
Internet and Mobile Interventions for Adults with PTSD and Their Family Members

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PREFACE

The VA Evidence Synthesis Program (ESP) was established in 2007 to conduct timely, rigorous, and independent systematic reviews to support VA clinicians, program leadership, and policymakers improve the health of Veterans. ESP reviews have been used to develop evidence-informed clinical policies, practice guidelines, and performance measures; to guide implementation of programs and services that improve Veterans' health and wellbeing; and to set the direction of research to close important evidence gaps. Four ESP Centers are located across the US. Centers are led by recognized experts in evidence synthesis, often with roles as practicing VA clinicians. The Coordinating Center, located in Portland, Oregon, manages program operations, ensures methodological consistency and quality of products, engages with stakeholders, and addresses urgent evidence synthesis needs.

Nominations of review topics are solicited several times each year and submitted via the [ESP website](#). Topics are selected based on the availability of relevant evidence and the likelihood that a review on the topic would be feasible and have broad utility across the VA system. If selected, topics are refined with input from Operational Partners (below), ESP staff, and additional subject matter experts. Draft ESP reviews undergo external peer review to ensure they are methodologically sound, unbiased, and include all important evidence on the topic. Peer reviewers must disclose any relevant financial or non-financial conflicts of interest. In seeking broad expertise and perspectives during review development, conflicting viewpoints are common and often result in productive scientific discourse that improves the relevance and rigor of the review. The ESP works to balance divergent views and to manage or mitigate potential conflicts of interest.

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Operational Partners

Operational partners are system-level stakeholders who help ensure relevance of the review topic to the VA, contribute to the development of and approve final project scope and timeframe for completion, provide feedback on the draft report, and provide consultation on strategies for dissemination of the report to the field and relevant groups.

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Disclosures

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The findings and conclusions in this document are those of the author(s) who are responsible for its contents and do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. The final research questions, methodology, and/or conclusions may not necessarily represent the views of contributing operational and content experts. No investigators have affiliations or financial involvement (eg, employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

Main Report

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ABBREVIATIONS TABLE

Abbreviation	Definition
CAPS	Clinician-Administered PTSD Scale
CAPS-5	Clinician-Administered PTSD Scale for DSM-5
CBT	Cognitive behavioral therapy
CI	Confidence interval
Couple HOPES	Couple Helping Overcome PTSD and Enhance Satisfaction
DoD	Department of Defense
DSM-5	Diagnostic and Statistical Manual of Mental Disorders - version 5
IES	Impact of Events Scale
IES-R	Impact of Events Scale - Revised
iCBT	Internet-based cognitive behavioral therapy
KQ	Key Question
MINI	Mini International Neuropsychiatric Interview
NRT	Non-randomized trial
OECD	Organisation for Economic Co-operation and Development
OR	Odds ratio
PC-PTSD	Primary Care PTSD Screen
PCL-5	PTSD Checklist for DSM-5
PCL-C	PTSD Checklist – Civilian version
PCL-M	PTSD Checklist – Military version
PCL-S	PTSD Checklist – Specific version
PDS	Posttraumatic Stress Diagnostic Scale
PE	Prolonged exposure
PI	Prediction interval
PSS-I	Posttraumatic Symptom Scale – Interview version
PSS-SR	Posttraumatic Symptom Scale – Self-report
PTS	Posttraumatic stress
PTSD	Posttraumatic stress disorder
RCT	Randomized controlled trial
SMD	Standardized mean difference
SMS	Short messaging service
SOE	Strength of evidence
TAU	Treatment as usual
TES	Traumatic Event Scale
UK	United Kingdom
VA	Department of Veterans Affairs
VA-CRAFT	Veterans Affairs – Community Reinforcement and Family Training
VHA	Veterans Health Administration
WET	Written exposure therapy



BACKGROUND

Approximately 10% of United States (US) military Veterans experience posttraumatic stress disorder (PTSD) at some point in their lifetime,¹ with nearly one-quarter of Veterans reporting significant posttraumatic stress (PTS) symptoms.² Untreated PTSD is associated with significant functional impairment,³ high rates of psychiatric⁴ and medical comorbidities,⁵ substance misuse,⁶ and death by suicide.⁷ Veterans with PTSD engage in high levels of healthcare utilization⁸ and pursue disability compensation at a high rate.⁹ Individual face-to-face trauma focused treatments, to include trauma-focused cognitive behavioral therapies (CBT) and eye movement desensitization and reprocessing (EMDR), have been identified as the most effective treatments for PTSD and are considered first-line treatments.¹⁰ The Department of Veterans Affairs (VA) and Department of Defense (DoD) have invested significant resources in developing and broadly implementing clinical pathways that incorporate effective therapeutic approaches.¹¹ Routine screening and access to evidence-based treatment for PTSD are now standard practices across all VA medical facilities.¹² However, despite these considerable investments in care, the majority of the military population (Veterans and military service members) with PTSD do not access and benefit from PTSD treatments.^{13,14}

Increasing access to effective PTSD treatments is a high priority for the VA and DoD. Veterans endorse several obstacles that may prevent them from engaging in PTSD treatment such as shame and stigma, fear of social consequences, and logistical challenges.¹⁵⁻¹⁷ Virtual treatments for PTSD that offer more flexible treatment delivery options with reduced provider requirements have the potential to overcome many of these barriers, especially given Veterans' receptivity to home-based telehealth options.^{17,18} Over the past 2 decades several types of technology-assisted treatments for PTSD have been developed and tested.¹⁹ Internet and mobile interventions have also been developed to support family members and caregivers of adults with PTSD who often experience psychological distress and caregiver burden related to their relationship.²⁰ These interventions aim to overcome similar access barriers to improve family member/caregiver wellbeing.

Virtual treatments, in which a provider delivers evidence-based therapies via synchronous telehealth, are now largely considered equivalent to in-person therapy for PTSD.^{21,22} Self-guided, asynchronous PTSD treatments that use the internet or mobile phone applications (apps) have also become available in recent years. These interventions, which differ in level of therapeutic support but are generally lower intensity than conventional in-person therapy, have the potential to expand access to effective PTSD therapies to anyone with the internet or a smartphone.

Internet treatments are generally structured interventions that deliver therapeutic content over the internet with varying levels of provider guidance.²³ Recent reviews indicate that internet-based cognitive behavioral therapies (iCBTs) may be more effective in reducing PTSD symptoms relative to waitlist conditions.²⁴ Although iCBTs are generally rated favorably by participants, high dropout rates present a limitation to these treatments.²⁵ Mobile mental health apps use smartphone technology to offer self-directed or remotely facilitated therapeutic content.²⁶ The evidence supporting these newer treatment approaches is mixed. Two recent reviews evaluating apps for the treatment of PTSD detected no significant benefits of these interventions relative to a control comparison,^{27,28} while a more recent review detected a small effect of stand-alone, smartphone-based mental health apps.²⁹

There is considerable variation among existing internet and mobile interventions in terms of treatment modality used (*ie*, delivered over the internet, an app, or SMS), the content and duration of the treatment, the extent and nature of facilitation, and the targeted population of the treatment. Studies

also differ in whether they compare interventions to no treatment (waitlist or treatment as usual), active control conditions, or in-person therapy. Examining how these factors impact treatment effectiveness can help inform implementation considerations. Given the potential benefits and broad accessibility of internet and mobile interventions for PTSD, the aim of this review is to synthesize available evidence on the effectiveness of internet and mobile interventions (with asynchronous therapist-guided or self-guided content and resources) for adults with PTSD and their family members or caregivers.

METHODS

REGISTRATION AND REVIEW

A preregistered protocol for this review can be found on the PROSPERO international prospective register of systematic reviews ([CRD42023471333](https://doi.org/10.1111/CRD4.2023471333)). A draft version of this report was reviewed by external peer reviewers; their comments and author responses are located in the [Appendix](#).

KEY QUESTIONS AND ELIGIBILITY CRITERIA

The following key questions (KQs) were the focus of this review:

Key Question 1	Are internet and mobile interventions with asynchronous therapist-guided or self-guided content and resources designed to improve PTSD symptom severity and/or self-management effective for improving PTSD symptoms and other mental health symptoms among adults with a diagnosis of PTSD?
Key Question 2	Are internet and mobile interventions with asynchronous therapist-guided or self-guided content and resources designed to enhance coping and symptom management skills for family members and caregivers of adults with PTSD effective for improving stress, mental health symptoms, and coping skills?

Eligibility Criteria

Study eligibility criteria are shown in the table below. We included studies where a substantial portion of the sample (about half, at minimum) met criteria for probable PTSD, as defined by the study. For studies meeting these criteria, we used a best-evidence approach and prioritized evidence from randomized controlled trials (RCTs) and cohort studies, when available.

Population	KQ1: Adults diagnosed with PTSD using a validated clinician-administered or self-report PTSD instrument. KQ2: Family members and caregivers of adults diagnosed with PTSD.
Intervention	KQ1: Internet and mobile interventions with asynchronous therapist-guided or self-guided content and resources designed to improve PTSD symptom severity and/or self-management. Interventions may address mental health or medical comorbidities, provided the intervention includes components to address PTSD symptoms. KQ2: Internet and mobile interventions with asynchronous therapist-guided or self-guided content and resources designed to enhance coping and symptom management skills of family members and caregivers of adults with PTSD. For both KQs, therapist guidance associated with the internet or mobile intervention cannot exceed 5 hours. There are no restrictions on the number of interactions with a therapist or the length of the program, and interventions may be delivered alone or in conjunction with other psychological interventions.
Comparator	Alternate intervention, treatment as usual, waitlist control, post-intervention (pre-post studies).
Outcomes	KQ1: Mental health symptom severity, functioning/quality of life. KQ2: Stress or mental health symptom severity, coping skills.
Setting	We will include studies conducted in the US or comparable countries (OECD member countries).
Study Design	Any comparative or pre-post studies will be eligible, but we may prioritize more rigorous designs in our synthesis.

SEARCHING AND SCREENING

To identify articles relevant to the key questions, a research librarian searched Ovid MEDLINE, PsycINFO, PTSDpubs, and the Cochrane Central Register of Controlled Trials through October 2023 using terms for *PTSD* and *internet and mobile interventions* (see [Appendix](#) for complete search strategies). Additional citations were identified from clinicaltrials.gov and hand-searching reference lists of relevant systematic reviews. English-language titles, abstracts, and full-text articles were independently reviewed by 2 investigators, and disagreements were resolved by consensus.

DATA ABSTRACTION AND RISK OF BIAS ASSESSMENT

Effect information and population, intervention, and comparator characteristics were abstracted from all included studies. When needed effect information was reported only in plots or other graphics, we abstracted data using the WebPlotDigitizer tool (<https://apps.automeris.io/wpd/>). Data abstraction was first completed by 1 investigator and checked by another. The internal validity (risk of bias) of each included study was rated using the Cochrane Risk of Bias 2.0 tool for randomized controlled trials³⁰ and the ROBINS-I tool for non-randomized studies.³¹ Internal validity ratings were completed independently by 2 investigators. Disagreements were resolved by consensus or discussion with a third reviewer (see [Appendix](#) for risk of bias ratings).

SYNTHESIS

Available evidence was synthesized using a best-evidence approach,³² prioritizing findings from RCTs and cohort studies over pre-post studies. Findings were organized by key question, outcome, and outcome assessment timing (immediately post-treatment, 1-3 month follow-up, or longer-term follow-up). For KQ1, PTSD and depression symptom severity were primary outcomes, and we did not conduct strength of evidence assessment on other outcomes. Although not originally planned, a sufficiently large number of studies were identified in Veterans or active-duty service members to allow reporting of primary outcomes separately for military and civilian populations.

We were also interested in intervention and study methodological characteristics that may influence intervention effects on PTSD and depression symptoms severity. These characteristics were 1) intervention modality (internet, app, or SMS/text message), 2) level of facilitation, 3) intervention duration, 4) presence or absence of a written exposure component (CBT-based interventions only), 5) outcome assessment method (clinician-administered or self-reported measure), and 6) comparison group type (active control, in-person therapy, minimal contact, intervention without exposure component, intervention without guidance, psychoeducation only, treatment as usual, or waitlist control). Level of facilitation was categorized as *none* (reminders or technical support only), *minimal support* (guidance/feedback on writing assignment or homework and/or other minimal unstructured support), or *direct facilitation* (provider directly delivers some aspect of intervention). Intervention duration was categorized as *brief* (1 week or less or a single session), *moderate* (2-5 weeks), *long* (6 weeks or longer), or *self-guided timeline*. Virtually all interventions used CBT or were informed by CBT principles, so it was not feasible to compare effects of CBT and non-CBT interventions.

Between-group differences in PTSD and depression symptom severity at each assessment point were represented as bias-adjusted standardized mean differences (SMDs; Hedges' *g*). Several included studies also reported the proportion of patients with clinically significant PTSD symptom improvement; the proportion who recovered, were in remission, or no longer met PTSD diagnostic

criteria; and/or the proportion with reliable PTSD symptom improvement or change. Odds ratios (ORs) were used to quantify between-group differences in these outcomes.

Effect estimates for primary outcomes were synthesized with hierarchical random-effects models, given that many studies reported multiple measures of the same construct and/or assessed the same outcome at multiple time points (even after subgrouping effect estimates into the assessment timeframes described above). Models assumed a correlation of 0.7 between measures of the same outcome construct and 0.9 between assessment time points (*ie*, autocorrelation). Cluster-robust confidence intervals and degrees of freedom calculated using the Satterthwaite approximation were used for models of dependent effect estimates. Conventional random-effects models were used when included studies each contributed a single effect estimate. Regardless of modeling approach, analyses with fewer than 10 studies incorporated the Knapp-Hartung method or comparable adjustment to standard errors. Meta-regression models used to investigate moderation by intervention and study characteristics included all effect estimates regardless of assessment time point, accounting for dependencies among estimates in the same fashion as main analyses. Meta-analyses were conducted using the *metafor*³³ package for R (R Foundation for Statistical Computing, Vienna, Austria).

Between-study variation in effects (heterogeneity) was estimated using restricted maximum-likelihood estimation, and in moderation analyses, the amount of heterogeneity was allowed to differ across study subgroups. For all analyses, heterogeneity is presented as 95% prediction intervals (PIs). Prediction intervals describe the likeliest range of true effects (*eg*, true differences in PTSD symptoms between groups) across studies and provide an estimate of the magnitude and direction of effects that would be found in future studies similar to those included in a synthesis.³⁴ A PI encompassing effects similar to the overall estimate suggests limited heterogeneity, whereas a PI that includes effects in the same direction as the overall estimate but that vary widely in magnitude (*ie*, small to large benefits) suggests moderate heterogeneity. If a PI encompasses effects that range widely in both magnitude and direction, then substantial heterogeneity is likely present. Prediction intervals were evaluated alongside forest plots to reach conclusions about whether effect estimates in a given analysis were consistent, moderately inconsistent, or highly inconsistent.

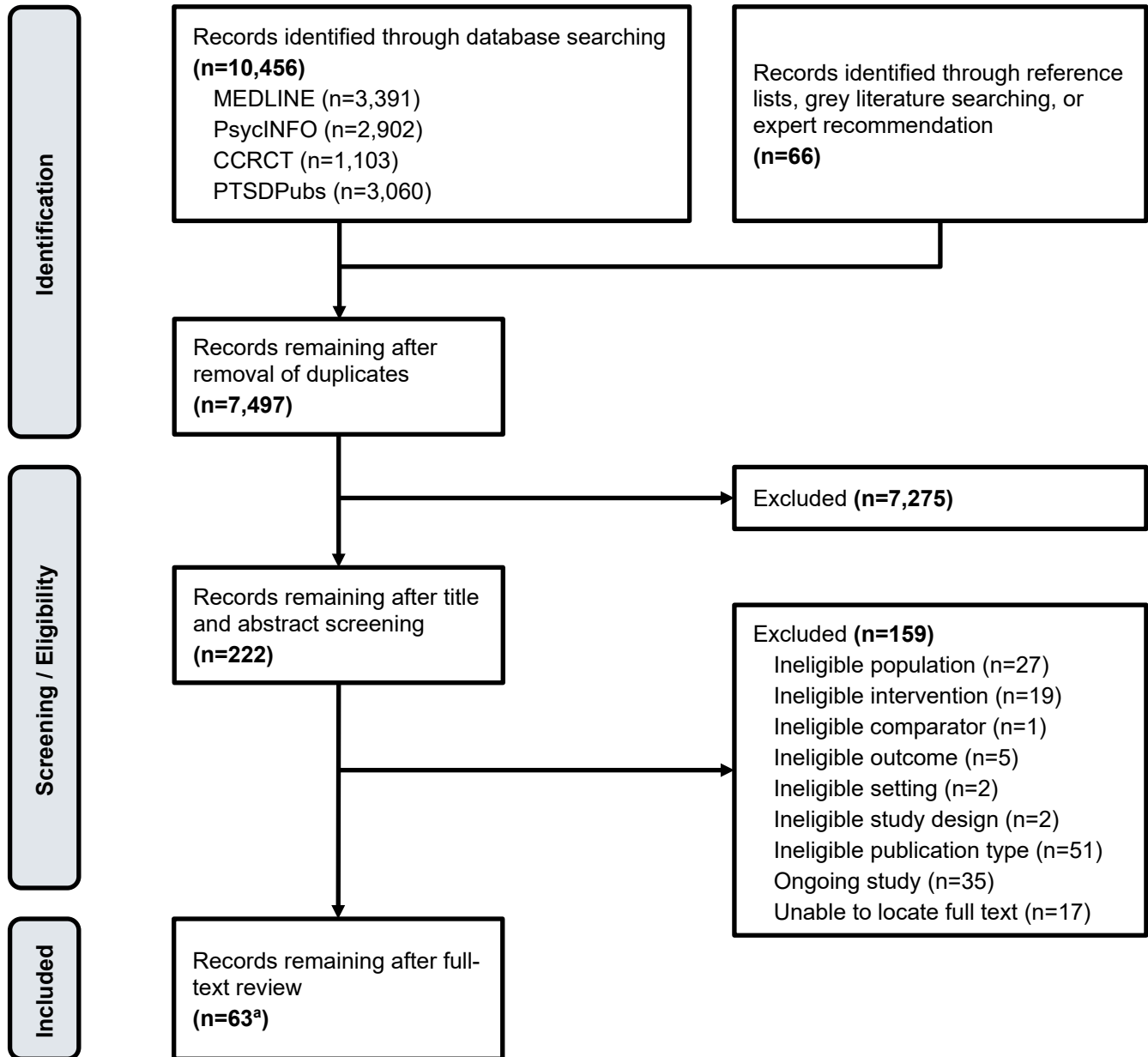
Strength of Evidence

After synthesizing available evidence, we rated the strength of evidence based on the methodology and risk of bias of available studies, the consistency and certainty of findings, and the directness of outcomes (whether reported outcomes are relevant to patients and providers).³⁵ For this review, we applied the following general algorithm: *high strength* evidence consisted of multiple trials with low risk of bias, consistent and precise findings, and clinically relevant outcomes; *moderate strength* evidence consisted of multiple trials with low to unclear risk of bias, consistent and precise findings, and clinically relevant outcomes; *low strength* evidence consisted of a single trial, or multiple small trials, with unclear to high risk of bias, inconsistent or imprecise findings, and/or outcomes with limited clinical relevance; and *insufficient* evidence consisted of a single trial with unclear or high risk of bias.

RESULTS

LITERATURE FLOW DIAGRAM

The literature flow diagram summarizes the results of the study selection process. A full list of excluded studies is provided in the [Appendix](#).



Notes. ^a 60 primary studies in 63 records.

Abbreviations. CCRCT=Cochrane Central Register of Controlled Trials.

OVERVIEW OF INCLUDED STUDIES

Our search identified 222 potentially relevant articles after deduplication and title and abstract screening. We included 60 primary studies (in 63 publications) meeting eligibility criteria: 36 RCTs, 1 non-randomized trial, 1 cohort study, and 22 pre-post studies. We prioritized evidence from comparative studies, and did not include pre-post studies in our synthesis, except for pre-post studies on family members/caregivers, where few comparative studies were available. Characteristics of prioritized studies are shown in Table 1. We identified 35 underway studies (see [Appendix](#)).

PTSD Studies

Of the studies prioritized for synthesis (N = 36), 34 were RCTs,³⁶⁻⁶⁹ 1 was a non-randomized trial,⁷⁰ and 1 was a cohort study.⁷¹ Most were conducted in the US (N = 22), with the remaining studies conducted in Sweden (N = 4), the Netherlands (N = 3), Australia (N = 3), Canada (N = 1), Germany (N = 1), and the UK (N = 2). Sample sizes ranged from 20-196 (median = 63). Two-thirds of the studies had predominately female samples. Of the studies that reported on race or ethnicity (N = 23), all but 3^{48,59,60} had predominately White samples. Thirteen studies^{36,42,44,51,54,55,58-61,65-67} were conducted with US Veterans or military Service members. Among these, 10 studies^{36,42,51,54,55,59,61,65-67} were conducted exclusively among Veterans and 7^{36,51,55,59,65-67} were conducted exclusively among Veterans enrolled in Veterans Health Administration (VHA) care or recruited from VHA health care settings. The proportion of study participants meeting criteria for a PTSD diagnosis or probable/provisional PTSD diagnosis was 100% in 21 studies, between 75-99% in 5 studies, and between 48-74% in 8 studies (exact proportions were not reported for 2 studies). PTSD diagnostic status was determined by a structured clinical interview using the gold standard Clinician-Administered PTSD Scale (CAPS) in 9 studies. Most studies used a version of the PTSD Checklist (PCL) to establish a provisional PTSD diagnosis, with cut-off scores varying across studies. Other measures used included the Mini International Neuropsychiatric Interview (MINI), the Posttraumatic Symptom Scale (interview or self-report version; PSS-I or PSS-SR), and the revised Impact of Events Scale (IES-R).

Most studies (N = 30) evaluated internet interventions, 5 studies^{47,52,61,62,66} evaluated mobile app interventions, and a single study³⁹ evaluated a text messaging (SMS) intervention. Most interventions were CBT-based (N = 32), and 18 studies specifically evaluated a trauma-focused CBT. Among civilian studies, 14 evaluated a trauma-focused CBT; among military studies, 4 studies tested a trauma-focused CBT. In the military trials, trauma-focused CBT interventions were either based on prolonged exposure (PE)^{60,61} or written exposure.^{51,65} Other interventions were based on executive function training (N = 3)^{42,45,54} or goal setting (N = 1).⁵⁹ Over half of studies (21) investigated long-duration interventions (6 or more weeks); moderate-duration interventions (2-5 weeks) were examined in 6 studies and brief interventions (1 week or less or a single session) in 5 studies. Interventions used a self-guided timeline in 4 studies. Fifteen studies evaluated interventions that included provider guidance and/or feedback, and 6 studies evaluated interventions with some direct facilitation (*ie*, delivery of intervention content) by a provider. The remaining studies (N = 15) evaluated self-guided interventions with no provider involvement other than reminders and/or technical support. Provider involvement was primarily asynchronous in 8 studies, primarily synchronous in 5 studies, and a combination of both in 7 studies.

Nineteen studies compared an intervention to an alternative intervention. For example, an intervention may have been compared to the same intervention without 1 or more components (*eg*, with and without therapist guidance) or to psychoeducation. Two studies^{41,60} compared the intervention to

synchronous in-person therapy. Other comparators included a waitlist (N = 13), treatment as usual (TAU; N = 3), and minimal contact (*ie*, phone monitoring or assessments only; N = 2).

PTSD symptom severity was most often assessed with a version of the PCL (PCL-M, N = 5; PCL-C, N = 5; PCL-5, N = 14; PCL-S, N = 1). Other measures used included the CAPS-5 (N = 4), PDS (N = 2), IES/IES-R (N = 7), PC-PTSD (N = 1), PSS-SR (N = 1), PSS-I (N = 3), and TES (N = 1). In addition to symptom severity, 10 studies reported on clinically significant improvement, 10 studies reported on remission, recovery, or no longer meeting PTSD criteria, and 6 studies reported on reliable improvement or change. Other mental health outcomes reported by more than 1 study included depression (N = 23), generalized anxiety (N = 16), alcohol use (N = 6), somatic symptoms (N = 3), and psychological distress (N = 2). Drug use, stress, panic disorder symptoms, social phobia/social anxiety symptoms, anger, and moral injury-related distress were each reported by a single study. Quality of life outcomes were reported by 10 studies, and 8 studies reported outcomes related to functioning.

Common methodological limitations of RCTs were small sample sizes, low treatment adherence, limited information on randomization and co-interventions, lack of blinding of participants and outcome assessors, and analyses that did not include all randomized participants. Common methodological limitations of non-randomized studies were low treatment adherence, a high degree of missing data, lack of information on co-interventions, and use of analyses that do not account for potential confounders.

Family Member/Caregiver Studies

Among studies evaluating interventions for family members or caregivers of adults with PTSD (Key Question 2; N = 5), 2 were RCTs^{72,73} and 3 were pre-post studies.⁷⁴⁻⁷⁶ Four of these studies were conducted among spouses or intimate partners and 1⁷³ was conducted among family members. All studies were conducted among intimate partners/family members of Veterans, military service members, or first responders. Four studies were conducted in the US, and 1 was conducted in Canada. Sample sizes ranged from 12-200 (median = 27). All studies had entirely or predominately female samples. Among the 4 studies that reported on race or ethnicity, all had predominately White samples. Three studies required that the patient with PTSD screen positive for probable PTSD using a self-report measure.

Four studies evaluated internet interventions, and 1 study⁷³ evaluated an app-based intervention. One RCT⁷² and 1 pre-post study⁷⁵ evaluated VA-CRAFT, an internet intervention that includes safety planning and psychoeducation on PTSD symptoms, self-care, communication skills, and supporting the Veteran in considering treatment options and while engaged in care. The RCT compared the intervention with a minimal contact control (*ie*, reminders only), and the pre-post study evaluated VA-CRAFT with additional coaching. Two pre-post studies^{74,76} evaluated Couple HOPES, a cognitive behavioral conjoint treatment that includes psychoeducation, communication skills training, and dyadic interventions to address behavioral avoidance, emotional numbing, and cognitions that underlie PTSD and relationship problems. Both studies included coaching. The final study⁷³ was an RCT comparing a group with access to PTSD Family Coach, an app that includes psychoeducation, stress management tools, self-assessments, and information on connecting to additional resources, to a psychoeducation-only app.

VA-CRAFT and Couple HOPES were categorized as long interventions, and PTSD Family Coach was completed on a self-guided timeline. Two studies^{72,73} (PTSD Family Coach and the VA-CRAFT RCT) evaluated self-guided interventions with no provider involvement other than reminders or technical

support. The remaining 3 studies evaluated interventions that included provider guidance and/or feedback. In 1 of these studies⁷⁵ the provider involvement was primarily synchronous, and the other 2 studies^{74,76} included a combination of synchronous and asynchronous provider involvement. Relevant outcomes assessed included depression symptoms (N = 4), anxiety symptoms (N = 3), caregiver burden (N = 3), and quality of life (N = 3).

Like studies of adults with PTSD, common methodological limitations of RCTs evaluating interventions for family members or caregivers of adults with PTSD included small sample sizes, low treatment adherence, lack of information on the randomization process, high rates of missing data, and lack of intent-to-treat analyses. Pre-post studies were limited by low treatment adherence, lack of accounting for potential confounders in analyses, lack of information on co-interventions, and high levels of missing data.

Table 1. Characteristics of Included Studies

Study	Sample Size Follow-Up	Study Design	Population % Probable PTSD	Intervention Characteristics Modality	Comparator	Outcomes Assessed
<i>PTSD studies</i>						
Acosta 2017 ³⁶	N=162 3 mos	RCT	OEF/OIF/OND Veterans with hazardous alcohol use or substance misuse 79%	Self-guided iCBT <i>Internet</i>	TAU	PTSD symptom severity, PTSD treatment response, alcohol use, drug use, quality of life
Allen 2022 ³⁷	N=49 3 mos	RCT	Adults 100%	Guided iCBT <i>Internet</i>	Waitlist	PTSD symptom severity, PTSD remission, psychological distress, depression, anxiety
Andersson 2021 ³⁸	N=64 40 wks	RCT	Adults with prior IPV and current at least moderate mental health problems 57.1%	Guided iCBT <i>Internet</i>	Waitlist	PTSD symptom severity, PTSD treatment response, PTSD remission, depression, anxiety, quality of life
Bedard-Gilligan 2022 ³⁹	N=109 8 wks	RCT	Adults reporting heavy episodic drinking 100%	CBT + framing SMS	Kind attention messages	PTSD symptom severity, alcohol use, anxiety, depression
Bedford 2023 ⁴⁰	N=71 1 mo	RCT	University students and community members NR	Safety Behavior Elimination for Traumatic Stress <i>Internet</i>	Modifiable Behavior Intervention	PTSD symptom severity
Bisson 2022 ⁴¹	N=196 44 wks	RCT	Adults 100%	Guided trauma-focused iCBT <i>Internet</i>	In-person trauma-focused CBT	PTSD symptom severity, PTSD remission, depression, anxiety, alcohol use, quality of life, functional impairment
Clausen 2019 ⁴²	N=21 PT	RCT	Male combat Veterans who served since OIF 60%	Executive function training <i>Internet</i>	Placebo training	PTSD symptom severity, depression
de Kleine 2019 ⁴³	N=107 6 mos	RCT	Adults with a history of IPV 100%	Self-guided cognitive bias modification training <i>Internet</i>	Placebo training	PTSD symptom severity, depression

Study	Sample Size Follow-Up	Study Design	Population % Probable PTSD	Intervention Characteristics Modality	Comparator	Outcomes Assessed
Engel 2015 ⁴⁴	N=80 18 wks	RCT	Recently deployed military Service members and Veterans 100%	Nurse-guided iCBT (DESTRESS) Internet	TAU	PTSD symptom severity, depression, anxiety, somatic symptoms, functioning
Fonzo 2019 ⁴⁵	N=84 PT	RCT	Adults 94%	Cognitive/affective remediation training Internet	Placebo training	PTSD symptom severity
Gawlytta 2022 ⁴⁶	N=25 12 mos	RCT	Patients after intensive care for sepsis and their spouses 73.5%	Guided iCBT Internet	Waitlist	PTSD symptom severity, PTSD treatment response, PTSD remission, psychological distress, health-related quality of life
Hensler 2022 ^{47,77}	N=179 PT	RCT	Adults 55.3%	PTSD Coach App	Waitlist	PTSD symptom severity, PTSD treatment response, PTSD remission, depression, somatic symptoms, functional disability
Hirai 2020 ⁴⁸	N=149 3 mos	RCT	Undergraduate students 56.3%	Emotion-focused expressive writing intervention Internet	Fact-focused expressive writing intervention	PTSD symptom severity, PTSD remission
Ivarsson 2014 ⁴⁹	N=62 1 yr	RCT	Adults 100%	Guided iCBT Internet	Waitlist	PTSD symptom severity, PTSD treatment response, PTSD remission, depression, anxiety, quality of life
Knaevelsrud 2007 ⁵⁰	N=96 3 mos	RCT	Adults 70%	Guided iCBT (Interapy) Internet	Waitlist	PTSD symptom severity, depression, anxiety, functioning
Krupnick 2017 ⁵¹	N=34 12 wks	RCT	OIF/OEF/OND Veterans 100%	Guided trauma-focused iCBT writing intervention (WIRED) Internet	TAU	PTSD symptom severity, depression, alcohol abuse
Kuhn 2017 ⁵²	N=120 3 mos	RCT	Adults 92.5%	PTSD Coach App	Waitlist	PTSD symptom severity, PTSD treatment response, depression, psychosocial functioning

Study	Sample Size Follow-Up	Study Design	Population % Probable PTSD	Intervention Characteristics Modality	Comparator	Outcomes Assessed
Lange 2003 ⁵³	N=184 6 wks	RCT	Adults 90%	Guided iCBT (Interapy) <i>Internet</i>	Waitlist	PTSD symptom severity, PTSD treatment response, depression, anxiety, somatic symptoms
Larsen 2019 ⁵⁴	N=29 1 mo	RCT	Veterans 100%	Active emotional working memory training <i>Internet</i>	Placebo training	PTSD symptom severity, PTSD treatment response, depression, anxiety, stress, negative affect
Lehavot 2021 ⁵⁵	N=102 6 mos	RCT	Women Veterans 100%	Guided iCBT (DESTRESS) <i>Internet</i>	Phone monitoring	PTSD symptom severity, PTSD treatment response
Lewis 2017 ⁵⁶	N=42 3 mos	RCT	Adults 100%	Guided trauma-focused iCBT <i>Internet</i>	Waitlist	PTSD symptom severity, depression, anxiety, alcohol use, functional impairment
Littleton 2016 ⁵⁷	N=87 3 mos	RCT	Women college students with rape-related PTSD 100%	Guided iCBT (From Survivor to Thriver) <i>Internet</i>	Access to psychoeducation website	PTSD symptom severity, depression, anxiety
Litz 2007 ⁵⁸	N=45 4 mos	RCT	Service members 100%	Guided iCBT (DESTRESS) <i>Internet</i>	Supportive counseling	PTSD symptom severity, depression, anxiety
McCall 2023 ⁷⁰	N=163 8 wks	NRT	Public safety personnel <i>NR</i>	Guided iCBT <i>Internet</i>	Wellbeing course	PTSD symptom severity, PTSD treatment response, depression, anxiety, panic symptoms, social phobia symptoms, anger
McGuire 2023 ⁵⁹	N=48 <i>PT</i>	RCT	Veterans of Iraq or Afghanistan 100%	Self-guided goal setting intervention (MOVED) <i>Internet</i>	Online assessments only	PTSD symptom severity, moral injury-related distress, quality of life
McLean 2021 ⁶⁰	N=40 6 mos	RCT	Active-duty Service members and Veterans 100%	Prolonged exposure <i>Internet</i>	In-person present-centered therapy	PTSD symptom severity, depression, functioning
McLean 2022 ⁶¹	N=93 6 wks	RCT	Veterans 100%	Self-management app (Renew) <i>App</i>	Waitlist	PTSD symptom severity

Study	Sample Size Follow-Up	Study Design	Population % Probable PTSD	Intervention Characteristics Modality	Comparator	Outcomes Assessed
Miner 2016 ⁶²	N=49 1 mo	RCT	Adults 100%	PTSD Coach App	Waitlist	PTSD symptom severity, PTSD treatment response
Morabito 2023 ⁶³	N=51 1 mo	RCT	University students and community members 100%	Tonic immobility-focused psychoeducation Internet	Health education only	PTSD symptom severity
Nieminen 2016 ⁶⁴	N=56 PT	RCT	Women with traumatic childbirth 100%	Guided trauma-focused iCBT Internet	Waitlist	PTSD symptom severity, depression, anxiety, quality of life
Possemato 2011⁶⁵	N=31 PT	RCT	Veteran primary care patients 48.4%	Self-guided written emotional disclosure Internet	Time management narratives	PTSD symptom severity, quality of life
Possemato 2016⁶⁶	N=20 PT	RCT	Veteran primary care patients 100%	Clinician-supported PTSD Coach App	Self-managed PTSD Coach	PTSD symptom severity, PTSD treatment response, depression, quality of life
Possemato 2019⁶⁷	N=30 12 wks	RCT	Veteran primary care patients with hazardous alcohol use 60%	Peer-supported iCBT Internet	Self-managed iCBT	PTSD symptom severity, alcohol use, quality of life
Spence 2011 ⁶⁸	N=44 PT	RCT	Adults 100%	Guided iCBT Internet	Waitlist	PTSD symptom severity, PTSD remission, depression, anxiety, psychosocial functioning
Spence 2014 ⁶⁹	N=125 3 mos	RCT	Adults 86%	Guided iCBT with exposure Internet	iCBT without exposure	PTSD symptom severity, PTSD remission, depression, anxiety
Wiltsey Stirman 2021 ⁷¹	N=51 PT	Cohort	Adults 100%	Cognitive Processing Therapy Internet	Talkspace as usual (propensity score-matched)	PTSD symptom severity, PTSD treatment response
<i>Family member/caregiver studies</i>						
Crenshaw 2023⁷⁴	N=27 1 mo	Pre-post	Romantic partners of military members,	Guided cognitive-behavioral conjoint	NA	Depression, anxiety, anger, alcohol misuse, quality of life, functioning

Study	Sample Size Follow-Up	Study Design	Population % <i>Probable PTSD</i>	Intervention Characteristics Modality	Comparator	Outcomes Assessed
			Veterans, and first responders with PTSD NA	treatment (Couple HOPES) <i>Internet</i>		
Erbes 2020 ⁷²	N=46 <i>PT</i>	RCT	Spouses or intimate partners of Veterans with PTSD NA	Self-guided family outreach training (VA-CRAFT) <i>Internet</i>	NA	Caregiver burden, general mental health symptoms and distress, quality of life
Kuhn 2023 ⁷⁵	N=12 <i>PT</i>	Pre-post	Spouses and intimate partners of Veterans with PTSD NA	Coach-guided family outreach training (VA-CRAFT) <i>Internet</i>	NA	Depression, anxiety, caregiver burden
Morland 2023 ⁷⁶	N=15 <i>PT</i>	Pre-post	Romantic partners of Veterans with PTSD NA	Guided cognitive-behavioral conjoint treatment (Couple HOPES) <i>Internet</i>	NA	Depression, quality of life
van Stolk-Cooke 2023 ⁷³	N=200 <i>PT</i>	RCT	Adult family members of veterans with PTSD NA	PTSD Family Coach <i>App</i>	Psychoeducation -only app	Caregiver burden, stress, depression, anxiety, self-efficacy

Notes. **Bold** font indicates studies conducted among Veterans and/or military service members .

Abbreviations. CBT=cognitive behavioral therapy; DESTRESS=Delivery of Self Training and Education for Stressful Situations; HOPES=Helping Overcome PTSD and Enhance Satisfaction; iCBT=internet-based cognitive behavioral therapy; IPV=interpersonal violence; MOVED= Moral Elevation Online Intervention for Veterans Experiencing Distress Related to PTSD and Moral Injury; NA=not applicable; NR=not reported; NRT=non-randomized trial; OEF=Operation Enduring Freedom; OIF=Operation Iraqi Freedom; OND=Operation New Dawn; PT=posttreatment; PTSD=posttraumatic stress disorder; RCT=randomized controlled trial; SMS=short messaging service; TAU=treatment as usual; VA-CRAFT=Veterans Affairs—Community Reinforcement and Family Training; WIRED=Warriors Internet Recovery & Education.

KEY QUESTION 1: INTERNET AND MOBILE INTERVENTIONS FOR ADULTS WITH PTSD

PTSD Outcomes

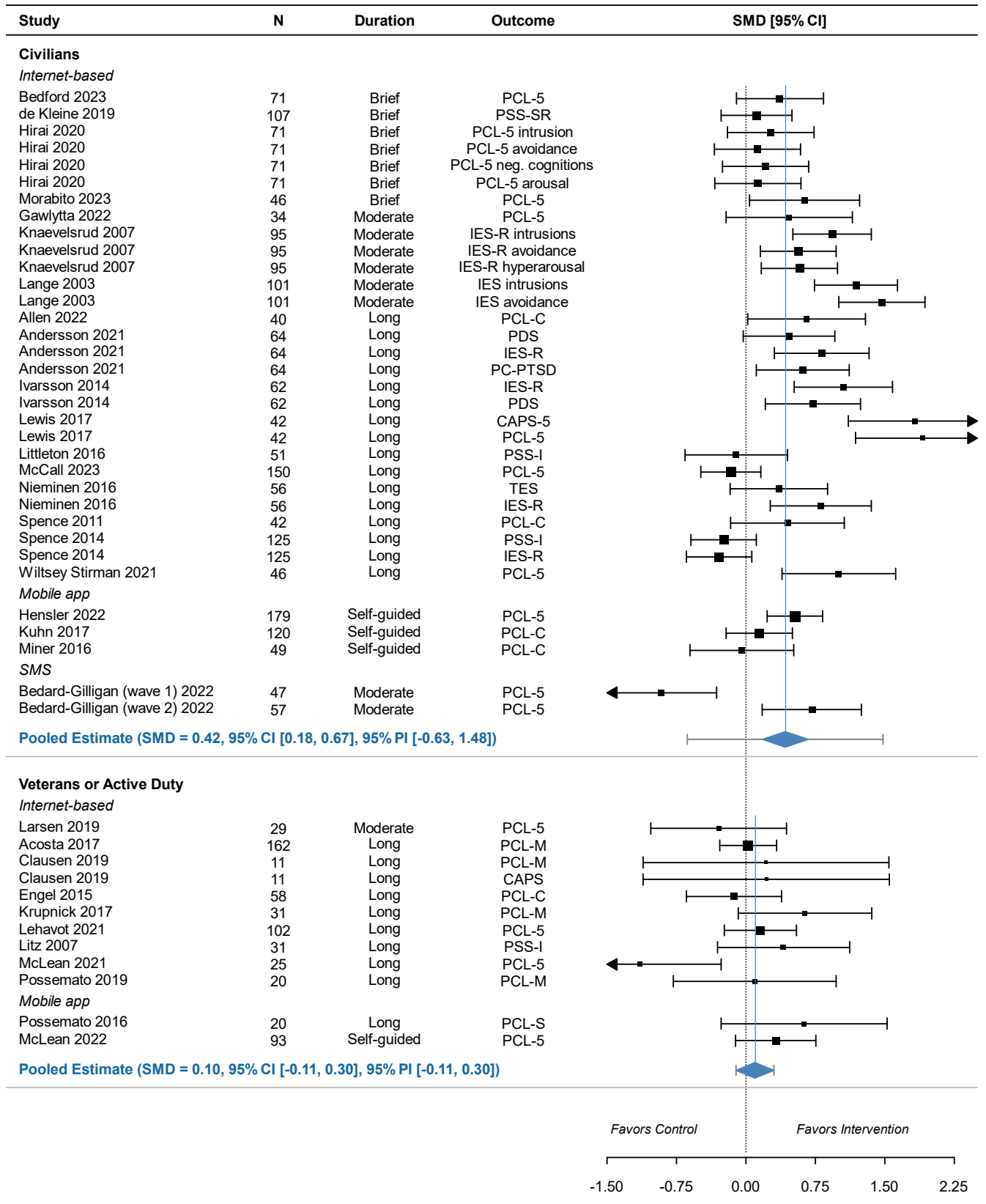
Thirty-two studies^{36–40,42–44,46–58,60–64,66–71} assessed the effectiveness of internet or mobile interventions on PTSD symptoms immediately post-treatment (31 RCTs, 1 cohort; total $N = 2,237$). Of these, 21 studies were conducted in civilian populations (total $N = 1,655$) and 11 in military populations (Veterans or active-duty service members; total $N = 582$). Among civilians, internet or mobile interventions may result in moderate post-treatment improvements in PTSD symptom severity (SMD = 0.42, 95% CI [0.18, 0.67]; number of effect sizes [N_{es}] = 34). However, intervention effects among military populations may be small to negligible (SMD = 0.10, 95% CI [-0.11, 0.30]; $N_{es} = 12$). For both populations, we have low confidence in findings (low SOE) because of study methodological limitations and moderate inconsistency in effects across studies.

Eighteen RCTs^{36,39–41,43,44,48,51,54–58,60,63,65,67,69} reported PTSD symptom severity outcomes at short-term follow up (1-3 months; total $N = 1,228$). Nine of these studies were carried out in military populations (total $N = 470$). Among civilians, overall improvement in PTSD symptom severity was smaller and no longer statistically significant compared with immediately post-treatment (SMD = 0.24, 95% CI [-0.18, 0.65]; $N_{es} = 20$). Intervention effects remained small to negligible for Veterans or active-duty service members (SMD = 0.10, 95% CI [-0.13, 0.33]; $N_{es} = 11$). Five RCTs^{41,43,55,58,60} (total $N = 388$) also reported outcomes at long-term follow up (4 to 11 months), and when pooled, no intervention effect on PTSD symptom severity was apparent (SMD = -0.06, 95% CI [-0.45, 0.33]; $N_{es} = 6$). This result includes evidence from both civilian and military populations because of the small number of studies. Based on this evidence, internet or mobile interventions may have no effect on PTSD symptom severity among civilian or military populations at 1-3 months or 4+ months after treatment. We have low confidence in these findings based on study methodological limitations, imprecision, and moderate inconsistency.

Comparatively few trials reported on the proportion of participants with clinically meaningful PTSD symptom improvement, reliable change, or recovery/remission after the intervention (ranging from 6 to 13 trials per outcome). Results could be disaggregated by military or civilian status only for clinically meaningful PTSD symptom improvement. Based on available evidence, internet and mobile interventions may increase odds of clinically meaningful PTSD symptom improvement post-treatment among civilian but not military populations. Interventions may improve odds of recovery, remission, or no longer meeting diagnostic criteria and reliable symptom improvement or change, but it is unclear whether this benefit differs between civilian and military populations. Our confidence in these findings is low based on study methodological limitations, imprecision, and substantial inconsistency.

Compared with control participants, civilian participants receiving the intervention had greater odds of clinically meaningful PTSD symptom improvement post-treatment (OR = 1.97, 95% CI [0.80, 4.83]; $k = 6$, $N_{es} = 7$), though this difference was nonsignificant. Odds of clinically meaningful improvement also favored the intervention among Veterans or active-duty service members (OR = 1.36, 95% CI [0.52, 3.58]; $k = 4$, $N_{es} = 7$), but the difference was much smaller in magnitude compared with civilians and also nonsignificant. Not accounting for military or civilian status, participants who received the intervention also had significantly greater odds of recovery, remission, or no longer meeting diagnostic criteria (OR = 2.27, 95% CI [1.24, 4.17]; $k = 13$, $N_{es} = 13$) and reliable symptom improvement or change (OR = 3.92, 95% CI [1.46, 10.54]; $k = 6$, $N_{es} = 8$).

Figure 1. Differences in PTSD Symptoms Immediately Post-Treatment



Abbreviations. CAPS=Clinician-Administered PTSD Scale; CAPS-5=Clinician-Administered PTSD Scale for DSM-5; CI=confidence interval; IES=Impact of Events Scale; IES-R=Impact of Events Scale – Revised; PCL-5=PTSD Checklist for DSM-V; PCL-C=PTSD Checklist – Civilian version; PCL-M=PTSD Checklist – Military version; PCL-S=PTSD Checklist – Specific version; PDS=Posttraumatic Stress Diagnostic Scale; PI=prediction interval; PSS-I=Posttraumatic Stress Symptom Scale – Interview version; PSS-SR=Posttraumatic Symptom Scale – Self-report; SMD=standardized mean difference; TES=Traumatic Event Scale.

Depression Outcomes

Intervention effects on depression symptoms followed a similar pattern to effects on PTSD symptoms. Twenty trials^{37–39,42–44,47,49–54,56–58,64,66,69,70} evaluated the effectiveness of internet or mobile interventions on depression symptoms immediately post-treatment (19 RCTs, 1 NRT; total $N = 1,458$). Of these, 6 trials were conducted in military populations (total $N = 171$). Based on this evidence, internet and mobile interventions may result in small post-treatment improvements in depression symptoms among civilians (SMD = 0.28, 95% CI [0.04, 0.53]; $N_{es} = 17$), but may not result in post-treatment symptom improvements among Veterans or active-duty service members (SMD = -0.03, 95% CI [-0.36, 0.30]; $N_{es} = 6$). Based on 11 studies,^{39,41,43,44,51,54,56–58,69} internet and mobile interventions may have no effect on depression symptom severity 1-3 months after treatment among both civilians (SMD = 0.07, 95% CI [-0.41, 0.55]; $k = 7$, $N_{es} = 7$) and military populations (SMD = -0.11, 95% CI [-0.41, 0.20]; $k = 4$, $N_{es} = 5$). We have low confidence in findings on depression outcomes due to study methodological limitations and inconsistency in effects across studies.

Variation in Intervention Effects

Results of subgroup analyses based on intervention and methodological characteristics are shown in Table 2. These results are informative about potential sources of variation in intervention effects on PTSD and depression symptom severity but should be interpreted with caution because they are based on all available evidence regardless of time point and military or civilian status. Results of moderation analyses were not considered in overall conclusions about intervention effectiveness or strength of evidence judgments.

Subgroup analyses suggest that a potential source of variability in intervention effectiveness is delivery modality. As shown in Table 2, comparable-magnitude improvements in PTSD symptoms were observed for both internet interventions and mobile interventions. In contrast, the overall effect for SMS-based interventions was negligible or potentially negative based on results from a single trial of 2 independent cohorts.³⁹ Another apparent source of variability in effects is the level of facilitation. Interventions that used direct facilitation appeared to have the largest effect on PTSD symptoms. Interventions with guidance or feedback only had a somewhat smaller overall effect, while the pooled effect estimate for interventions that offered no facilitation (*ie*, reminders or technical support only) was small to negligible. Intervention effects did not appear to differ based on intervention duration (brief, moderate, long, or self-guided timeline) or whether the intervention incorporated written exposure elements.

Regarding study methodological characteristics, observed intervention effects were similar regardless of whether a clinician-administered or self-reported outcome measure was used (Table 2). Observed effects strongly favored interventions when compared with a completely inactive condition like waitlist control. Effects were considerably smaller against another active treatment condition (excluding in-person therapy). As noted above, 2 studies^{41,60} compared an internet treatment to an evidence-based in-person therapy. One of these was a large RCT⁴¹ ($N = 139$) that compared iCBT to face-to-face CBT among civilians in the United Kingdom (UK) National Health Services, finding that the internet

intervention was non-inferior on PTSD outcomes at post-treatment.⁴¹ The second study⁶⁰ was a small feasibility study (N = 40) on treatment-seeking military service members and Veterans that found no difference in post-treatment PTSD symptoms between web-based PE and face-to-face present-centered therapy.

Table 2. Subgroup Analysis Results for PTSD and Depression Symptom Severity

	PTSD SMD [95% CI]	Depression SMD [95% CI]
Modality		
Internet	0.34 [0.14, 0.54] (<i>k</i> = 28, <i>N_{es}</i> = 74)	0.22 [0.02, 0.42] (<i>k</i> = 18, <i>N_{es}</i> = 32)
App	0.31 [-0.06, 0.68] (<i>k</i> = 5, <i>N_{es}</i> = 5)	0.33 [-0.78, 1.44] (<i>k</i> = 2, <i>N_{es}</i> = 2)
SMS/text message	-0.12 [-9.88, 9.64] (<i>k</i> = 1, <i>N_{es}</i> = 4) ^a	-0.24 [-8.99, 8.50] (<i>k</i> = 1, <i>N_{es}</i> = 4) ^a
Facilitator Involvement^b		
Direct facilitation	0.60 [-0.12, 1.32] (<i>k</i> = 6, <i>N_{es}</i> = 15)	0.31 [-0.58, 1.20] (<i>k</i> = 4, <i>N_{es}</i> = 8)
Minimal support	0.35 [0.02, 0.67] (<i>k</i> = 14, <i>N_{es}</i> = 30)	0.26 [-0.03, 0.55] (<i>k</i> = 10, <i>N_{es}</i> = 15)
None (reminders or technical support only)	0.18 [-0.04, 0.40] (<i>k</i> = 13, <i>N_{es}</i> = 37) ^a	0.05 [-0.35, 0.44] (<i>k</i> = 7, <i>N_{es}</i> = 15) ^a
Duration		
Brief	0.33 [-0.05, 0.71] (<i>k</i> = 5, <i>N_{es}</i> = 20)	0.27 [0.01, 0.54] (<i>k</i> = 1, <i>N_{es}</i> = 3)
Moderate	0.37 [-0.44, 1.17] (<i>k</i> = 5, <i>N_{es}</i> = 12) ^a	0.19 [-0.76, 1.13] (<i>k</i> = 4, <i>N_{es}</i> = 8) ^a
Long	0.29 [0.04, 0.55] (<i>k</i> = 20, <i>N_{es}</i> = 47)	0.14 [-0.06, 0.35] (<i>k</i> = 14, <i>N_{es}</i> = 25)
Self-guided timeline	0.29 [-0.14, 0.72] (<i>k</i> = 4, <i>N_{es}</i> = 4)	0.33 [-0.78, 1.44] (<i>k</i> = 2, <i>N_{es}</i> = 2)
Written Exposure		
CBT + written exposure	0.39 [0.05, 0.73] (<i>k</i> = 13, <i>N_{es}</i> = 38)	0.26 [-0.09, 0.62] (<i>k</i> = 8, <i>N_{es}</i> = 12)
CBT only	0.28 [0.06, 0.51] (<i>k</i> = 19, <i>N_{es}</i> = 41) ^a	0.18 [-0.11, 0.46] (<i>k</i> = 11, <i>N_{es}</i> = 23) ^a
Outcome Assessment		
Clinician-administered	0.24 [-0.40, 0.88] (<i>k</i> = 6, <i>N_{es}</i> = 12)	—
Self-reported	0.31 [0.13, 0.49] (<i>k</i> = 32, <i>N_{es}</i> = 71) ^a	—
Comparison Condition		
Active Control	0.18 [-0.13, 0.50] (<i>k</i> = 11, <i>N_{es}</i> = 33) ^a	0.03 [-0.47, 0.53] (<i>k</i> = 6, <i>N_{es}</i> = 14) ^a
In-person therapy	-0.48 [-5.67, 4.71] (<i>k</i> = 2, <i>N_{es}</i> = 7)	-0.12 [-0.52, 0.29] (<i>k</i> = 1, <i>N_{es}</i> = 2)
Minimal contact	0.15 [-0.53, 0.83] (<i>k</i> = 1, <i>N_{es}</i> = 3)	—
No exposure	-0.24 [-0.26, -0.22] (<i>k</i> = 1, <i>N_{es}</i> = 4)	0.05 [0.03, 0.06] (<i>k</i> = 1, <i>N_{es}</i> = 2)
No guidance	0.30 [-2.96, 3.57] (<i>k</i> = 2, <i>N_{es}</i> = 3)	-0.10 [-0.97, 0.78] (<i>k</i> = 1, <i>N_{es}</i> = 1) ^c
Psychoeducation	0.58 [0.44, 0.72] (<i>k</i> = 1, <i>N_{es}</i> = 2)	-0.27 [-0.50, -0.04] (<i>k</i> = 1, <i>N_{es}</i> = 2)
Treatment as usual	0.15 [-0.61, 0.90] (<i>k</i> = 3, <i>N_{es}</i> = 8)	-0.16 [-1.18, 0.86] (<i>k</i> = 2, <i>N_{es}</i> = 5)
Waitlist	0.63 [0.36, 0.88] (<i>k</i> = 13, <i>N_{es}</i> = 23)	0.50 [0.27, 0.72] (<i>k</i> = 9, <i>N_{es}</i> = 12)

Notes. ^a Bedard-Gilligan 2022 reports results for 2 independent waves. ^b McLean 2022 (*N* = 93) combined 2 active conditions into a treatment group and is not included in subgroup analysis. ^c Reported SMD (*d*) and estimated 95% CI from single trial with *no guidance* comparison condition (Possemato 2016).

Abbreviations. *N_{es}*=number of effect sizes included in analysis; SMD=standardized mean difference (*g*).

Other Outcomes

Other outcomes of interest reported on by more than 1 study included generalized anxiety symptom severity, alcohol use, psychological distress, somatic symptoms, quality of life, and functioning. We did not conduct a meta-analysis or assess strength of evidence for these outcomes, but, overall, findings were mixed across studies.

Fifteen studies^{37–39,41,44,49,50,54,56–58,64,68–70} reported on anxiety symptom severity (Table 3). Of these, 12 studies were conducted among civilian populations and 3 with Veteran or military populations. No studies were conducted exclusively among Veterans receiving VHA care. Among the civilian studies, 1 trial⁴¹ that compared iCBT to face-to-face CBT found that improvements in generalized anxiety symptoms in the iCBT group were non-inferior to the face-to-face CBT group. Four other civilian trials that compared iCBT to a waitlist condition found significant improvements on anxiety severity at post-treatment favoring iCBT.^{49,50,56,68} The 3 trials conducted with Veterans and/or military service members found non-significant improvements on anxiety severity at posttreatment relative to an active comparator.^{44,54,58}

Five RCTs^{36,39,41,51,56,67} reported on alcohol use/misuse outcomes (Table 4). Three of these studies^{36,39,67} evaluated interventions that targeted alcohol misuse in addition to PTSD and required that participants endorse alcohol misuse. Three studies were conducted among Veterans receiving VHA care; the remaining 2 studies were conducted among civilians. Outcomes varied and results were mixed across trials and were not consistent across comparator types.

Two RCTs^{37,46} conducted among civilians reported on psychological distress; neither found that CBT-based internet interventions for PTSD improved psychological distress symptoms at post-treatment compared to waitlist. Three RCTs reported on somatic symptoms; 2 evaluated internet interventions^{44,53} and 1 evaluated an app-based intervention.⁴⁷ One RCT⁵³ conducted among civilians comparing an internet intervention to waitlist found a large effect at post-treatment, but the study was rated high risk of bias. The other 2 studies, including 1 study⁴⁴ conducted among Veterans and military service members, did not find evidence of an effect on somatic symptom severity.

Ten RCTs^{36,38,41,46,49,59,64–67} reported on quality-of-life outcomes (Table 5). Five of these studies were conducted among Veterans receiving VHA care; the remaining 5 studies were conducted among civilians. Results were mixed across trials and were not consistent across comparator types.

Eight RCTs^{41,44,47,50,52,56,60,68} reported on outcomes related to functioning (Table 6). Two studies were conducted among Veterans and military service members; the remaining studies were conducted among civilians. Results were mixed across trials and were not consistent across comparator types. Five trials conducted among civilians reported some positive effect of internet or mobile interventions for PTSD on functioning, but neither trial conducted among Veterans and military service members found a significant effect of the intervention on functioning outcomes.

Table 3. Effects of Internet and Mobile Interventions for PTSD on Anxiety Symptom Severity

Study Follow-Up	N	Intervention and Comparator	Anxiety Outcomes
<i>Internet interventions</i>			
Allen 2022 ³⁷ <i>PT</i>	40	iCBT compared to waitlist	No significant difference between groups in change in GAD-7 score from pre- to post-treatment ($F_{2, 73.49} = 0.47, p = 0.63$); between group effect size ($g [95\% CI] = 0.26 [-.47, .98]$).
Andersson 2021 ³⁸ <i>PT</i>	64	iCBT compared to waitlist	No significant group differences at PT: iCBT group mean (SD) = 15.62 (11.33); waitlist group mean (SD) = 20.70 (12.5).
Bisson 2022 ⁴¹ <i>44 weeks</i>	160	iCBT compared to in- person CBT	iCBT was non-inferior to face-to-face CBT at 8 weeks ($d [95\% CI] = 0.10 [-\infty, 0.41]$) but inconclusive at 44 weeks ($d [95\% CI] = 0.47 [-\infty, 0.78]$).
Engel 2015 ⁴⁴ <i>12 weeks</i>	58	iCBT compared to TAU	No significant difference between groups in change in PHQ anxiety score at PT, 6-week, or 12-week follow-up.
Ivarsson 2014 ⁴⁹ <i>PT</i>	62	iCBT compared to waitlist	Significant time by treatment interaction effects for BAI score favoring iCBT group at PT: Cohen's $d [95\% CI] = 0.60 [0.04, 1.13]$.
Knaevelsrud 2007 ⁵⁰ <i>PT</i>	95	iCBT compared to waitlist	Significant time by treatment interaction effects for BSI anxiety score favoring iCBT group at PT: $F = 10.73; p < .001$.
Larsen 2019 ⁵⁴ <i>1 month</i>	29	Active emotional working memory training compared to control training	No significant difference between groups in change in DASS anxiety score from pre- to post-treatment or 1-month follow-up.
Lewis 2017 ⁵⁶ <i>1 month</i>	42	iCBT compared to waitlist	At PT there was a significant difference in BAI score between groups favoring the iCBT group (between-group mean difference $[95\% CI] = 13.40 [-19.91, -6.35]$). These differences remained at 1 month.
Littleton 2016 ⁵⁷ <i>PT</i>	51	iCBT compared to psychoeducational website	No significant difference between groups in change in FDAS score from pre- to post-treatment ($b = 8.62, SE = 5.71, p = 0.139, d = 0.46$).
Litz 2007 ⁵⁸ <i>4 months</i>	31	iCBT compared to supportive counseling	No significant differences between groups in BAI score in ITT analyses; between group effect sizes (d) = 0.40 at PT, $d = 0.54$ at 3 months, $d = 1.01$ at 6 mos.
McCall 2023 ⁷⁰ <i>PT</i>	150	iCBT compared to well-being course	No significant difference between groups in change in GAD-7 score ($\chi^2 = 2.9, p = .166$) from pre- to post-treatment.
Nieminen 2016 ⁶⁴ <i>PT</i>	56	iCBT compared to waitlist	No between group effect for BAI score ($d [95\% CI] = .18 [-0.34, .071]$)
Spence 2011 ⁶⁸ <i>PT</i>	42	iCBT compared to waitlist	iCBT group had significantly lower PT GAD-7 scores than the control group at PT ($F_{1,39} = 4.62, p < .04$), with a moderate between-group effect ($d [95\% CI] = 0.55 [-1.03, 3.00]$).

Study Follow-Up	N	Intervention and Comparator	Anxiety Outcomes
Spence 2014 ⁶⁹ <i>3 months</i>	125	iCBT with exposure compared to iCBT without exposure	No evidence of significant differential changes from baseline to PT or 3 months between groups in GAD-7 scores ($F_{2, 123} = 0.8, p = 0.451$); PT between-group effect size (d [95% CI] = 0.24 [-0.11, 0.59], 3-month between-group effect size (d [95% CI] = -0.04 [-0.39, 0.31])
SMS interventions			
Bedard-Gilligan 2022 ³⁹ <i>1 month</i>	109	CBT-based SMS intervention compared to kind attention messages	Wave 1: Change in DASS anxiety score not significantly different between groups at PT (B[SE] = 0.16 [0.17]) and 1 month (B[SE] = 0.10 [0.31]) Wave 2: Reduction was greater in the CBT group at PT (B[SE] = -0.61 [0.20], $p < .05$) but not at 1 month (B[SE] = -0.68 [0.36]).

Notes. **Bold** font indicates studies conducted among Veterans and/or military service members.

Abbreviations. BAI=Beck Anxiety Inventory; BSI=Brief Symptom Inventory; CI=confidence interval; DASS=Depression Anxiety Stress Scale; FDAS=Four Dimensional Anxiety Scale; GAD-7=Generalized Anxiety Disorder-7; iCBT=internet-based cognitive behavioral therapy; ITT=intent-to-treat; PDSS-SR=Panic Disorder Severity Scale Self-Report; PHQ=Patient Health Questionnaire; PT=post-treatment; SE=standard error; SIAS-6=Social Interaction Anxiety Scale; SMS=short messaging service; SPS-6=Social Phobia Scale; TAU=treatment as usual.

Table 4. Effects of Internet and Mobile Interventions for PTSD on Alcohol Use Outcomes

Study Follow-Up	N	Intervention and Comparator	Alcohol Use Outcomes
<i>Internet interventions</i>			
Acosta 2017 ³⁶ 3 months	162	iCBT compared to TAU	iCBT group reported significantly greater declines in % heavy drinking days vs TAU at PT on the TLFB (difference [\pm SE] = -1.80 ± 0.79 ; $p < 0.05$), with effects maintained at 3 months (difference [\pm SE] = 1.89 ± 1.33). Differences between groups in % drinking days were non-significant at PT and 3 months.
Bisson 2022 ⁴¹ 44 weeks	160	iCBT compared to in-person CBT	On the AUDIT, iCBT was non-inferior to in-person CBT at 8 weeks (d [95% CI] = $0.15 [-\infty, 0.32]$) and 44 weeks (d [95% CI] = $0.13 [-\infty, 0.35]$).
Krupnick 2017 ⁵¹ 12 weeks	31	iCBT compared to TAU	No significant time by treatment interaction effects for AUDIT score. AUDIT scores increased for both groups.
Lewis 2017 ⁵⁶ 1 month	42	iCBT compared to waitlist	No significant differences in AUDIT scores between groups at PT (between-group mean difference [95% CI] = $2.13 [-6.02, 1.63]$) or at 1 month.
Possemato 2019 ⁶⁷ 12 weeks	20	Peer-supported iCBT compared to self-managed iCBT	No between group differences were observed using the TLFB at PT for drinking days (d [95% CI] = $.13 [-.59, .84]$) or heavy drinking days (d [95% CI] = $.17 [-.55, .89]$).
<i>SMS interventions</i>			
Bedard-Gilligan 2022 ³⁹ 1 month	109	CBT-based SMS intervention compared to kind attention messages	Wave 1: Change in drinks per week ^a was not significantly different between groups at PT (B [SE] = $0.11 [0.21]$) and 1 month (B [SE] = $-0.01 [0.40]$). Among participants with at least 1 heavy drinking episode, reductions in HED ^b were greater for the treatment group at PT (B [SE] = $-0.60 [1.29]$) and 1 month (B [SE] = $-0.67 [1.28]$). Wave 2: Change in drinks per week was not significantly different between groups at PT (B [SE] = $-0.28 [0.16]$) and 1 month (B [SE] = $-0.03 [0.25]$). Changes in HED were not significantly different between groups at PT (B [SE] = $-2.34 [1.40]$) and 1 month (B [SE] = $-2.09 [1.39]$).

Notes. **Bold** font indicates studies conducted among Veterans and/or military service members.

^a Drinks per week assessed using the Daily Drinking Questionnaire; ^b Heavy episodic drinking assessed using the National Institute on Alcohol Abuse and Alcoholism Recommended Alcohol Questions.

Abbreviations. AUDIT= Alcohol Use Disorders Identification Test; CBT=cognitive behavioral therapy; CI=confidence interval; HED=heavy episodic drinking; iCBT=internet-based cognitive behavioral therapy; PT=post-treatment; SE=standard error; SMS=short messaging service; TAU=treatment as usual; TLFB=Timeline Follow Back.

Table 5. Effects of Internet and Mobile Interventions for PTSD on Quality of Life

Study Follow-Up	N	Intervention and Comparator	Quality of Life Outcomes
<i>Internet interventions</i>			
Acosta 2017 ³⁶ 3 months	162	iCBT compared to TAU	There was no significant effect of treatment on WHOQOL-BREF scores over time.
Andersson 2021 ³⁸ PT	64	iCBT compared to waitlist	No significant group differences in QOLI scores at PT: iCBT group mean (SD) = 0.56 (1.92); waitlist group mean (SD) = 0.07 (1.57).
Bisson 2022 ⁴¹ 44 weeks	160	iCBT compared to in- person CBT	On the EQ-5D-5L, iCBT was non-inferior to in-person CBT at 8 weeks (d [95% CI] = 0.09 [-∞, 0.33]) and borderline non-inferior at 44 weeks (d [95% CI] = 0.22 [-∞, 0.50]).
Gawlytta 2022 ⁴⁶ PT	34	iCBT compared to waitlist	No association between score changes on the EQ-5D-5L and iCBT with effect size (95% CI) = 0.25 (-0.42, 0.93).
Ivarsson 2014 ⁴⁹ PT	62	iCBT compared to waitlist	Significant time by treatment interaction effects on the QOLI favoring iCBT group at PT (Cohen's d [95% CI] = 0.53 [-0.02, 1.06]).
McGuire 2023 ⁵⁹ PT	36	Internet goal setting intervention compared to minimal contact	At PT, the treatment group reported a medium, significant increase in the physical (Cohen's d = 0.71) and psychological domains (Cohen's d = 0.74) of the WHOQOL-BREF but no changes in the social or environmental domains. Participants in the control group reported no significant changes in any of the domains.
Nieminen 2016 ⁶⁴ PT	56	iCBT compared to waitlist	No between group effect at PT for QOLI (d [95% CI] = -.07 [-.59, .45]) or EQ-5D-5L (d [95% CI] = -.07 [-.59, .48]).
Possemato 2011 ⁶⁵ PT	26	iCBT (written emotional disclosure) compared to time management narratives	On the SF-12, iCBT group did not have significantly larger increases in physical health-related QOL (p = 0.96) or mental health-related QOL (p = 0.62) at PT compared to control participants.
Possemato 2019 ⁶⁷ PT	20	Peer-supported iCBT compared to self- managed iCBT	No between-group differences were observed at PT on the WHOQOL-BREF for psychological QOL (d [95% CI] = .34 [-.39, 1.06] or social QOL (d [95% CI] = .13 [-.59, .84]).
<i>App-based interventions</i>			
Possemato 2016 ⁶⁶ PT	20	Clinician-supported PTSD Coach compared to self- managed PTSD Coach	Group by time effect sizes for changes in psychological QOL and social QOL on the WHOQOL-BREF were medium (d = .59) and large (d = 1.46), respectively.

Notes. **Bold** font indicates studies conducted among Veterans and/or military service members.

Abbreviations. CI=confidence interval; EQ-5D-5L= EuroQol 5-dimension 5-level; iCBT=internet-based cognitive behavioral therapy; PT=post-treatment; PTSD=posttraumatic stress disorder; QOL=quality of life; QOLI=Quality of Life Inventory; SF-12=12-Item Short Form Health Survey; TAU=treatment as usual; WHOQOL-BREF=World Health Organization Quality of Life – Brief.

Table 6. Effects of Internet and Mobile Interventions for PTSD on Functioning

Study Follow-Up	N	Intervention and Comparator	Functioning Outcomes
<i>Internet interventions</i>			
Bisson 2022 ⁴¹ 44 weeks	160	iCBT compared to in-person CBT	On the WSAS, iCBT was non-inferior to in-person CBT at 8 weeks (d [95% CI] = -0.14 [-∞, 0.13]) but inconclusive at 44 weeks (d [95% CI] = 0.24 [-∞, 0.53]).
Engel 2015 ⁴⁴ 12 weeks	58	iCBT compared to TAU	Group by time interaction on the SF-36 was non-significant at all time points.
Knaevelsrud 2007 ⁵⁰ PT	95	iCBT compared to waitlist	On the SF-12, group by time pre-post effect size change favored the iCBT group for mental health functioning ($F=5.95, p < .05$), but the effect was not significant for physical health functioning.
Lewis 2017 ⁵⁶ 1 month	42	iCBT compared to waitlist	At PT, there was a significant difference between groups on the SDS (between-group mean difference [95% CI] = 9.36 [-13.56, -3.93]). These differences remained at 1 month.
McLean 2021 ⁶⁰ 6 months	25	Web prolonged exposure compared to in-person present-centered therapy	Group by time interaction was not significant for either the mental or physical component scores of the VR-12.
Spence 2011 ⁶⁸ PT	42	iCBT compared to waitlist	iCBT group did not have significantly lower PT SDS scores than waitlist (d [95% CI] = 0.62 [-2.38, 4.85]).
<i>App-based interventions</i>			
Kuhn 2017 ⁵² PT	120	PTSD Coach compared to waitlist	PTSD Coach condition had greater improvement on the B-IPF than waitlist ($F[1, 117] = 7.63, p = .007, d = 0.51$).
Hensler 2022 ⁴⁷ PT	179	PTSD Coach compared to waitlist	PTSD Coach condition had greater improvement on the WHODAS than waitlist ($B = -5.39, SE = 2.49, 95\% CI = -10.28, -0.50, t(301.83) = -2.17, p = 0.031; Cohen's d = -0.27$).

Notes. **Bold** font indicates studies conducted among Veterans and/or military service members.

Abbreviations. B-IPF=Brief Inventory of Psychosocial Functioning; CBT=cognitive behavioral therapy; CI=confidence interval; iCBT=internet-based cognitive behavioral therapy; PT=post-treatment; SDS=Sheehan Disability Scale; SF-12=12-Item Short Form Health Survey; SF-36= 36-Item Short Form Health Survey; TAU=treatment as usual; VR-12=Veteran's RAND 12-item Health Survey; WHODAS=World Health Organization Disability Assessment Schedule; WSAS=Work and Social Adjustment Scale.

KEY QUESTION 2: INTERNET AND MOBILE INTERVENTIONS FOR FAMILY MEMBERS AND CAREGIVERS OF ADULTS WITH PTSD

Five studies^{72–76} were included that evaluated an intervention for family members or caregivers of adults with PTSD (2 RCTs, 3 pre-post studies; total $N = 300$). Three different family interventions were identified across the included studies: 2 internet interventions (*VA-CRAFT*, *Couple HOPES*) and 1 mobile intervention (*PTSD Family Coach*). The 2 RCTs were conducted on *VA-CRAFT* (comparator was waitlist control) and *PTSD Family Coach* (comparator was psychoeducation app). Four of the studies were conducted in the US and 1 in Canada; all the trials were conducted among intimate partners/family members of Veterans, military Service members, or first responders.

Studies reported on a variety of outcome measures. Four outcomes that were reported by at least 2 studies were included in our synthesis: caregiver burden, depression, anxiety, and quality of life. Across treatments and outcomes, there appeared to be little to no benefit of interventions on most outcomes. Most studies had high risk of bias and the strength of evidence across outcomes was low.

Caregiver Burden

It is unclear whether internet and mobile interventions reduce caregiver burden symptoms for family members of adults with PTSD. Our confidence in this finding is low based on study methodological limitations and inconsistent findings across studies. Three studies^{72,73,75} (2 RCTs and 1 pre-post; $N = 258$) assessed the effectiveness of an internet (2 studies) or mobile intervention (1 study) on caregiver burden symptoms at post-treatment (Table 7). Two studies^{72,75} evaluated the same internet intervention (*VA-CRAFT*). Caregiver burden symptoms improved in the first study relative to a waitlist control group (RCT, $N = 46$),⁷² but no improvements were detected in the second study (pre-post; $N = 12$).⁷⁵ One RCT⁷³ ($N = 200$) that evaluated an app-based intervention did not detect any improvement in caregiver burden relative to an education-only app comparator.

Table 7. Effects of Internet and Mobile Interventions for Family Members of Adults with PTSD on Caregiver Burden

Study Follow-Up	N	Intervention and Comparator	Caregiver Burden Outcomes
<i>Internet interventions</i>			
Erbes 2020 ⁷² PT	46	VA-CRAFT compared to waitlist	Large treatment effect for intervention group at PT ($F[1, 12] = 9.31$, $\eta^2 = 0.20$, $p < .01$).
Kuhn 2023 ⁷⁵ PT	12	Guided VA-CRAFT (pre-post)	No significant change in CBS scores from baseline to PT ($d = -0.02$, $p = .942$).
<i>App-based interventions</i>			
Van Stolk-Cooke 2023 ⁷³ PT	200	PTSD Family Coach app compared to psychoeducation-only app	No significant treatment by time interaction for CBS scores at PT (d [95% CI] = 0.1 [-0.2, 0.4], $p = .45$).

Abbreviations. CBS=Caregiver Burden Scale; CI=confidence interval; PT=posttreatment; PTSD=posttraumatic stress disorder.

Depression

Internet and app-based interventions for family members of adults with PTSD may have no effect on depression symptoms. Though findings were consistent across studies, our confidence in this finding is low based on high risk of bias of all studies. Four studies (1 RCT and 3 pre-post; N = 254) assessed the effectiveness of an internet (3 studies)⁷⁴⁻⁷⁶ or mobile intervention (1 study)⁷³ on depression symptoms at post-treatment (Table 8). Across studies, there were no improvements detected on depressive symptoms at post-treatment.

Table 8. Effects of Internet and Mobile Interventions for Family Members of Adults with PTSD on Depression

Study Follow-Up	N	Intervention and Comparator	Depression Outcomes
<i>Internet interventions</i>			
Crenshaw 2023 ⁷⁴ 1 month	27	Couple HOPES (pre-post)	No improvement on PHQ-9 from baseline to PT (g [95% CI] = 0.42 [-0.02, 0.87]) or baseline to 1-month (g [95% CI] = 0.38 [-0.41, 1.18]).
Kuhn 2023 ⁷⁵ PT	12	Guided VA-CRAFT (pre-post)	No change in PHQ-9 scores from baseline to PT (d = 0.32, p = .364).
Morland 2023 ⁷⁶ PT	15	Couple HOPES (pre-post)	No change in PHQ-9 scores from baseline to PT (g = -0.20, p = .142).
<i>App-based interventions</i>			
Van Stolk-Cooke 2023 ⁷³ PT	200	PTSD Family Coach app compared to psychoeducation-only app	No significant treatment by time interaction for PHQ-8 scores at PT (d [95% CI] = -0.0 [-0.3, 0.3], p = .93).

Abbreviations. CI=confidence interval; iCBT=internet-based cognitive behavioral therapy; PHQ-8=8-item Patient Health Questionnaire; PHQ-9=9-item Patient Health Questionnaire; PT=posttreatment; PTSD=posttraumatic stress disorder.

Anxiety

Internet and mobile interventions for family members of adults with PTSD may have no effect on anxiety symptom severity. Though findings were consistent across studies, our confidence in this finding is low based on high risk of bias of all studies. Three studies (1 RCT and 2 pre-post; N = 239) assessed the effectiveness of internet (2 studies)^{74,75} or mobile interventions (1 study)⁷³ on anxiety symptoms (Table 9). No significant benefits were detected across treatments.

Table 9. Effects of Internet and Mobile Interventions for Family Members of Adults with PTSD on Anxiety

Study Follow-Up	N	Intervention and Comparator	Anxiety Outcomes
<i>Internet interventions</i>			
Crenshaw 2023 ⁷⁴ 1 month	27	Couple HOPES (pre-post)	No improvement on GAD-7 from baseline to PT (g [95% CI] = 0.17 [-0.19, 0.51]) or baseline to 1-month follow-up (g [95% CI] = 0.52 [-0.06, 1.10]).

Study Follow-Up	N	Intervention and Comparator	Anxiety Outcomes
Kuhn 2023 ⁷⁵ PT	12	Guided VA-CRAFT (pre-post)	No change in PROMIS-SF anxiety scores from baseline to PT ($d = 0.08$, $p = .822$).
<i>App-based interventions</i>			
Van Stolk-Cooke 2023 ⁷³ PT	200	PTSD Family Coach app compared to psychoeducation-only app	No significant treatment by time interaction for GAD-7 scores at PT (d [95% CI] = -0.1 [-0.4, 0.2], $p = .55$).

Abbreviations. CI=confidence interval; GAD-7=Generalized Anxiety Disorder-7; iCBT=internet-based cognitive behavioral therapy; PT=posttreatment; PROMIS-SF=Patient-Reported Outcomes Measurement Information System – Short Form; PTSD=posttraumatic stress disorder.

Quality of Life

It is unclear whether internet interventions for family members of adults with PTSD improve quality of life. Our confidence in this finding is low based on study methodological limitations and inconsistent findings across studies. Three studies^{72,74,76} (1 RCT and 2 pre-post; N = 88) assessed the effectiveness of internet-based interventions on quality of life (Table 10). One pre-post study⁷⁴ (*Couple HOPES*) detected improvement in quality of life from baseline to PT, but not from baseline to 1-month follow-up. No significant benefits were detected in the 2 other trials.^{72,76}

Table 10. Effects of Internet and Mobile Interventions for Family Members of Adults with PTSD on Quality of Life

Study Follow-Up	N	Intervention and Comparator	Quality of Life Outcomes
<i>Internet interventions</i>			
Crenshaw 2023 ⁷⁴ 1 month	27	Couple HOPES (pre-post)	Significant improvement in QOL on the WHOQOL from baseline to PT (g [95% CI] = 0.56 [0.10, 1.02]), but not from baseline to 1-month follow-up (g [95% CI] = 0.61 [-0.04, 1.26]).
Erbes 2020 ⁷² PT	46	VA-CRAFT compared to waitlist	No significant difference between groups at PT on the WHOQOL-BREF for psychological QOL ($F[1, 12] = 2.00$, $\eta^2 = 0.05$) or relationship QOL ($F[1, 12] = 1.18$, $\eta^2 = 0.03$).
Morland 2023 ⁷⁶ PT	15	Couple HOPES (pre-post)	No change in BBQ scores from baseline to PT ($g = -0.05$, $p = .326$).

Abbreviations. BBQ= Brunnsviken Brief Quality of Life Scale; CI=confidence interval; iCBT=internet-based cognitive behavioral therapy; PT=posttreatment; QOL=quality of life; WHOQOL=World Health Organization Quality of Life; WHOQOL-BREF= World Health Organization Quality of Life – Brief.

DISCUSSION

Self-guided, asynchronous PTSD treatments that utilize internet or mobile phone technology have developed rapidly over the past 2 decades. These treatments can be delivered remotely to patients and require variable therapeutic support, potentially expanding access to PTSD treatments for adults with PTSD and their caregivers. The current systematic review examined the effectiveness of internet and mobile interventions for adults with PTSD. Primary outcomes were analyzed separately for civilian and military (Veterans or active-duty service members) populations. The effectiveness of internet and mobile interventions for caregivers and family members of adults with PTSD was also evaluated.

Our primary results indicated differential effectiveness of treatments for civilian and military populations. Internet and mobile interventions may be moderately effective in reducing PTSD and depression severity in civilians, immediately post-treatment. In contrast, military populations treated with internet or mobile interventions experienced small to negligible benefits. For both populations, no treatment effects were evident at shorter and longer-term follow-up periods. Based on available evidence, internet and mobile interventions may increase the odds of clinically meaningful PTSD symptom improvement post-treatment among civilian but not military populations. We have low confidence in these findings based on study methodological limitations, imprecision, and moderate inconsistency.

Findings that internet and mobile interventions for PTSD may have limited benefits in military populations are consistent with prior research that has shown that PTSD can be less responsive to treatment in military populations compared with civilians.⁷⁸ However, differences in study designs and intervention characteristics limit our ability to make strong conclusions about the effectiveness or ineffectiveness of the interventions among Veterans and active duty military personnel. Future studies might explore whether internet and mobile resources have a beneficial role in supporting the established VA clinical pathway for PTSD, for example to improve treatment adherence or facilitate at-home activities that reinforce principles and practices introduced during in-person therapy.

We further explored how intervention and study factors may impact treatment effectiveness. Research has shown that integrating therapist involvement in digital interventions increases treatment effectiveness.^{66,79} Our results are consistent with this finding and indicated that direct facilitation had the largest benefits on treatment outcomes, followed by minimal facilitation. Interventions with no active provider support showed the least benefit for both depression and PTSD severity. In one large civilian trial (N = 196), trauma-focused iCBT with a high level of direct therapeutic support (avg of 3.5 hours/participant) was non-inferior to an established face-to-face PTSD treatment for treatment-naïve patients.⁴¹ Exploring the appropriate level of therapeutic support (who and how much) is an important consideration in any implementation effort and should take into account the targeted population and anticipated reach of the intervention, desired effectiveness, and available health system resources.

Trauma-focused CBT treatments for PTSD are recommended as first-line treatments in clinical practice guidelines based on the current evidence.¹⁰ Only 4 of the 13 included studies on a military sample evaluated a trauma-focused CBT. Two of these were based on PE^{60,61} and 2 utilized approaches based on written exposure therapy (WET).^{51,65} Most of these studies included a small sample size and had high drop-out rates or low treatment engagement rates. Across all 4 studies, there were nonsignificant differences on PTSD severity between treatment arms at post-treatment. In comparison, over 60% of the civilian studies evaluated a trauma-focused CBT. In addition to written exposure paradigms, these treatments also included several iCBT interventions that incorporated multiple

trauma-focused treatment components (*ie*, in vivo and imaginal exposure; cognitive restructuring, grounding and relaxation exercises). Our subgroup analyses did not show that inclusion of written exposure contributed to improved treatment effectiveness, but there are other relevant trauma-focused treatment components worth exploring in future research. Given the promising effects of iCBT in civilians, future studies on military populations may benefit from incorporating similar treatment approaches.^{41,56} Further, none of the trauma-focused CBTs in the military population incorporated direct therapist involvement. Based on the promising results of civilian studies that incorporated direct facilitation with trauma-focused CBT interventions,^{41,56} future military trials may want to investigate whether increasing levels of provider involvement impacts treatment retention and effectiveness. Examining the cost-effectiveness of increasing provider support relative to offering traditional face-to-face trauma-focused treatments would need to be a consideration.

Treatment benefits were largest when interventions were compared with a completely inactive condition like waitlist control, and small to negligible when compared to more active treatment condition. An exception to this finding was the previously mentioned study in which iCBT with a high level of therapeutic support demonstrated non-inferiority to in-person PTSD treatment.⁴¹ Treatment effects were also larger against lower-intensity comparator interventions (*eg*, psychoeducation). Internet and online interventions may still play a role in increasing treatment access for those patients who are unable or unwilling to engage in a trauma-focused treatment. Future studies should explore whether internet or mobile PTSD interventions have an impact on the care pathway for patients at different levels of treatment engagement.

It is unclear whether internet and mobile interventions for caregivers and family members of adults with PTSD improve any mental health outcomes. Only 5 studies were identified and included that evaluated an internet or mobile intervention for caregivers or family members of an adult with PTSD. We examined 4 different outcomes that were assessed in at least 2 of the studies: caregiver burden, depression, anxiety, and quality of life. There was some indication that treatments may reduce caregiver burden and improve quality of life, but findings were inconsistent across individual trials. Given the study limitations, inconsistent findings across outcomes, and unknown precision, we have low confidence in these findings.

Limitations

There are several limitations to this review that are worth noting. Many of the included studies were small pilot trials testing the feasibility and acceptability of the online intervention and were likely inadequately powered to detect all but the largest treatment effects. There were only 4 military studies that evaluated a trauma-focused CBT, and these treatments were based on specific trauma treatments. Thus, we are unable to conclude whether our findings would generalize to other forms of trauma-focused iCBT interventions. Most studies used self-assessments to determine PTSD status and treatment outcomes rather than clinician-administered measures. Inclusion criteria in many studies did not require a full PTSD diagnosis and so the included sample often included participants with subthreshold PTSD symptoms. Although most studies included Veterans in their samples, a substantial proportion of participants were treatment-seeking White females, which may limit the applicability of findings to the VA population.

FUTURE RESEARCH

Recommendations for future research on internet and mobile interventions for PTSD include the following:

- Evaluate whether trauma-focused iCBTs that integrate direct therapeutic support increase treatment retention and effectiveness for military populations. Examining the cost-effectiveness of increasing provider support relative to offering traditional face-to-face trauma-focused treatments would need to be a consideration.
- Examine whether iCBTs may be differentially effective for specific military populations. For instance, do internet interventions for treatment-naïve veterans with less complex symptom presentations demonstrate better results?
- Explore whether internet and mobile resources have a beneficial role in supporting the established VA clinical pathway for PTSD, for example to improve treatment adherence or facilitate at-home activities that reinforce principles and practices introduced during in-person therapy.
- Characterize factors that influence Veteran engagement in internet and mobile interventions, such as technology literacy or internet access, and evaluate strategies to maintain adherence.
- Evaluate the appropriate level of therapeutic training and specific competencies necessary for providers to successfully support patient engagement in iCBTs.
- Examine components of internet and mobile interventions to identify whether certain trauma-focused CBT interventions have a greater influence on treatment outcomes.

CONCLUSIONS

Internet and mobile interventions for PTSD have the potential to expand access to PTSD treatments for adults with PTSD and their caregivers. The current review examined the effectiveness of these digital treatments and explored treatment factors that may impact implementation considerations. Results indicated that civilians may experience moderate benefits from these interventions at post-treatment, but military populations experience small to negligible benefits on PTSD and depression outcomes. Treatment effects for both populations are not sustained at shorter and longer-term follow-up periods. Consistent with previous research, level of facilitation could be a key factor in the effectiveness of internet and mobile interventions for PTSD. Internet and mobile interventions do not appear to benefit family members of adults with PTSD. Currently, available evidence does not support the use of internet and mobile interventions as a replacement for first-line, in-person treatments for PTSD. Future studies could explore whether internet and mobile resources have a beneficial role in supporting the established VA clinical pathway for PTSD, including whether they improve treatment engagement for Veterans who are unable or unwilling to engage in trauma-focused therapies.

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