studies are summarized in Table S2. A majority of papers described studies that collected data multiple times a day (59.6%, 53/89) versus or in addition to daily diaries (40.5%, 36/89; one study used both methods). The most common data collection modality was phone-based (e.g., applications, web-based survey platforms; 59.5%, 50/84), followed by personal or study-provided electronic devices (e.g., personal digital assistant; 17.9%, 15/84). Fewer used pen and paper approaches (14.3%, 12/84) or cellphone call surveys or texts (e.g., IVR; 9.5%, 8/84). More than half of the unique studies adopted an interval-contingent design (64.0%, 55/86), over a third used a random or pseudorandom signal-contingent design (38.4%, 33/86), and fewer used an event-contingent design (7.0%, 6/86). The average study length was 19.4 days (range: 1–90), and average number of assessment timepoints throughout the day (i.e., for studies with interval- or signal-contingent surveys) was 3.0 (range: 1–17). Studies also commonly assessed psychological and behavioral constructs in addition to PTSD symptoms. The most frequently represented included substance use (37.7%, 29/77) and affect, mood, or emotions (37.7%, 29/77). Other constructs assessed included sleep (18.2%, 14/77), social support/interpersonal situations (14.3%, 11/77), coping strategies (11.7%, 9/77), anxiety and depressive symptoms (10.4%, 8/77), pain (9.1%, 7/77), characteristics of intrusive memories (7.8%, 6/77), negative life events or stressors (5.2%, 4/77), suicidal or self-injurious thoughts and behaviors (5.2%, 4/77), romantic relationship functioning (3.9%, 3/77), and nightmare characteristics (3.9%, 3/77). See Table S2 for the full list of constructs assessed.

Most unique studies identified in the review (64.4%, 56/87) described using Likert scales to measure PTSD symptom severity during momentary assessments, with fewer using a count of the number of times a symptom was present (17.2%, 15/87), checklists to identify the presence or absence of symptoms (16.1%, 14/87), or a sliding scale of symptom severity (e.g., 0–100; 4.6%, 4/87). The most common PTSD measure adopted for momentary assessments was one or more versions of the PCL (including abbreviated versions; 52.4%, 44/84). Other measures included assessment of wake-time intrusions only (21.4%, 18/84), nightmares only (3.6%, 3/84), and a version of the Davidson Trauma Scale (3.6%, 3/84). On average, PTSD symptoms were assessed using 9.4 items (range: 1–28). The reference periods used to assess PTSD metrics generally included a lookback period of the last day (48.8%, 39/80), since the last assessment or prompt (26.3%, 21/80), or within the past few hours (15.0%, 12/80). Three studies assessed PTSD symptoms "in the moment" or "right now" (Brockdorf et al., 2025a; Dvorak et al., 2024; Zaso et al., 2025), two assessed PTSD symptoms as recently as the past 10 min (Pugach et al., 2023; Wisco et al., 2025), and one assessed symptoms in the past 30 min (Mojallal et al., 2024).

Information on ESM compliance varied by sample. Of the 89 unique samples, 72 (80.9%) reported compliance information; one study reported compliance but did not define how it was calculated. Of the 71 studies that reported this information, 28 (39.4%) reported compliance as the total number of surveys completed across all participants out of the total number of surveys possible (this included but was not limited to observations of PTSD symptoms). The average reported compliance rate across studies using this method was 73.0%. The second most common method (36.6%, 26/71) of reporting compliance was the average percentage of assessments completed, calculated from the mean number of entries per participant divided by the total possible number of entries. Most of these studies reported the average percentage completed over the course of the study; a few reported the daily average. The average reported compliance rate across studies using this method was 78.6%. Some studies (9.9%, 7/71) reported compliance as the percentage of participants who met a certain threshold of completion (e.g., the proportion of participants who completed at least 505 of available surveys). Almost half of all studies with compliance information (46.5%, 33/71) reported dropping participants who did not meet the study-specified completion threshold. Only 64.0% (57/89) of included studies clearly described whether financial compensation was offered to study participants. Of these papers, 17.5% (10/57) reported that financial compensation was not provided for completion of momentary assessments. Some of these studies (40.0%, 4/10) offered course credit as compensation for participation; one study (Short et al., 2017) offered the choice of course credit or financial compensation. Of the studies that offered financial compensation (84.2%, 48/57), many reported doing so based on a specified amount per assessment (41.7%, 20/48), for the overall study (20.8%, 10/48), per week (10.4%, 5/48), or per day (6.3%, 3/48). Over half (56.3%, 27/48) of these studies reported using a bonus incentive to encourage responses. Most did so based on the percentage of responses received at the end of the study period (63.0%, 17/27), the end of each week (37.0%, 10/27), or based on another payment schedule (e.g., for every fourth consecutive assessment completed, timely responses as defined by the study team; 25.9%, 7/27); several studies used a combination of these incentives.

Goal 3: Characterize Major Data Analytic Approaches of ESM PTSD Studies

Analytic approaches for each article are listed in Table S3. Regarding the level of analysis for PTSD, almost half (44.9%; 61/136) of the articles used only composite scores created from individual ESM items to represent an overall measure of PTSD. Almost a quarter of articles (23.5%; 32/136) examined PTSD at the symptom level only, which was partially driven by studies examining a single PTSD symptom such as intrusive memories. Other articles (8.8%; 12/136) analyzed their PTSD ESM data grouped by symptom cluster only. About a fifth of articles (18.4%; 25/136) used a combination of two approaches (e.g., overall and cluster). Information on the level of analysis was not available for a small number of studies (4.4%; 6/136).

There was a more even distribution in the way articles approached the calculation of PTSD scores. About a third (29.4%; 40/136) used a sum score only, about a fifth (18.4%; 25/136) used a mean score only, and about a fifth (17.6%; 24/136) used a count

only. A small number of articles took a different approach, using individual symptom ratings for analysis (8.1%; 11/136), peak scores (Sanjuan et al., 2019), or percentages only (Simons et al., 2018). Less than a fifth of articles (14.7%; 20/136) used a combination of at least two approaches (e.g., sum score and peak score). Information on the calculation of PTSD scores was not available for about a tenth of studies (9.6%; 13/136).

For the timeframe of how PTSD was represented in analyses, there was a relatively even split between analyses performed at the day level only and at the survey level only (i.e., per ESM record). There were about a third of articles in each category (day level: 36.0%; 49/136; survey level: 31.6%; 43/136). A minority of articles examined PTSD at the week level only (5.9%; 8/136) or across the ESM period (3.7%; 5/136). A different time frame was used in other studies, including analyzing per 30 days (Ford et al., 2022), per 10 days (Rieder et al., 2022b), per multi-hour "time block" (Biggs et al., 2025), per hour (Rosi-Andersen et al., 2022), and connected to what was happening in concurrent treatment (Weiss et al., 2023). Several articles (14.0%; 19/136) used more than one timeframe in their analyses (e.g., per day and per ESM record). Information on the timeframe analyzed was not available for a small number of studies (5.1%; 7/136).

PTSD score calculation and statistical modeling details for each study are presented in Table S3. For statistical modeling, the majority (60.0%; 81/136) of articles primarily used multilevel models to analyze their ESM data on PTSD symptoms. Less common methods for analyzing ESM data included: structural equation modeling (5.9%, 8/136), network analysis only (5.2%, 7/136), a combination of two or more methods (3.7%, 7/136), time series analysis (Horsch et al., 2017; Iyadurai et al., 2018), growth models only (Greene et al., 2017; Hruska et al., 2016), group iterative multiple model estimation (Brick et al., 2025; Ringwald et al., 2025), nonlinear dynamic systems analysis only (Benight et al., 2025; Littleton et al., 2023), and cross-lagged autoregressive models only (Campbell et al., 2017). About a tenth of articles (8.1%; 11/136) used more traditional statistical approaches only (e.g., correlations, regressions, analysis of variance, generalized estimating equations), and some (6.6%; 9/136) examined descriptives (e.g., means) only. A few articles (3.9%; 4/103) did not analyze their PTSD ESM data and focused on evaluating feasibility/compliance or changes in other measures before and after the ESM period. See Table S3 for a full list of the analytical methods used in each article.

Exploratory Goal: Characterize Adherence to ESM Reporting Guidelines

An additional exploratory goal was to determine the degree to which manuscripts were consistent with recommended reporting guidelines for ESM studies. Table S4 reflects the proportion of papers identified in our review that adhered to each of the recommended reporting guidelines for ambulatory assessment studies proposed by Trull and Ebner-Priemer (2020). We emphasize that many of the papers were published before the release of these guidelines, and our findings should be interpreted with that point in mind. The most commonly followed guidelines included: describing the level of analysis (99.3%, 133/134); reporting the full text of items (98.5%, 134/136); describing preparation for data analyses (98.5%, 132/134); define valid and missing data (86.0%, 117/136); describing procedures to enhance compliance (80.1%, 109/136); and describing the final dataset (78.7%, 107/136). Approximately two thirds of the articles (66.9%, 89/133) fully described the hardware and software used. Less than 50% of articles reported information consistent with the following guidelines: reporting the psychometric properties of the ESM items (47.8%, 65/136); explaining the rationale for the sampling density and scheduling (38.2%, 52/136); explaining the rationale for the sampling design (16.9%, 23/136); and justifying the sample size (16.2%, 22/136).

Transparency and Openness

The extracted data on which all analyses were based are available in Supplementary Tables 1-4. Data sheets to support Figures 1 and 2 are available upon request from the corresponding author.

Discussion

PTSD is a common and debilitating psychiatric disorder, making our understanding of its symptoms and their impact a critical public health concern. The emphasis of ESM on querying individuals about their experiences in or close to real time and in their natural contexts may offer unique insights into PTSD, as several symptoms of this disorder are characterized by discrete psychological and behavioral phenomena (e.g., intrusions, avoidance behaviors, negative cognitions and mood, and hyperarousal experiences) and may be contextually dependent. In addition, PTSD is commonly comorbid with low mood and dysregulated behaviors such as substance use, which have also been studied using ESM (Armey et al., 2015; Shiffman, 2009). Our overarching goal in this scoping review was to characterize the design and key methodological features of ESM studies of PTSD symptoms. We also summarized to what extent this literature adheres to new recommendations for reporting ESM studies. Our search encompassed peer-reviewed, empirical literature published through August 2025 across five search databases and ultimately identified 136 manuscripts reflecting 89 unique samples, with the vast majority being published from 2015 to 2025.

Goal 1: Characterizing Participants in ESM Studies of PTSD

Our first primary aim of this paper was to identify the main demographic characteristics of participants in ESM studies of PTSD, along with the settings from which they were recruited and the types of trauma to which they were exposed. The overwhelming majority of studies focused on samples from the United States, with only nine countries represented across the review. Trauma exposure and PTSD specifically are global burdens (Benjet et al., 2016; Koenen et al., 2017). It is important that support for ESM via resources, training, data access, and so forth be available to anyone who wishes to employ this methodology and see its value for their population or problem of interest. Consistent with this principle, recent recommendations offer guidelines to make trauma-related ESM data "FAIR" (i.e., Findable, Accessible, Interoperable, and Reproducible; Hruska et al., 2025).

The burdens of trauma exposure and PTSD are not distributed equally across those reflecting various demographic characteristics

(e.g., sex, race/ethnicity, socioeconomic status, age; Norris, 1992). Ensuring representation of the full range of individuals impacted by trauma in ESM studies of PTSD symptoms will be important to generating generalizable findings. Similarly, using ESM to capture contextual experiences (e.g., unique stressors, discriminatory experiences) that may be relevant for mental health outcomes across different demographic groups could be another application of the tool. In the following text, we outline how two demographic characteristics were captured in the review. Psychological science's consideration of the unique facets of biological sex and gender has progressed considerably in recent years (American Psychological Association, 2020). Consistent with this, the few manuscripts that distinguished between sex and gender in this review were published since 2020. Across the studies included in the review, women slightly predominated, although we cannot say conclusively whether gender or sex was measured in many of the studies.

We limited our characterizations of race and ethnicity to samples from the United States. This facilitated the use of common labels but clearly reflects an American-centric perspective on race and ethnicity. As the use of ESM proliferates as a method to understand the experience of PTSD across the globe, careful consideration of racial and ethnic dynamics that are relevant to the local geographic and sociopolitical contexts will be important. Among the samples characterized in this review, White and non-Hispanic/Latinx participants represented the majority of participants, although representation varied by sample. Recent work has also begun to examine how symptoms of race-based trauma align with and diverge from PTSD symptoms (Carter et al., 2020; Williams & Zare, 2022), but we did not identify any studies using ESM to examine this question, highlighting opportunities for future work. Finally, we noted that approximately half of the studies had no specific trauma exposure as their inclusion criteria. Clarifying how trauma types (e.g., sexual assault, combat exposure, multiple traumas) impact individuals' experiences of PTSD symptoms and how these experiences may vary across demographic groups represents an important next step for the field.

Goal 2: Describe Key Design Characteristics of ESM Studies of PTSD

Our findings indicated that ESM studies of PTSD vary markedly in their design characteristics. However, some broad themes emerged. The majority of studies employed some form of the PCL or PCL-5 with a Likert rating scale, but the specific items administered were not consistent. Formal psychometric investigations of ESM items exist for other clinical constructs (e.g., suicidal ideation; Forkmann et al., 2018), and similar investigations of PTSD-related items are crucial. Studies assessing PTSD symptoms at multiple points throughout the day predominated over daily diary-based assessments, but the number of time points assessed per day varied. Reference periods for reporting on PTSD symptoms were approximately evenly divided between the past day and the past several hours. These approaches have the benefit of broadly capturing experiences of PTSD but may still suffer from some level of error due to retrospective reports and could be complemented by additional studies that probe for experiences "in the moment" or "right now." ESM design recommendations encourage a sampling frequency that reflects the phenomenon of interest (Bolger & Laurenceau, 2013; Fritz et al., 2024), but the natural fluctuation of PTSD symptoms in total or at the specific symptom level is unknown. Random and pseudo-random assessments of PTSD symptoms assume that the reported values are representative of the full timeframe assessed. However, none of the studies in the review reported over what timeframe different PTSD symptoms typically fluctuate (or remain static) at either the within or between-person levels. Such information would be a valuable contribution to the ESM PTSD literature to the enhance capacity to capture valid, reliable fluctuations in PTSD symptoms while minimizing response burden for study participants.

Use of app-based methodologies to record ESM data was common and likely reflects the increasing ubiquity of these devices. It is notable, however, that methodologies such as interactive voice recording continue to be used in even more recently published studies (Weiss et al., 2023). Such approaches may be more sensitive or appropriate among certain populations of trauma survivors, in which discoverable records such as apps and daily diary records could potentially compromise safety (e.g., in the context of intimate partner violence; Newberger et al., 2023).

One of the strengths of ESM is its capacity to elucidate dynamic associations of multiple constructs. Our review demonstrated this method is being actively used to investigate the co-occurrence of PTSD with a variety of related constructs, most notably substance use and varied forms of affect. Future efforts should continue to build on this foundation while exploring the associations of PTSD with other related risk behaviors (e.g., self-directed violence, disordered eating), mental health symptoms (e.g., depression symptoms), contextual factors (e.g., interpersonal stressors and support, environmental exposures), health promoting behaviors (e.g., healthcare use, exercise), and functional outcomes (e.g., role satisfaction, sexual functioning, well-being).

Methods of measuring compliance varied considerably across the studies reviewed, and a meta-analysis of overall compliance was outside the scope of the current review. However, preliminary aggregation across the two most common methods of assessing compliance revealed completion rates comparable to those observed in ESM studies of other clinical constructs such as substance use (Jones et al., 2019) and self-injurious thoughts and behaviors (Kivelä et al., 2022). This is promising and suggests that participants are willing and able to report on PTSD symptoms via ESM methods despite the centrality of avoidance to PTSD. A formal meta-analysis of compliance in ESM PTSD protocols would offer further confirmation of the feasibility of this method in studying PTSD, as well as help identify what study characteristics amplify or mitigate compliance. More broadly, future inquiries via systematic reviews or meta-analyses should examine how particular design characteristics influence the study findings. We did not consider this, as our goal was to provide a description of the ESM PTSD literature as a whole. However, it would be valuable to consider such questions within particular subsections of the literature that have similar aims (e.g., how do design characteristics impact the findings for ESM studies of PTSD symptoms and problematic alcohol use?).

Goal 3: Characterize Major Data Analytic Approaches of ESM PTSD Studies

PTSD is a conspicuously heterogeneous disorder (Galatzer-Levy & Bryant, 2013). A growing body of work suggests that

PTSD symptom clusters and even individual symptoms may relate differentially to outcomes such as self-directed violence, alcohol use, and disordered eating (Jeon et al., 2024; Livingston et al., 2020; Spitzer et al., 2020; Zelkowitz et al., 2024). It is thus notable that almost half of the manuscripts in this review focused on total PTSD symptoms. An additional segment of papers examined PTSD symptom clusters in addition to total PTSD symptoms. Those that focused on individual symptoms predominantly examined intrusions. As the field progresses, there will be rich opportunities to harness the granularity of ESM data to yield important insights into specific drivers of PTSD-related outcomes, comorbid conditions, and risk and protective factors. Such investigations could also extend the multilevel modeling analytical techniques that predominate in the existing literature to incorporate idiographic models of PTSD symptoms (Beltz & Gates, 2017; Fisher et al., 2017; Gates & Molenaar, 2012). These models will be critical to developing personalized approaches to PTSD assessment and treatment to enhance their effectiveness (Galovski et al., 2024; Nye et al., 2023).

Exploratory Goal: Describe Overall Adherence to ESM Reporting Guidelines

In addition to the three main goals described earlier, we also examined to what extent the published PTSD ESM literature has adhered to recommended reporting guidelines for ambulatory assessments (Trull & Ebner-Priemer, 2020). In general, results of this review suggest that many PTSD ESM articles have reported information consistent with the guidelines (despite many papers being released before the publication of the guidelines themselves) PTSD ESM papers tended to comprehensively describe elements of the ESM protocol (e.g., technical details of sampling, hardware and software used, procedures to enhance compliance) and details of data analysis (e.g., characteristics of the final dataset, processing of data such as centering variables, and type of analysis applied). Areas for improvement, as indicated by comparatively lower adherence rates (i.e., reported in fewer than 50% of manuscripts), included justification of the study design (e.g., power analyses to justify sample size, rationale for the sampling design, rationale for the sampling density, and scheduling) and reporting the psychometric properties of ESM items. Historically, limited tools/resources to conduct relevant analyses may have contributed to lower reporting of factors such as sample size justification. To this end, several accessible tools and tutorials have recently been developed to guide a priori decisions about study design (e.g., tutorial by Oleson et al., 2022, power calculator by Kleiman, 2021). Valid and reliable measurement is essential to any psychological investigation. Although some have called for using multiple items per construct even within an ESM context to establish reliability and validity (Trull & Ebner-Priemer, 2020), others have demonstrated the validity of single-item measures within ESM (Song et al., 2023). Ultimately, investigators must weigh the tradeoffs of potentially improved reliability versus increased burdensomeness in identifying the precise numbers of items per construct to include in their ESM batteries. Castro-Alvarez et al. (2025) noted the unique challenges associated with measurement reliability in ESM, given the emphasis on brief assessment batteries to minimize respondent burden, the need for reliability statistics that account for dependence across many repeated measures, and the importance of distinguishing within-person versus between-person reliability. Nezlek (2017) provided an overview of reliability estimation within ESM. The most appropriate estimation method will vary by the goals of the study; recent primers offer both overviews and code to calculate a range of reliability statistics that are relevant for ESM (Castro-Alvarez et al., 2025; Fried et al., 2024). In the current review, for example, Cox et al. (2025) reported on the psychometric properties of a daily version of the PCL-5. Such inquiries across a range of PTSD measures and ESM designs will be invaluable to advancing the field.

Strengths and Limitations

Strengths of the current review include its comprehensive search strategy (i.e., targeting five unique databases to identify relevant articles and including several ESM-relevant terms), double-coding of each article for the main research questions, and overall adherence to scoping review guidelines and best practices (Peters et al., 2015). Nevertheless, it is important to consider the findings in light of certain limitations. First, given our focus on the ESM study methodology, we did not synthesize findings at the individual study level, either qualitatively or via a quantitative meta-analysis. The substantial differences in measurement methods, covariates assessed, and key elements of study design in the literature made the scoping review a more appropriate method to address our research questions, which were descriptive in nature. As noted, however, systematic considerations of how ESM study design characteristics impact findings among studies with similar aims will guide future investigators and provide important context for interpreting disparate findings across the literature. Meta-analyses characterizing the dynamic associations of PTSD symptoms in particular populations or the covariation of PTSD symptoms and related constructs will also be invaluable, and we aim for the current review to serve as a springboard for such future syntheses. ESM also refers to a broader collection of methodologies that carry a variety of labels. Although we endeavored to be as comprehensive as possible in our search term strategy, it is possible that relevant articles using obscure terms to describe intensive longitudinal methods were not included. In addition, we excluded articles focused on PTSD symptoms among children and adolescents. Investigations of PTSD symptoms using ESM among children and adolescents are burgeoning, however (Müller et al., 2021; Ortiz et al., 2008; T. Wilson et al., 2022), and would represent an important topic for future focused reviews. Despite these limitations, the present review provides a foundational survey of the ESM PTSD literature among adults that provides a benchmark for how ESM PTSD studies have been conducted and analyzed to date and articulates high-priority areas for future research in the field.

Future Directions

An important question within ESM research more broadly concerns the impact of repeated assessment on the experience of the construct of interest. This is perhaps even more important in the context of ESM PTSD research, given the cardinal role that avoidance plays in PTSD. That is, what does it mean to ask individuals to repeatedly reflect on some of the very symptoms that they seek to avoid? How do such reflections impact an individual's experience of the disorder itself? To the best of our knowledge, no study

to date has examined the ongoing (i.e., long term) impact of ESM on the experience of PTSD symptoms. Research on measurement reactivity to ESM more broadly is sorely needed, as findings thus far have been mixed as to whether affect changes over the course of a sampling period, for example (Eisele et al., 2023; Ottenstein et al., 2024).

By definition, ESM focuses on assessment, but self-monitoring may be an important intervention in its own right. In a review of technology-based symptom monitoring (including ESM methods) for mental health, self-monitoring was endorsed by some participants as providing increased insight into and better management of their symptoms (Walsh et al., 2016). For PTSD specifically, an early study examined whether PTSD symptoms and other constructs varied among participants who reported via ESM versus weekly versus no-monitoring conditions; no significant effects between groups were observed (Simpson et al., 2005). However, a subsequent study found that PTSD symptoms were actually reduced among those who completed a 2-week ESM monitoring period versus no ESM procedure (Dewey et al., 2015). Future work is needed to examine the impact of ESM on PTSD symptoms in different populations and among those exposed to different forms of trauma.

Clinical practice guidelines for PTSD recommend several cognitive behavioral therapy-based treatments (American Psychological Association, 2025a; VA/Department of Defence, 2023), a family of interventions that often incorporate self-monitoring (Cohen et al., 2013; Linehan, 2004; G. T. Wilson & Vitousek, 1999). However, few of the studies included in this review reported on ESM for PTSD symptoms in the context of an intervention, and fewer still examined ESM as part of an evidence-based treatment for PTSD. Such evidence-based treatments for PTSD are broadly effective, but opportunities remain to enhance their clinical impact and help patients remain engaged while pursuing these challenging treatments. The latter would highlight another potential clinical utility of using ESM to track PTSD symptoms. Key questions would include whether tracking PTSD symptoms via ESM improves the effectiveness of evidence-based treatments or mitigates dropout.

There is a growing demand for developing smartphone-based digital therapeutics to ease the public health burden of mental illness, including PTSD (American Psychological Association, 2025b). Such therapeutics may broaden access to treatment to those who are unable or unwilling (for any reason) to participate in traditional models of psychotherapy (e.g., regular outpatient visits either in person or via telehealth). These could include approaches such as ecological momentary interventions, which involve delivering brief interventions to an individual in their natural context often based on ESM responses (Balaskas et al., 2021) and just-in-time adaptive interventions (Wang & Miller, 2020), which similarly aim to administer tailored interventions based on an individual's expressed or detected need (e.g., through additional smartphone data collected passively on location and communication patterns). ESM PTSD investigations will play at least some role in the development of such interventions. In considering how best to incorporate ESM into interventions for PTSD, clinical investigators should also balance the burden to the participant or user with the clinical utility of ESM in the context of interventions. It will be useful to complement quantitative ESM PTSD studies with qualitative explorations of how their findings could most effectively be used to ensure future interventions are truly trauma-informed, acceptable, and useful to individuals impacted by traumatic stress. See Table 1 for a summary of research gaps and recommendations for future directions for the field.

Table 1
Research Gaps and Recommendations for Future Research on PTSD Symptoms Using ESM

- Promote representation of a broad range of participants reflecting communities impacted by trauma.
- Characterize temporal variability of PTSD symptoms.
- Evaluate the reliability and validity of ESM measures of PTSD symptoms.
- Expand investigations of how PTSD symptoms may be associated with relevant constructs, including co-occurring mental health symptoms, contextual factors, and functional outcomes.
- Promote consistency to recommended ESM reporting guidelines.
- Assess the impact of PTSD ESM study design characteristics on compliance.
- Examine whether ESM results in clinical benefits, either when delivered alone or integrated into clinical interventions for PTSD symptoms.
- Investigate potential measurement reactivity of PTSD symptoms to ESM and moderators of any such reactivity.

Note. PTSD = posttraumatic stress disorder; ESM = experience sampling methodology.

Conclusion

Use of ESM to investigate PTSD has grown substantially in recent years. The proliferation of ESM PTSD studies has added to our knowledge of the dynamics of PTSD symptoms, although wide variability in the design features of such studies makes formal synthesis of their findings challenging at this stage. Nonetheless, ESM offers a valuable tool with which to understand—and hopefully relieve—the symptoms of this significant and devastatingly prevalent disorder.

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