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Cultural Adaptations of Psychological Interventions for Prevalent Sleep Disorders and Sleep Disturbances: A Systematic Review of Randomized Controlled Trials in the United States

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Summary

Psychological interventions for sleep-wake disorders have medium-to-large effect sizes, however whether behavioral randomized controlled trials (RCTs) targeted underserved populations or addressed contextual and cultural factors is unknown. We conducted a systematic review to: (a) examine sociodemographic characteristics of behavioral RCTs for prevalent sleep-wake disorders and sleep disturbances that targeted undeserved adults, (b) identify types of cultural adaptations (surface-level, deep-level), and (c) describe intervention effectiveness on primary sleep outcomes. Overall, 6.97% of RCTs (56 studies) targeted underserved groups (veterans, women, racial/ethnic minorities, low socioeconomic status, disability status); 64.29% made surface-level and/or deep-level cultural adaptations. There was a lack of racial/ethnic, socioeconomic, sexual orientation, and linguistic diversity. Most cultural adaptations were made to behavioral therapies, and cognitive behavioral therapy for insomnia (CBT-I). Surface-level cultural adaptations to the delivery modality and setting were most common. Deep-level cultural adaptations of the content and core intervention components were also typical. Intervention effectiveness varied by type of adapted intervention and participant population. RCTs of adapted CBT-I interventions among participants with a definite sleep disorder or sleep disturbance showed consistent significant reductions in adverse sleep outcomes versus control. These findings have important implications for the use of cultural adaptations to address behavioral sleep medicine disparities.

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Keywords

cultural tailoring; sleep; psychological treatments; effectiveness; underserved; mental health care disparities

Sleep-wake disorders such as insomnia, obstructive sleep apnea, and nightmare disorder, have a population prevalence ranging from six to 38% in the United States, and are associated with substantial public health burden, including increased risk of cardiovascular disease, obesity, depression, motor vehicular or workplace accidents, and death (1–11). Sleep-wake disorders as well as sleep disturbances such as short sleep duration and poor sleep quality are also associated with substantial economic costs and account for roughly $100 billion per year in direct and indirect costs (12–15). It is no surprise then that there is concerted national attention to improving both pernicious sleep disorders and sleep disturbances in the United States (16).

Meta-analyses and systematic reviews of randomized controlled trials (RCTs) testing psychological interventions for sleep-wake disorders indicate that psychological interventions such as Cognitive Behavioral Therapy for Insomnia or Behavioral Therapies (e.g., stimulus control, sleep restriction therapies) are both efficacious and effective for the resolution or amelioration of sleep disorders or sleep disturbances in the short- and long-term, with medium-to-large effect sizes among adults (17–19). However, none of these meta-analyses or systematic reviews examined the effectiveness of these interventions among underserved groups or populations at higher risk of one of these disorders or disturbances (e.g., insomnia, short sleep duration) or at greater risk of experiencing disproportionate burden from these conditions, including racial/ethnic minorities, women, sexual orientation or gender minorities, immigrants, linguistic minorities, veterans, those with a disability, and those from lower socioeconomic groups. While one systematic review addressed behavioral treatments for sleep disturbances in children and adults with intellectual disabilities, none of the included studies were of RCTs targeting adults (20). As such, RCTs of psychological interventions for sleep disorders that target underserved adult populations for whom modifications or changes to the intervention may be warranted in order to maximize its effectiveness are sparse.

A cultural adaptation of a psychological intervention refers to the systematic process of changing an evidence-based treatment to include culturally sensitive components (e.g., language, culture, and context) that are consonant with a patient's worldview (21, 22). These changes can include surface-level cultural adaptations such as translating the intervention to a patient's language of preference when working with linguistic minorities and/or deep-level cultural adaptations such as incorporating sociocultural values such as *familismo* in the intervention by incorporating family members into the treatment paradigm when working with Latina/os (21, 22). Deep-level cultural adaptations can also include integration of concepts and metaphors into the intervention content that are culturally consonant with the target population (e.g., use of proverbs) (21, 22). Systematic reviews of cultural adaptations of psychological interventions for depression, and behavioral health issues indicate adapted interventions yield more favorable improvements and higher retention rates

than control conditions, particularly for racial/ethnic minorities (23–27). In fact, results from meta-analyses of cultural adaptations of psychological interventions corroborate these findings and indicate a large overall effect size ($g = 0.67$, $p<.001$) for adapted interventions compared to no intervention or other interventions, and a medium effect size ($g = 0.52$) for the adapted versus un-adapted version of the same intervention (23, 25). Of note, most of these systematic reviews and meta-analyses focused on RCTs of psychological interventions with cultural adaptations for racial/ethnic minorities, which represent but one of many underserved or marginalized groups in the United States. Further, to our knowledge, none of these reviews of cultural adaptations included psychological interventions that targeted a prevalent sleep disorder or sleep disturbance as a primary outcome. As such, significant gaps remain in our understanding of the types of cultural adaptations made to psychological interventions for common sleep-wake disorders and sleep disturbances, and in turn, their effect on primary sleep outcomes among underserved groups in the United States.

The primary aims of this systematic review were to (a) examine the sociodemographic characteristics of RCTs of psychological interventions for prevalent sleep-wake disorders or sleep disturbances that targeted underserved groups including racial/ethnic minorities, those with low socioeconomic status, immigrants, sexual orientation minorities, women, veterans, and those with a disability, (b) identify the types of surface-level or deep-level cultural adaptations made to psychological interventions for prevalent sleep-wake disorders or sleep disturbances, and (c) describe the effectiveness of the culturally adapted psychological interventions for prevalent sleep-wake disorders or sleep disturbances on primary sleep outcomes. Herein, we focused on sleep-wake disorders with a national population prevalence of about 5% or greater, these included insomnia, nightmare disorder, obstructive sleep apnea, restless legs syndrome, and circadian rhythm sleep-wake disorder shift-work type (11), and sleep disturbances that may or may not be concomitant with these conditions.

METHODS

Protocol and Registration

Our systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for conducting and reporting the article search (28, 29). This systematic review is registered as: PROSPERO2016:CRD42016039070 (www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42016039070)

Eligibility Criteria, Information Sources, and Search

Eligible articles had to: (a) be conducted in the US mainland (b) written in English; (c) be a randomized controlled trial or comparative effectiveness trial that uses random assignment to compare groups; (d) target an underserved group, specifically non-White racial/ethnic group, women, low socioeconomic status backgrounds, immigrants, sexual orientation minorities, veterans, or individuals from a disability status group; (e) focus on adults; (f) compare a psychological or behavioral intervention to minimal or no intervention, another psychological intervention, or a pharmacological intervention; (g) include one of the following psychological interventions or its derivatives as a primary intervention:

Behavioral Therapy, Cognitive Behavioral Therapy, Relaxation Therapy, Sleep Hygiene, Motivational Enhancement Therapy, Stimulus Control Therapy, Mindfulness Based Stress Reduction, self-help, psycho-education; (h) include one of the following primary sleep outcomes: insomnia, obstructive sleep apnea, nightmare disorder, restless legs syndrome, circadian rhythm sleep-wake disorder shift-work type, sleep quality, sleepiness symptoms, sleep duration, circadian processes.

We searched the biomedical electronic databases Ovid MEDLINE, EMBASE, The Cochrane Library, CINAHL, PsycINFO, AMED, Clinicaltrials.gov, and the WHO International Clinical Trials Registry Platform for research articles, and conference proceedings on randomized controlled trials of psychological interventions for prevalent sleep-wake disorders published in peer-reviewed journals from inception to January 16, 2020. All relevant subject headings and free-text terms were used to represent underserved groups, and the sleep-wake disorders and psychological interventions under investigation. Terms were applied to limit results to RCTs and to adult populations sampled in the United States. Additional records were identified by scanning the reference lists of relevant studies and reviews, using the Similar Articles feature in PubMed and the Cited Reference Search in ISI Web of Science. Relevant study and clinical trials registry websites such as Clinicaltrials.gov, and the WHO International Clinical Trials Registry Platform were also searched. The specific search terms used within each electronic database are detailed in the Supplemental Files.

Study Selection, Data Collection Process, and Data Items

We used a two-stage process to determine article eligibility. First, two of four review authors (CA, EPM, IPI, LGC, TV) independently scanned the abstract and title of every record retrieved for initial screen. Second, all potentially relevant articles were retrieved as full-text for further assessment. During both stages, discrepancies were resolved through consensus.

For studies that met the inclusion criteria, two of four review authors (CA, IPI, LGC, TV) independently extracted key study and adaptation characteristics after a period of calibration. All discrepancies were resolved through consensus. Study characteristics included *Intervention characteristics* including type of intervention, delivery modality, duration, intensity and comparator; *trial characteristics* including trial identifier, design, and duration; *cultural adaptation* including presence/absence of adaptation, type of adaptation, description of adaptation; *outcomes* including primary and secondary outcomes, summary of primary sleep outcomes results; *participant sociodemographic characteristics* including sample size, population group, percentage of women, race/ethnicity, age, education, nativity or immigrant status, veterans status, sexual orientation minority, disability, household income, and unemployment status. We also extracted participant inclusion and exclusion criteria to determine whether participants had a sleep disorder or sleep disturbance diagnosis at the time of enrollment. A determination of *definite* sleep disorder or sleep disturbance was made when studies directly assessed for and confirmed the presence a sleep disorder or sleep disturbance diagnosis, and included this information in the inclusion criteria. A determination of *probable* sleep disturbance was made when studies directly assessed for any sleep disturbance but did not include endorsement of a sleep disturbance as part of the

inclusion criteria. A determination of *potential* sleep disturbance was made when studies did not directly assess for the presence of a sleep disturbance but based on the scientific literature the participant population would likely have a sleep disturbance concomitant with the co-morbid health or mental health condition. Information was also extracted on the following secondary outcomes: quality of life and psychological factors (e.g., depressive symptoms, anxiety symptoms), fatigue, mood, pain, PTSD, stress, substance use, and suicidality (Supplemental Table).

Following Barrera, Castro, Strycker & Toobert (21), who summarized existing cultural adaptation frameworks (30–33), we distinguished between surface-level and deep-level cultural adaptations, and extracted these data. Surface-level cultural adaptations modify intervention materials and messages to include observable, "superficial" characteristics of the target population (32). Surface-level cultural adaptations included linguistic strategies (e.g. bilingual and bicultural materials and staff, translation of materials), peripheral strategies (i.e. inclusion of culturally familiar activities and lifestyle elements), constituent involving strategies (e.g. use of community health workers, same race/ethnicity or status role models), delivery modality (e.g. delivery of the intervention in group settings), and setting (e.g. safe locations familiar to participants). Deep-level cultural adaptations refer to the integration of cultural elements into intervention activities and messages (as described in (21). Herein, deep-level cultural adaptations included the incorporation of sociocultural strategies (e.g. incorporation of cultural values in intervention design or implementation, involvement of family or important social members), linguistic strategies (e.g. adjustment of materials to literacy level), use of social support and networks, changes to the content of the intervention (e.g., inclusion of trauma-related sleep disturbances content), and changes to the core components of the intervention in order to address symptoms unique to that target population (e.g., combining imagery rehearsal therapy and behavioral therapy for veterans to address nightmares and other sleep disturbances).

We categorized articles accordingly to the type of psychological intervention. Primary psychological interventions of the selected studies included Acceptance and Commitment Therapy (ACT), Behavioral Therapy (BT), Cognitive Behavioral Therapy (CBT), Cognitive Behavioral Therapy for Insomnia (CBT-I), Cognitive Processing Therapy (CPT), Complementary and Alternative Medicine (CAM) therapies, Imagery Rehearsal Therapy (IRT), Mindfulness-based Stress Reduction (MBSR), and Problem-solving Therapy (PST). Also, Clinical Emotional Freedom Techniques, and Mission Reconnect program were grouped as Eclectic Therapy. CAM interventions that focused broadly on mind-body practices such as meditation, yoga, Tai-Chi, and relaxation practices were considered.

Risk of Bias in Individual Studies

Three of the authors (CA, LGC, IPI) independently assessed the risk of bias in all selected articles following the Cochrane Risk of Bias assessment tool (34). We assessed *selection bias* due to inadequate generation of a randomized sequence or allocation concealment, *performance bias* due to knowledge of the allocated interventions by participants and personnel during the study, *detection bias* due to knowledge of allocated interventions by outcome assessors, *attrition bias* due to the amount, nature, or handling of incomplete

outcome data, and *reporting bias* due to selective outcome reporting. We rated whether included articles exhibited low risk, high risk or unclear risk across each bias domain. To calibrate our evaluation process for assessing risk of bias, we completed and discussed ratings on five randomly selected articles. We achieved adequate inter-rater reliability once we reached consensus on rating across the five bias domains. Next, each paper was independently assessed by two reviewers and all discrepancies were resolved through consensus among three of the authors (CA, LGC, IPI).

RESULTS

Study Selection

Overall, 8,182 unique records were identified and screened (Figure 1). The original search yielded 8,721 records, and 1 additional record was identified through other sources. A total of 7,378 records were excluded after the initial screen. A total of 803 full-text articles were then assessed for eligibility; of these 747 full-text articles were excluded. Reasons for exclusion included wrong setting (n=329), wrong study design (n=215), wrong participant population (n=184), wrong outcomes (n=9), wrong comparator (n=4), wrong language (n=4), wrong intervention (n=1), and full-text not retrieved (n=1). This resulted in a total of 56 studies that met inclusion criteria and were included in the qualitative synthesis. As such, only 6.97% of full-text articles assessed for eligibility focused on psychological interventions for sleep-wake disorders for underserved populations.

Study and Trial Characteristics

Table 1 displays the study characteristics of the 56 RCT studies that met inclusion criteria. The average sample size was 85.23 participants (SD=54.49, Range=11–219) across arms, 40.91 (SD=26.18, Range=6–106) in the intervention arm, and 38.40 (SD=24.09, Range=5–91) in the control arm. The average percentage of women participants was 55.35% (SD =43.22). The average percentage of White participants was 64.86% (SD=21.67), followed by 28.16% (SD=23.38) who were Black participants, 9.23% (SD=10.35) Other Ethnicity participants, 9.45% (SD=10.23) Latina/o participants, and 4.06% (SD=4.26) Asian participants. The average age was 51.75 (SD=11.76, Range=29–77.1), and average education was 14.42 years (SD=1.20, Range=12–15.75). Of the included studies reporting employment (n=15) and disability status (n=6), the average percentage of participants who were unemployed was 40.78% (SD=26.13), and the average percentage of those with a disability was 36.46% (SD=31.81). By and large, studies did not include immigrants, linguistic minorities, or participants who identified as a sexual orientation minority (i.e., LGBTQ+), with two exceptions. One study reported that 24.02% of participants received treatment in Spanish, and another study reported that 4% of the sample was a gender minority (transgender). Twenty-three studies (41.07%) focused on women, one study (1.79%) focused on men in prison, five studies (8.93%) focused on older adults, and 25 studies (44.64%) focused on veteran population. One study focused on unemployed adults diagnosed with HIV/AIDS (1.79%).

There was variation in the primary psychological interventions tested. Twenty (35.71%) studies tested CBT-I as the primary intervention (35–54). Eight (14.29%) tested

Complementary and Alternative Therapies (CAM) (55–62). Seven (12.50%) tested Behavioral Therapy (BT) (63–70). Four (7.14%) tested Cognitive Behavioral Therapy (CBT) (71–74). Three (5.36%) tested Acceptance and Commitment Therapy (ACT) (75–77). Three (6.67%) tested Cognitive Processing Therapy (CPT) (78–80). Four (7.14%) tested Mindfulness Based Stress Reduction (MBSR) (81–84). Three (5.36%) tested some form of Eclectic Therapy (ET) (85–87). Three (5.36%) tested Imagery Rehearsal Therapy (IRT) (88–90). One (1.79%) tested Problem-Solving Therapy (PST) (91).

Of included studies, 57.14% (n=32) included participants with a definite diagnosis of a sleep disorder or endorsement of a sleep disturbance, 16.07% (n=9) included participants with a probable sleep disturbance, and 26.79% (n=15) included participants with a potential sleep disturbance (Table 2). Of studies with a definite sleep disorder or sleep disturbance diagnosis, 75% targeted insomnia, 9.38% targeted nightmares and poor sleep quality, 6.25% targeted poor sleep quality, 3.12% targeted nightmares and insomnia, 3.12% targeted nocturia, and 3.12% targeted restless legs syndrome. All of the intervention studies testing CBT-I or IRT had a definite diagnosis or endorsement of a sleep disorder or sleep disturbance. Roughly half of the studies testing BT or CAM interventions had a definite diagnosis or endorsement of a sleep disorder or sleep disturbance. Studies on ACT, CBT, CPT, ET, MBSR, and PST were largely if not exclusively conducted with participants who had a probable or potential sleep disorder or sleep disturbance. There was also variation in the delivery modality for the primary intervention. The most common comparator was sleep hygiene or a sleep education program. Three RCTs (5.3%) tested the effectiveness of a surface-level culturally adapted behavioral intervention against the same un-adapted intervention. The overwhelming majority of studies (91.07%) utilized a 2-arm RCT trial design. The average trial duration was 7.69 weeks (SD=4.51), and the range for intervention follow-up was two weeks to up to 10 years. Importantly, eleven of studies (19.64%) tested telehealth delivery (telephone, teleconference, internet, mobile, audio files).

Risk of Bias Within Studies

Table 3 reports the risk of bias assessment for all included studies. While 42 (75.0%) of the included studies had low risk of selection bias due to the use of random sequence generation in the randomized controlled trial design, 14 studies or 25% did not describe the random sequence generation method used and were assessed as unclear risk of bias. Similarly, ratings of selection bias due to allocation concealment were much more mixed. Twenty-seven (48.21%) were rated as low risk of bias for allocation concealment, two (3.57%) were rated high risk of bias for allocation concealment, and 27 (48.21%) were rated unclear risk of bias for allocation concealment because there was insufficient information to permit judgment of risk. Twenty-four studies (42.86%) were rated as high risk for performance bias due to lack of blinding of participants and personnel, whereas of the remaining studies, 18 (32.14%) did not describe any measures used to blind study participants and personnel from knowledge of which intervention the participant received and as such were rated as unclear risk of performance bias, and 14 (25.00%) were rated low risk of performance bias. Twenty-four studies (42.86%) were rated as low risk for detection bias due to blinding of outcome assessors, whereas nine (16.07%) were rated high risk for detection bias because the outcome assessors had knowledge of the intervention assignment, and 23 (41.07%) were

rated as unclear risk of detection bias because there was insufficient information to permit judgment of risk. The overwhelming number of studies (n=41, 73.21%) were rated low risk for attrition bias due to the amount, nature, or handling of incomplete data, whereas 11 (19.64%) were rated high risk of attrition bias, and four (7.14%) were rated as unclear risk for attrition bias. Twenty-six studies (46.43%)were rated unclear risk for reporting bias because insufficient information was provided to evaluate low or high risk for reporting bias due to selective outcome, 28 (50%) were rated low risk for reporting bias, and two (3.57%) were rated high risk of reporting bias. Of note, only five studies (8.93%) were rated as low risk of bias across the six domains, thereby representing the highest quality studies (35, 36, 56, 68, 90). Of these, three evaluated CBT-I or BT as the primary intervention against sleep education (35, 36, 68), one evaluated Tai Chi Chih against CBT-I (56), and another evaluated IRT and CBT-I against CBT-I alone in veterans (90).

Results of Individual Studies

Types of Cultural Adaptations.—Thirty-six studies (64.29%) conducted either a surface -and/or deep-level cultural adaptation of a psychological intervention for one of the specified underserved groups, whereas the remaining 20 (35.71%) did not adapt the intervention to the underserved target population group (Table 4). In particular, of the adapted studies, 17 (30.36%) conducted both a surface-level and a deep-level cultural adaptation, 16 studies (28.57%) conducted only a surface-level adaptation, and three studies (5.36%) conducted only a deep-level cultural adaptation. Of studies having conducted a cultural adaptation, CBT-I (n=14; 38.89%) BT (n=5; 13.89%), CBT (n=4; 11.11%), and CAT (n=4, 11.11%) were the most commonly adapted treatments. Cognitive Processing Therapy and Problem-Solving Therapy were not adapted for any of the specified underserved target populations identified in this review. There was wide variation in the types of surface- or deep-level cultural adaptations made across psychological interventions.

There were several types of surface-level cultural adaptations identified, including changes to the delivery modality (n=17; 47.22%), setting (n=14; 38.89%), treatment dose (i.e., duration, intensity, or timing) (n=8; 22.22%), use of constituent –involving strategies (n=5; 13.89%), linguistic changes (n=1; 2.78%), and other type of surface-level adaptation (i.e., provision of materials) (n=1, 2.78%). Surface-level cultural adaptations of delivery modality were mostly focused on adaptations of in-person one-on-one interventions (ACT, CBT, CBT-I, eclectic treatments, IRT, MBSR) for telephone delivery for women with breast cancer, rural older adults, post-menopausal women, veterans including veterans living in rural settings, older adults with low-incomes, and adults with multiple sclerosis (42, 45–47, 71, 73, 74, 77, 85), for virtual/digital/online delivery for veteran populations, rural middle-aged and older adults, or pregnant women (48, 50, 72, 75, 77) or for group delivery among women with breast cancer, veterans, and adults with multiple sclerosis (39, 82, 85, 89). Surface-level cultural adaptations to the setting were made to accommodate delivery in a safe and known location such as a patient’s home (63, 64), at home or a community partner site (73, 74), Veterans hospital (43, 49, 51, 53, 58, 89, 90), or at a clinic or cancer wellness center for breast cancer patients (46, 84) or gynecological clinic for pregnant women (50). Eight studies altered the treatment dose, that is the treatment duration, intensity, or timing. Four of these targeted older adults and made adaptions to the treatment duration by either

reducing the duration of individual sessions of BT or MBSR intervention for older veterans or women diagnosed with breast cancer (68, 82), reducing the number of total sessions of CBT for older adults with low-incomes (73) or adding additional monthly booster sessions of CBT for up to 3 months post treatment based on patient preference for older adults from low-income communities (74). An additional study that focused on adapting CBT-I for women with breast cancer undergoing chemotherapy also shortened the session duration (46). One study adapted the treatment intensity by increasing the number of respirations per minute to nine breaths instead of six for the use of biofeedback among veterans with PTSD (61). Additionally, two studies made alterations to the timing of intervention. In particular, the MBSR intervention was delivered after completion of cancer treatment due to peak in stress concurrent to cancer treatment (83). Similarly, Palesh, Scheiber (46) scheduled the CBT-I sessions for in-clinic delivery based on participant's chemotherapy regimen. Five studies incorporated constituent-involving strategies. Of these, two focused on women's sleep health used role models that mirrored the target population; women sleep coaches in a study with menopausal women (45), and a senior woman yoga instructor in a study with older women (55). an additional two studies included non-clinicians in the delivery of CBT-I for older veterans with insomnia, or the delivery of CBT for older adults from low-income backgrounds (35, 74), and one study had CBT-I delivered by specialists in obstetrics and gynecology (50). Of note, Lee, Jong (70) made Other type of surface adaptation by providing materials (i.e., noise machine or fan to reduce noise in bedroom environment) to facilitate the implementation of BT for adults with HIV/AIDS who were unemployed or disabled.

Deep-level cultural adaptations included content-level adaptations (n=11; 30.56%), core component adaptations (n=9; 25.00%), incorporation of sociocultural strategies and cultural values (n=3; 8.33%), linguistic adaptations (n=2; 5.56%), and involvement of family (n=1; 2.78%). Deep-level cultural adaptations of intervention content mostly included the *a priori* inclusion of cancer related experiences to ACT, thoughts and fears of recurrence of cancer to CBT-I and MBSR, and patient reported symptoms following chemotherapy to BT among women breast cancer survivors (40, 64, 77, 82), education about cancer-related circadian changes (46), psycho-education about sleep changes during menopause in CBT-I among postmenopausal women (45), inclusion of trauma-related sleep disturbances to CBT-I or combat-related nightmares for veterans with PTSD in IRT (49, 89), or education on newborn care or infant sleep development (50, 54). Only one study that targeted veterans included general information about military specific factors relating to sleep in BT for combat-exposed military veterans (66). Deep-level cultural adaptations of BT core components included a loosening of sleep hygiene guidelines such as adding one hour to sleep recommendation to reflect the need for more rest in response to chemotherapy for BTs that targeted women with breast cancer (63, 64), substituting sleep compression for sleep restriction therapy, and modifying standard stimulus control instructions in older adult veteran population (68). Three studies with veteran populations changed core intervention components by combining either BT or CBT-I, and IRT to address nightmares in context of insomnia and other sleep disturbances (43, 65, 90) or eliminating sleep restriction altogether (90). An additional two studies targeting pregnant women, either excluded the discussion of sleep restriction from the weekly sessions (50), or modified sleep restriction instructions

such that the sleep window was never less than 5.5 hours (54). Of note, Kahn et al. (87) conducted a deep-level cultural adaptation to a core component of an MBSR, support, and massage-based eclectic therapy through the inclusion of family, or romantic partner (veteran-partner dyads) in the treatment, such that the dyad and not an individual person was the patient. In another study targeting older, sedentary women, the yoga instruction was adapted to better suit the needs of the older women (55). Similarly, a study targeting women with metastatic breast cancer tailored a mindful yoga intervention through the integration of yoga poses that minimized the risk of falling or vertebrae fractures, and chairs to offset balance (62). Three studies incorporated sociocultural strategies and cultural values into the psychological intervention. Specifically, Stanley et al. (73, 74) integrated religion and spirituality in CBT for low-income older adults in both of their studies. In addition, in Scogin, Lichstein (48) psychotherapists delivering an integrated CBT-I and CBT for depression treatment to rural middle-aged and older adults participated in a cultural sensitivity workshop. Two studies made linguistic deep-level cultural adaptations. Specifically, Stanley, Wilson (74) and Scogin, Lichstein (48) used linguistic strategies to adjust the intervention materials to the literacy level of the older adult low-income and rural target population.

Publication Trends of Cultural Adaptations of Psychological Interventions Targeting Sleep-Wake Disorders or Sleep Disturbances.—Figure 3 illustrates the publication trends of surface-level and deep-level cultural adaptations of the peer-reviewed empirical literature published up until January 16, 2020. Of note, 2001 was the first year that a peer-reviewed article that utilized an RCT design and targeted one of the seven underserved groups and met inclusion criteria for this review was published. Overall, 2008 to 2015 saw a marked increase in the number of publications conducting surface-level cultural adaptations and deep-level cultural adaptations to psychological interventions, and the rate of publication of adapted interventions has only increased since 2015 . The publication rate for studies conducting a surface-level cultural adaptation markedly increased from 2015 to January 2020, which mirrors the overall trend for total publications of psychological interventions with underserved groups. Similarly, the overall rate of increase of deep-level cultural adaptations from 2008 to January 2020 appears to have remained the same.

Effectiveness of Cultural Adaptations of Psychological Interventions on Primary Sleep Outcomes by Presence of Sleep Disorder or Sleep Disturbance —Table 5 summarizes the RCT results on effectiveness of included studies on primary sleep outcomes classified according to the likelihood of a sleep disorder or sleep disturbance diagnosis in participant population and by type of primary intervention. Sleep quality (n=40; 71.43%) was the most common primary sleep outcome of included RCTs, followed by insomnia (n=30; 53.57%), sleep efficiency (n=21; 37.5%), sleep duration (n=21; 37.5%), nightmare frequency (n=8; 14.29%), and sleepiness (n=4; 7.14%).

Results of Culturally Adapted Intervention Studies among Participants with a Definite Sleep Disorder or Sleep Disturbance Diagnosis.—Overall, 20% of the RCTs of adapted behavioral treatments (BTs) included participants with a definite

sleep disorder or sleep disturbance diagnosis and results documented reductions in insomnia symptoms but no other sleep outcomes compared to control conditions (Table 5). Specifically, a deep-level culturally adapted combined BT-IRT intervention and a deep-level culturally adapted BT intervention found significant improvement in insomnia symptoms versus pharmacotherapy among veterans with a definite endorsement of sleep disorder or disturbance (insomnia, nightmares and poor sleep quality) at enrollment, but no statistically significant group differences in nightmare frequency, sleep duration, or sleep efficiency (65, 66).

All of the RCTs of adapted CBT-I targeted adults with a definite sleep disorder or sleep disturbance, namely insomnia or insomnia symptoms assessed at enrollment. By and large, the majority of the surface-level and deep-level cultural adaptions were made to CBT-I. Of the 14 RCTs testing adapted CBT-I among participants with a definite insomnia diagnosis, 11studies documented significant improvement in insomnia symptoms among those who received a surface-level and/or deep-level culturally adapted CBT-I intervention (35, 40, 43, 45, 46, 48–51, 53, 54) compared to sleep hygiene education, healthy eating education condition, wait-list control, group prenatal visits, modified pseudodesensitization therapy for insomnia, or usual care controls. One did not find significant between group differences (47), and two did not measure insomnia symptoms (39, 42). Relatedly, two out of eight RCTs that tested an adapted version of CBT-I among women with breast cancer with an insomnia diagnosis and included sleep duration as a primary sleep outcome found statistically significant improvement in sleep duration favoring an adapted group-delivered CBT-I intervention (39), and an adapted CBT-I intervention with deep-level content adaptations (e.g., thoughts and fears related to the recurrence of cancer) (40). The remaining six studies that tested an adapted CBT-I intervention among those with insomnia did not find any statistically significant between group differences in sleep duration (43, 45, 47, 48, 51, 68). Ulmer et al. (49) combined CBT-I and IRT for veterans and found that the adapted intervention resulted in significant improvements in sleep duration and nightmare frequency compared to usual care.

Six out of the 14 RCTs that tested an adapted CBT-I intervention among participants with insomnia found significant improvements in self-reported or actigraphy-based sleep efficiency (35, 40, 43, 45, 47, 48). Similarly, seven out of 14 RCTs that tested adapted CBT-I found significant improvements in sleep quality (35, 39, 40, 43, 45, 48, 49). However, two studies did not find statistically significant differences in sleep quality by treatment condition (42, 50). Importantly, Alessi et al. (35), one of the highest quality studies (Table 3), found significant improvements in insomnia, actigraphy-based sleep efficiency, and sleep quality in favor of adapted CBT-I among older veterans with insomnia.

Half of the RCTs (n=2) of adapted CAM interventions were conducted with participants with a definite sleep disorder or sleep disturbance. These two culturally adapted CAM therapies generated significant between group differences that favored the adapted intervention among participants with restless legs syndrome or poor sleep quality. Specifically, a yoga intervention with both deep-level and surface-level cultural adaptations for older adults with restless legs syndrome, and a mind-body bridging intervention with surface-level cultural adaptations for veterans with poor sleep quality resulted in significant

improvements favoring the adapted intervention over the control condition for insomnia reduction, longer sleep duration, and better sleep quality (55, 58). Similarly, all of RCTs of adapted IRT (n=2) were conducted with participants with a definite sleep disturbance. These two RCTs of deep-level culturally adapted IRT interventions among participants with a definite nightmares and poor sleep quality disturbances at enrollment did not report significant between group differences in nightmare frequency or sleep quality in veterans (89, 90). Of note, the only RCT of an adapted intervention to report effect on sleepiness found that an adapted CBT-I intervention did not generate significant between group differences in sleepiness reduction compared to usual care in participants with insomnia (51, 58).

Results of Culturally Adapted Intervention Studies among Participants with a Probable or Potential Sleep Disorder or Sleep Disturbance Diagnosis.—All of the RCTs testing adaptations of ACT were conducted among participants with a probable or potential sleep disturbance. None of these culturally adapted RCT studies (n=2) produced significant improvements in sleep efficiency (77) or sleep quality (75). Findings were mixed for the remaining three RCTs testing adapted BTs against various comparators among participants with a probable or potential sleep disturbance. Berger et al. (63, 64) found that a surface and deep-level cultural adaptation of BT versus a healthy eating lifestyle intervention significantly improved sleep quality for women with breast cancer and with potential sleep disturbances at enrollment at 30-days (63) and at 90-days (64) but not at 1-year (64). Similarly, in an RCT of a surface-level cultural adaptation of BT among adults diagnosed with HIV/AIDS with a probable or potential sleep disturbance, the adapted BT that included provision of materials (e.g., noise machine or fan to reduce noise in bedroom) compared to an attention control group did not generate significant between group differences in sleep duration; however, the adapted BT significantly improved sleep efficiency and sleep quality measured via self-report (70). Importantly, Martin et al. (68), one of the highest quality studies included in this review, did not find any statistically significant between group differences in insomnia, sleep duration, and sleep quality, though significant differences in self-reported sleep efficiency were found in favor of adapted BT versus the sleep education control condition in older veterans with a potential sleep disturbance diagnosis at enrollment.

All of the RCTs of adapted CBT were conducted among participants with a probable or potential sleep disturbance. Outcomes for these trials were also mixed, though most studies documented null effects. Specifically, Brenes et al. (71) documented that a surface-level culturally adapted telephone-delivered CBT versus non-directive telephone-delivered supportive therapy improved insomnia symptoms at four-, nine-, and 15-month follow-up (71) among rural older adults with a probable sleep disturbance at enrollment. However, a similarly adapted telephone-delivered CBT versus an in-person version did not generate significant between group differences in sleep quality in veterans with chronic back pain and with a potential sleep disturbance at enrollment (72). Similarly, a surface and deep-level cultural adaptation of a CBT program for rural older adults from low-income backgrounds compared to resource counseling (73, 74) did not generate significant group differences in insomnia among participants with a probable or potential sleep disturbances at enrollment.

The remaining half of RCTs of adapted CAM interventions were conducted with participants with probable or potential sleep disturbance and yielded largely null or inconsistent effects. For example, a surface-level adapted biofeedback intervention for veterans compared to a wait-list control did not generate significant treatment group differences in sleep duration or sleep quality (61). Moreover, a yoga intervention with deep-level cultural adaptations targeting women with metastatic breast cancer resulted in worse sleep quality scores at three months compared to a social support intervention, but did not generate significant treatment differences at eight weeks or six months follow-up (62).

All of the RCTs testing adapted eclectic therapies (n=2) were conducted among participants with a probable or potential sleep disturbance. Of these, a positive psychology intervention culturally adapted for group and telephone-delivery for adults with multiple sclerosis compared to a wait-list control did not generate significant group differences in sleep quality (85). In contrast, a mindfulness, support, and massage-based dyadic intervention that included surface-level (online delivered) and deep-level (involvement of family) cultural adaptations resulted in significant improvements in sleep quality at 8 week follow-up among a veteran sample (87).

Similarly all of the RCTs testing adapted MBSR interventions were conducted with participants with a probable or potential sleep disturbance. Results largely indicate no statistically significant between intervention group differences in sleep duration, sleep efficiency, or sleep quality (82, 83). However, a surface-level and deep-level culturally adapted MBSR intervention resulted in significant improvements in sleep efficiency at 12 weeks compared to usual care among women with breast cancer and a probable/potential sleep disturbance diagnosis (82). An additional surface-level cultural adaptation of MBSR compared to an active control condition resulted in significant improvements in sleep quality among women with breast cancer and a probable or potential sleep disturbance (84).

DISCUSSION

Our systematic review of the peer-reviewed English-language literature on RCTs conducted in the United States that tested psychological interventions for prevalent sleep-wake disorders and sleep disturbances found that only 6.97% of the published literature or 56 studies out of 803 full-text articles assessed for eligibility targeted an underserved or high risk adult group, defined as racial/ethnic minorities, women, low socioeconomic status groups (those who are unemployed, low income, low educational attainment), immigrants, sexual orientation minorities, veterans, or those with disabilities, and included a primary sleep outcome. Of included RCTs, 64.29% conducted a surface-level or deep-level cultural adaptation of a psychological intervention for prevalent sleep-wake disorders or sleep disturbances to address the target underserved or high risk population. The effectiveness of the culturally adapted interventions versus control conditions on important sleep outcomes varied by the type of psychological intervention and by the participant population, specifically whether participants had a definite, probable, or potential sleep disorder or sleep disturbance diagnosis at enrollment. We summarize key findings below and offer recommendations for future intervention research in this area.

Our first aim was to examine the extent to which sociodemographic characteristics were reported in RCTs of psychological interventions for prevalent sleep-wake disorders that targeted seven specified underserved groups. Overall, there was a lack of racial/ethnic, socioeconomic, sexual orientation, and linguistic diversity in the sample composition. Specifically, most studies were conducted with majority White samples (64.86%) and with a small representation of Asians (only 4.06%), Latina/os (9.45%), and American Indians/Alaska Natives (percentage unknown because often collapsed into the Other Ethnicity category, 9.23%), percentages that do not reflect the demographic composition of the United States (92). Of note, while on average, 28.16% of RCT participants were Black, which is more reflective of the composition of Black Americans in the United States (92), this percentage is driven by a few studies that recruited large samples of Black participants (42, 51, 73, 74). Importantly, some studies did not report the racial/ethnic composition of the sample in the published manuscript (44, 58, 81, 86). About half of the sample (55.35%) was composed of women (arguably mostly non-Hispanic White women), and similarly 44.64% of included trials targeted veterans. Most of the trial participants had high levels of educational attainment (average was 14.42 years), though there was more representation of lower income categories (<$20,000) across included studies than what is typically observed in RCTs. Six studies reported disability status (48, 69, 72, 73, 83, 85) and two studies targeted unemployed populations (68, 70). Two trials included rural adults (48, 71). By and large, none of the included RCTs explicitly focused on or reported data on sexual orientation or gender minorities, immigrant groups, or linguistic minorities, with two exceptions (54, 70). While it is possible that we may have missed RCTs that may have included immigrants, non-English speakers, and sexual or gender minorities but did not report these sociodemographic data, these omissions in data collection and data reporting reflect important limitations. The lack of RCTs directly testing interventions in linguistic minority communities in the US is particularly problematic in light of the fact that 85% of US immigrants aged 5 years or older speak a language other than English at home, and that 28.9% do not speak English at all or not well (93). Consistent with calls for increasing the diversity of psychological trials more generally as a means to enhance generalizability (94), future RCTs of psychological interventions in behavioral sleep medicine should seek to expand the representativeness of the participant sample to be more inclusive of underserved groups, and thereby increase the percentage of racial/ethnic minorities, those who are unemployed, sexual orientation and gender minorities, linguistic minorities, immigrants, those with disabilities, and those living in rural settings who participate in these trials. Moreover, while inclusion of racial/ethnic minorities and women is required for federally-funded research per the 1993 National Institute of Health Revitalization Act and its subsequent policy derivatives (95), and the CONSORT statement (96) instructs investigators to include a table showing baseline demographic and clinical characteristics for each intervention group, there were several studies that did not provide this information. Stronger enforcement of the NIH reporting policies and CONSORT statement is needed in order to assess sample representativeness, ensure inclusiveness, and evaluate generalizability.

Our second aim was to identify the extent to which investigators made surface-level or deep-level cultural adaptations to psychological interventions for prevalent sleep-wake

disorders or sleep disturbances to address important cultural and contextual factors. To that end, 64.29% of included RCTs conducted either a surface- and/or deep-level cultural adaptation. By far, the most common surface-level cultural adaptations included changes to the delivery modality (from in-person one-on-one to telephone, online, virtual, video-based, or group-based models) and setting (in home-delivery, primary care offices, community sites). Other surface-level cultural adaptations included changes to the treatment dose (e.g., shortening the treatment duration, alterations to the timing of intervention or intensity), and constituent –involving strategies (delivery of intervention by non-clinicians). Deep-level cultural adaptations mostly included content-level adaptations, such as the integration of cancer related experiences and fears of recurrence, or menopause-related sleep changes, or psycho-education about trauma, or infant development into the intervention. Deep-level cultural adaptations to core treatment components often included the combination of two treatments (e.g., CBT-I or BT and IRT), or modifying stimulus control instructions or sleep restriction therapy to better suit the health needs or limitations of the target populations (e.g., limiting sleep restriction to five hours for pregnant women). Other deep-level cultural adaptations such as the involvement of family, the incorporation of sociocultural strategies and cultural values into the psychological interventions were disproportionately less common, and occurred in only four studies (48, 73, 74, 87). Similarly, deep-level linguistic strategies such as revising the intervention materials to match the literacy level of participants were also less common, occurring in only two studies (48, 74). None of the RCTs that conducted deep-level cultural adaptations actively targeted social support and social networks into the intervention, which represent an important gap. While an estimated 51% of the US population demonstrate low level English literacy skills that are indicative of difficulties with performing complex tasks that require higher level reading skills or problem solving (97) the literacy level of intervention content is rarely reported in RCTs of psychological interventions. Further, the average educational attainment of RCT participants in this review was over 14 years. In order to ensure access to high quality mental health care for all, and adequately address mental health care disparities, it will be imperative that psychological interventions are developed with greater attention to general literacy, numeracy, and health literacy.

Our third aim was to describe the effectiveness of the culturally adapted psychological interventions for prevalent sleep-wake disorders and sleep disturbances on important primary sleep outcomes by participant population and intervention type. Of adapted RCTs, roughly 56% included participants with a definite diagnosis of a sleep disorder or endorsement of a sleep disturbance, 14% included participants with a probable sleep disturbance, and 31% included participants with a potential sleep disturbance at enrollment. Most of the surface-level and deep-level cultural adaptations were made to CBT-I, BT, CBT, and CAM interventions. Importantly, all of the RCTs of adapted CBT-I and IRT were conducted among participants with a definite sleep disorder or sleep disturbance. In contrast, all of RCTs on adapted ACT, CBT, MBSR, and eclectic therapies were conducted among participants with a probable or potential sleep disturbance. Overall, participant population appeared to pattern intervention effectiveness. There were more consistent and statistically significant between group differences documented favoring the adapted intervention against comparators in RCTs conducted among participants with a definite sleep disorder or sleep

disturbance, whereas a preponderance of null and inconsistent findings were documented in RCTs of adapted interventions conducted among participants with a probable/potential sleep disorder or sleep disturbance, For example, 78% of RCTs testing an adapted CBT-I intervention among participants with a definite insomnia diagnosis showed significant reductions in insomnia (and to a lesser extent sleep quality) in favor of the culturally adapted intervention versus other comparators. Similarly, RCTs of adapted BT and CAM interventions conducted in participant populations with a definite sleep disorder or sleep disturbance diagnosis also showed significant improvements in insomnia and sleep quality compared to various controls. Yet, the results were markedly less consistent for RCTs of adapted BTs, CBTs, and CAM interventions (e.g., yoga, mind-body bridging) conducted among participants with a probable or potential sleep disorder or sleep disturbance. Further, cultural adaptations of IRT, MBSR, ACT, and eclectic therapies did not produce consistent between intervention group differences in primary sleep outcomes (75, 77, 82, 83, 85, 87, 89), with two exceptions (82, 87). None of the RCTs tested cultural adaptations of CPT and PST, and this represents a significant gap and important area for future research. Moreover, only three RCTs (42, 72, 75) (5.3%) tested the effectiveness of a surface-level culturally adapted behavioral intervention (i.e., CBT-I, ACT, and CBT) against the same un-adapted intervention documenting no statistically between group differences in sleep quality. Future research should test the incremental effects of cultural adaptations against un-adapted treatments where possible (23). This type of comparative research will also help identify the surface or deep-level cultural adaptations required to improve effectiveness for all behavioral sleep interventions compared to un-adapted interventions, and identify which aspects of sleep interventions require adaptation.

Importantly, knowledge into these cultural adaptation factors and their effect on outcomes will help inform broad behavioral sleep medicine implementation and dissemination efforts. Collectively, these findings suggest that, on balance, psychological interventions for sleep disorders with cultural adaptations generally resulted in improved sleep outcomes particularly for interventions that targeted participant populations with a definite sleep disorder or sleep disturbance diagnosis determined by systematic assessment at study enrollment. The evidence of improved sleep outcomes, particularly insomnia and sleep quality for culturally adapted CBT-I, BT, and CAM interventions against comparators in RCTs with participants with a definite insomnia diagnosis or poor sleep quality appears to be quite strong and consistent. Herein, we reviewed both surface-level and deep-level cultural adaptations and did not prioritize one type of cultural adaptation over another. Future research should examine whether specific types of cultural adaptations or the number of cultural adaptations modify the effectiveness of a psychological intervention targeting sleep-wake disorders and sleep disturbances among underserved populations.

Our systematic review has several limitations. First, the heterogeneity in interventions, analytic method, article quality, types of cultural adaptations, and outcome measures prevented us from conducting a meta-analysis. We also included only English-language articles, which may contribute to publication bias. Second, as with any systematic review, we may have missed articles that met our inclusion criteria and particularly those that appeared in the grey literature. While we used multiple databases including those that identify conference proceedings and ongoing trials, as well as multiple coders to mitigate

this limitation, our findings could be influenced by the absence of a more exhaustive search of the grey literature (e.g., search of National Technical Information Service (NTIS) database and PsycEXTRA). Relatedly, none of the included RCTs targeted obstructive sleep apnea, or circadian-rhythm sleep-wake disorder shift-work type, despite our explicit inclusion in our search strategy; only one study included participants with a sleep disorder diagnosis of restless legs syndrome. As such, research that explores the development and testing of RCTs of cultural adaptations of psychological interventions targeting these sleep disorders is warranted. Third, our measure of methodological quality or risk of bias did not capture the variance in analytic methods across studies and relied on subjective assessment of risk domains. Relatedly, the risk of bias tool we used did not assess for fidelity to the study protocol when assessing performance bias, which may influence intervention effectiveness. However, we used multiple coders and a well-validated assessment tool to evaluate risk of bias to mitigate this limitation.

CONCLUSION

While access to high quality, patient-centered health care that is linguistically and culturally sensitive is a national health priority (98), disparities in access to high quality mental health care persist (99), including mental health care for the resolution of sleep-wake disorders and sleep disturbances. The development, testing, and dissemination of cultural adaptations of efficacious and effective psychological interventions for prevalent sleep-wake disorders and sleep disturbances are one means to address these disparities in mental health care for prevalent sleep-wake disorders and sleep disturbances. However, our systematic review found that only 6.97% of RCTs of psychological interventions targeted an underserved adult group in the United States and met the remaining inclusion criteria. None of the extant RCTs explicitly targeted linguistic minorities, immigrants, or LGBTQ adults, and there was limited racial/ethnic and socioeconomic diversity in the sample composition. Of those trials, 64.24% conducted either a surface-level or deep-level cultural adaptation. Most RCTs that conducted surface-level cultural adaptations made changes to the delivery modality or setting, whereas most RCTs that conducted deep-level cultural adaptations made changes to the content or the core components of the intervention. While RCTs testing adapted CBT-I interventions showed significant improvements in sleep outcomes in favor of the culturally adapted interventions versus other comparators, the results were less consistent for RCTs of adapted BTs, CBTs, and CAM interventions, and potentially dependent on participant population, specifically whether there was the presence of a definite, probable, or potential sleep disorder or disturbance at enrollment. In order to meet the demand for behavioral health specialists who can adequately treat sleep-wake disorders and sleep disturbances in an increasingly diverse United States of America, it will become imperative for intervention scientists to better leverage evidence-based approaches to cultural adaptations of behavioral health interventions (21) for prevalent sleep-wake disorders and sleep disturbances.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

ACT	Acceptance and commitment therapy
BT	Behavioral therapy
CAM	Complementary and alternative medicine
CBT-I	Cognitive behavioral therapy
CBT-I	Cognitive behavioral therapy for insomnia
CPT	Cognitive processing therapy
IRT	Imagery rehearsal therapy
LGBTQ	Lesbian, gay, bisexual, transgender, and queer
MBSR	Mindfulness-based stress reduction
PST	Problem-solving therapy
RCT	Randomized Controlled Trial

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Practice Points

- Only 6.97% of randomized controlled trials of psychological interventions for prevalent sleep-wake disorders or sleep disturbances ever published targeted an underserved adult subgroup (i.e., veterans, women, racial/ethnic minorities, low socioeconomic status, those with a disability).
- None of the included studies explicitly targeted linguistic minorities, immigrants, or LGBTQ adults, and there was limited racial/ethnic and socioeconomic diversity in the sample composition.
- Nearly 65% of randomized controlled trials tested psychological interventions with surface-level or deep-level cultural adaptations. Surface-level cultural adaptations to delivery modality and setting were most common.
- On balance, psychological interventions for sleep disorders with cultural adaptations generally resulted in improved sleep outcomes, though the evidence appears to be more consistent for culturally adapted CBT-I interventions among participants with a definite sleep disorder or sleep disturbance.

Research Agenda

- Future RCTs of psychological interventions in behavioral sleep medicine should seek to expand the diversity of the participant sample, and thereby enhance generalizability.
- The average educational attainment of RCT participants in this review was over 14 years. In order to ensure access to high quality mental health care for all, it will be imperative that psychological interventions are developed with greater attention to general literacy, numeracy, and health literacy concerns.
- Future research should examine whether specific types of cultural adaptations or the number of cultural adaptations modify the effectiveness of a psychological intervention targeting sleep disorders among underserved populations.

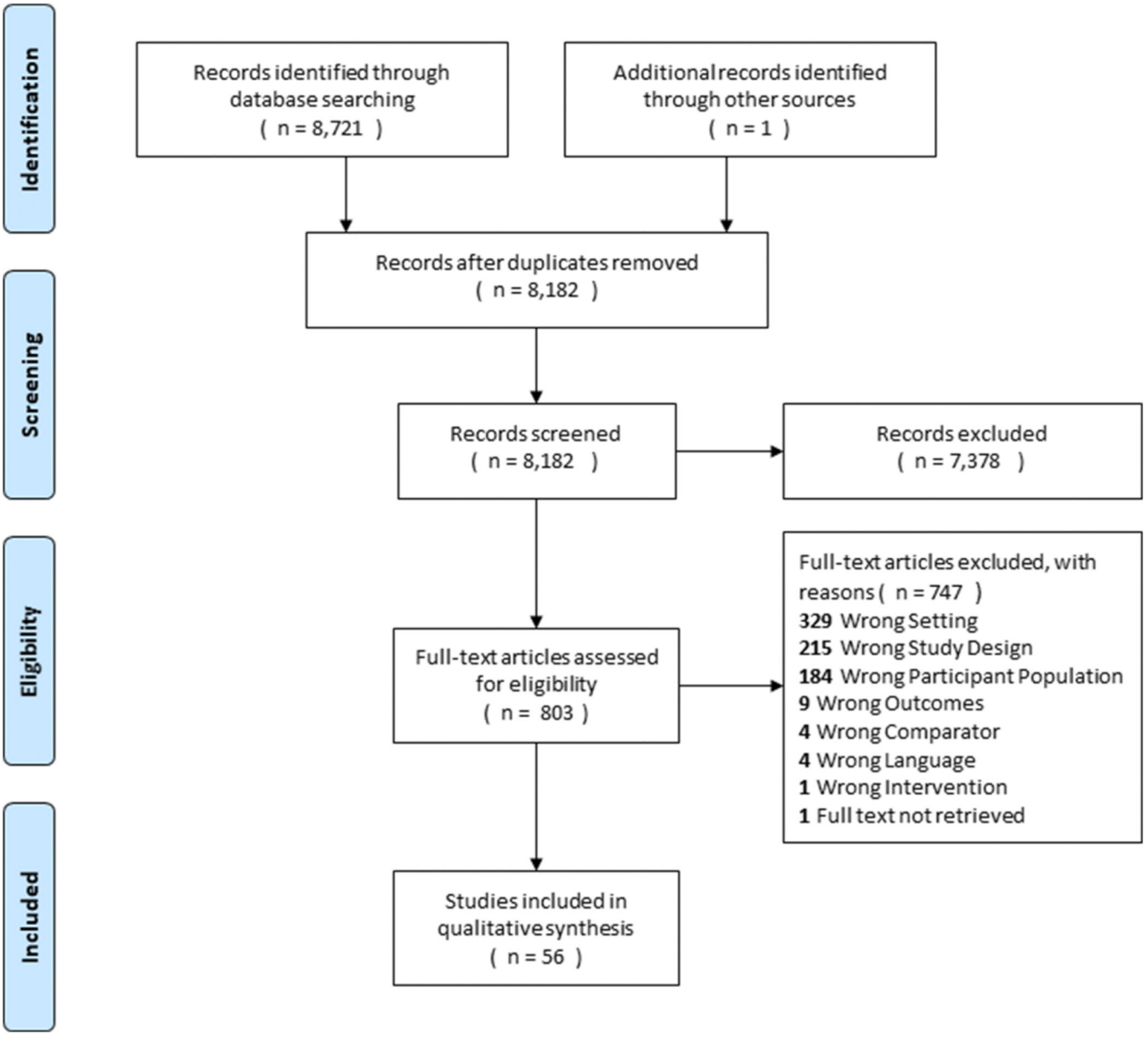

Figure 1.

PRISMA Flowchart of Review of Cultural Adaptations of Psychological Interventions for Prevalent Sleep Disorders and Sleep Disturbances. Final n includes two articles from one study (Berger et al, 2009a, Berger et al., 2009b).

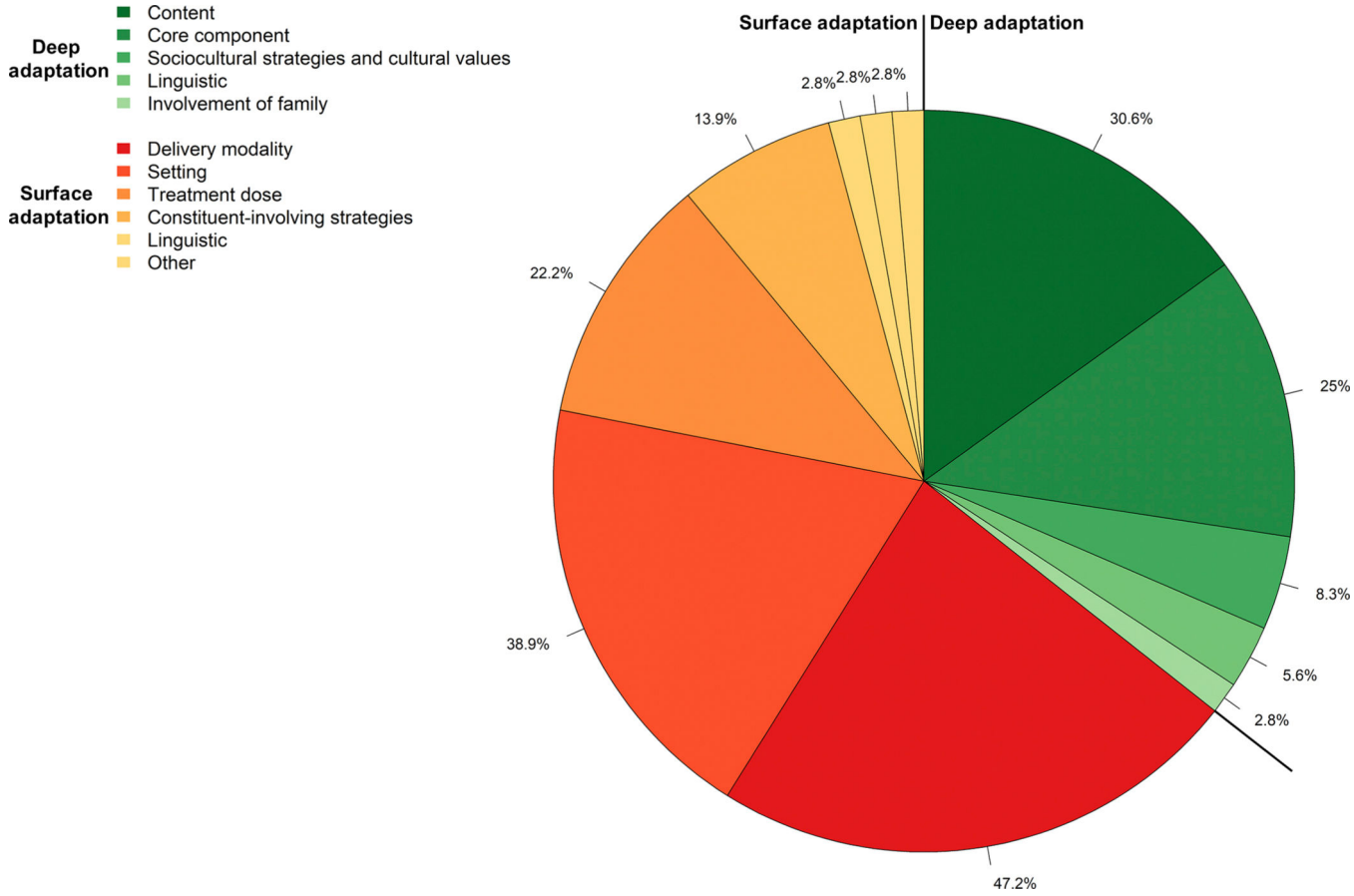

Figure 2.

Legend. Types of Surface-Level and Deep-Level Cultural Adaptations of Psychological Interventions for Prevalent Sleep Disorders and Sleep Disturbances. Percentages reflect the ratio of the number of times a specific type of cultural adaptation was made to the total number of studies testing adapted interventions multiplied by 100.

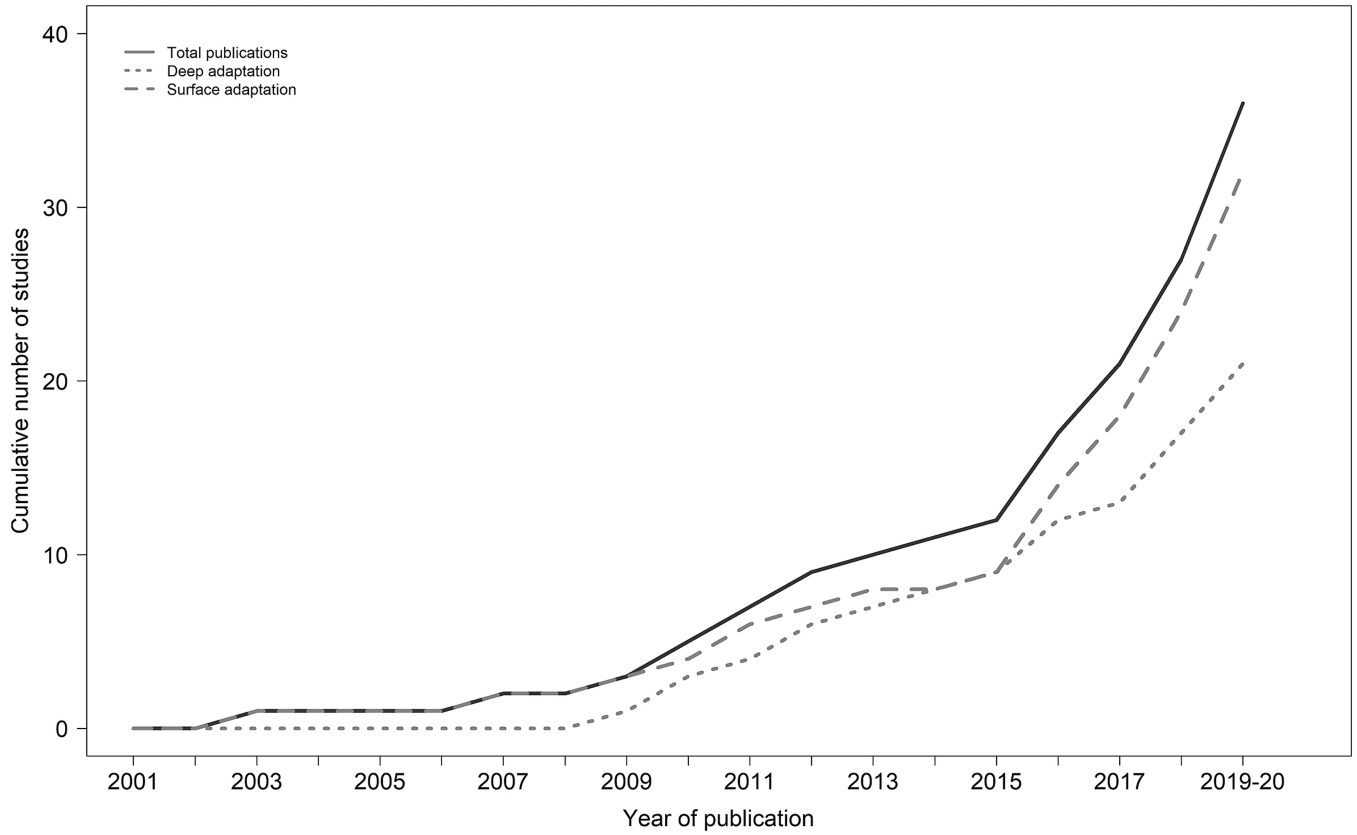

Figure 3.

Legend. Publication Trends of Cultural Adaptations of Psychological Interventions for Prevalent Sleep Disorders and Sleep Disturbances.

Table 1.

Study characteristics of included studies of Cultural Adaptations of Psychological Interventions for Prevalent Sleep-Wake Disorders (N =56)

Article	Underserved population	N	Women (%)	White (%)	Latino (%)	Black (%)	Asian (%)	Other (%)	Age M (SD)	Education M (SD); %)[a]	Income (%)	Disability (%)	Unemployment (%)
Acceptance and Commitment Therapy													
75. Herbert et al., 2017	Veterans with chronic, nonterminal pain condition	129	7.8	47.0	14	28	5	6	52 (13.3)	-	< $20,000 : 36	-	-
76. Lang et al., 2017	Veterans	160	20.0	75.0	13.1	11.3	3.8	10	34.2 (8)	14.2 (2.1); HS or less 20.2	< $10,000 : 13.1 $10,000 −24,999: 25.6	-	26.9
77. Mosher et al., 2018	Women with Stage IV breast cancer	47	100	89.4	-	-	-	-	Tx: 59.3 (12.0); Ctrl: 53.3 (10.9)	Tx: 14.3 (2.1); Ctrl: 14.5 (2.6)	≤ $50,999 : 31.9	-	4.3
Behavioral Therapy													
63, 64. Berger et al., 2009[a,bc]	Women with breast cancer	219	100	96.5	3.5	-	-	-	Tx:51.6; Ctrl: 52.9	≤ HS 19.7	< $20,000 : 5.8	-	-
69. Gebara et al., 2019	Older veterans	11	27.3	81.8	-	18.2	-	-	Tx: 64 (2.5); Ctrl: 66.2 (5.4)	<HS 18.2	-	27.3	-
65. Germain et al., 2012	Veterans with sleep complains	50	10.0	82.0	-	-	-	-	Tx: 40 (14.1); Ctrl1: 39.4 (11.9); Ctrl2: 43.6 (14.)	-	-	-	-
66. Germain et al., 2014	Combatexposed Military Veterans	40	15.0	78.0	-	-	-	-	Tx: 40.9 (12.0); Ctrl: 35.9 (11.2)	-	-	-	-
67. Johnson et al., 2016	Veteran men with nocturia	72	0	47.2	1.4	45.8	-	4.2	Tx: 66.2 (12.8); Ctrl.1: 63.7 (11.7); Ctrl.2: 67.8 (10.8)	-	< $30,000 : 61.1	-	-
70. Lee et al., 2020[d]	Adults diagnosed with	51	26.0	49.0	-	38.	-	-	57 (6.8)	≤ HS 28	-	-	100[e]
	HIV/AIDS with fatigue												

Article	Underserved population	N	Women (%)	White (%)	Latino (%)	Black (%)	Asian (%)	Other (%)	Age M (SD)	Education M (SD); %)[a]	Income (%)	Disability (%)	Unemployment (%)
68. Martin et al., 2017	Veterans 60 yrs or older	42	7.1	71.4	-	-	-	-	77.1 (9.9)	14.5 (2.5)	-	-	100
Cognitive Behavioral Therapy													
71. Brenes et al., 2016	Rural older adults	141	81.6	90.8	-	5.7	-	3.5	66.8 (6.2)	< HS: 5	≤ $24,999 : 23.4	-	-
72. Heapy et al., 2017	Veterans with chronic back pain	125	22.4	64.5	7.3	25.8	-	2.4	57.9 (11.6)	13.9 (2.1)	-	18.4	15.2
73. Stanley et al., 2016	Older adults from lowincome, or minority communities with anxiety worry	40	9.0	15.0	2.5	82.5	-	2.5	62.9 (8)	13.6 (1.8)	< $10,000 : 38.5 $10,000 - $20,000 : 28.2	26.3	-
74. Stanley et al., 2018	Older adults from lowincome, or minority communities with anxiety or worry	134	81.3	17.1	4.5	76.8	-	1.5	66.9 (9.2)	13.6 (2.8)	< $10,000 : 26.9	-	-
Cognitive Behavioral Therapy for Insomnia													
35. Alessi et al., 2016	Older veterans with insomnia	159	3.1	78.6	6.3	4.4	-	7.6	72.2 (7.7)	< HS: 3.8, HS: 15.7	-	-	76.1
50. Cain et al., 2019	Pregnant women	53	100	41.5	26.4	56.6	-	3.8	29.1 (5.6)	-	-	-	-
51. Chakravorty et al., 2019	Alcoholdependent veterans	22	0	-	-	73	-	-	54.5 (6.9)	12 (0.8)	-	-	64
36. Drake et al., 2019	Postmenopaus al women with insomnia	150	100	52.0	0.7	39.3	-	2	56.4 (5.6)	-	-	-	-
38. Edinger et al., 2009	Veterans with insomnia	81	13.6	58.0	-	-	-	-	54.2 (13.7)	-	-	-	-
37. Edinger & Sampson, 2003	Veterans	20	14.0	75.0	0	25	0	0	51 (13.7)	-	-	-	-
39. Epstein & Dirksen, 2007	Women with breast cancer	72	100	95.8	0	2.8	0	1.4	Tx: 57.1 (9.8); Ctrl: 59.1 (10.6)	Tx: 15.7 (3); Ctrl: 15.2 (2.5)	-	-	-
40. Fiorentino et al., 2010	Breast cancer survivors	14	100	85.7	7.1	-	7.1	7.1	61 (11.6)	-	-	-	-

Article	Underserved population	N	Women (%)	White (%)	Latino (%)	Black (%)	Asian (%)	Other (%)	Age M (SD)	Education M (SD); %)[a]	Income (%)	Disability (%)	Unemployment (%)
41. Fung et al., 2016	Older veterans	134	3.0	78.4	-	-	-	-	72.2 (7.7)	<HS 4.5; HS 14.2	-	-	-
52. Kalmbach et al., 2019	Postmenopaus al women	150	100	52	0.7	39.3	-	2	56.4 (5.6)	-	-	-	28.7
42. Laurel Franklin et al., 2018	Rural veterans with PTSD	18	0	28	-	66	-	6	53.8 (12)	HS 22.3	-	-	28
54. Manber et al., 2019[f]	Pregnant women	179	100	48	38	3.4	14.5	28.5	33	-	-	-	-
43. Margolies et al., 2013	Veterans with PTSD	40	10.0	40	-	60	-	-	37.7 (9.1)	-	-	-	-
44. Matthews et al., 2014	Women breast cancer survivors with chronic insomnia	56	100	-	-	-	-	-	Tx: 52.2 (6.9); Ctrl: 52.9 (7.8)	C: 66.1	Tx: $60,001 $80,000 ; Ctrl: $40,001 $60,000 [b]	-	-
45. McCurry et al., 2016	Postmenopaus al women with insomnia symptoms and hot flashes	106	100	91.5	-	0.9	-	7.6	54.8 (4.2)	< HS or GED: 4.7	-	-	-
46. Palesh et al., 2018	Women with Stage I-III breast cancer undergoing chemotherapy	71	100	9	0	3	1	0	52.5 (9.8)	-	-	-	-
47. Pigeon et al., 2017	Veterans with a diagnosis of MDD and sleep problems	27	11.1	81.5	-	18.5	-	-	-	< HS 7.4; HS 37	-	-	29.6
53. Pigeon et al., 2019	Veterans	50	20.0	70	4	-	-	-	54.8	≤ HS or GED 38	-	-	-
48. Scogin et al., 2018	Rural middleaged and older adults	40	90	57.5	-	-	-	-	58.1 (5.6)	Tx: 13.5 5); Ctrl: 12.7 (1.9)	-	32.5	17.5
49. Ulmer et al., 2011	Veterans with PTSD	22	38.8	33.3	-	33.3	-	33.3	46 (11.1)	-	-	-	-
Cognitive Processing Therapy													
78. Galovski et al., 2016	Women interpersonal assault survivors	92	100	50	3	50	-	20	36.9 (11.8)	14.2 (2.9); > HS: 50%	≤ $20,000 : 74	-	-

Article	Underserved population	N	Women (%)	White (%)	Latino (%)	Black (%)	Asian (%)	Other (%)	Age M (SD)	Education M (SD); %)[a]	Income (%)	Disability (%)	Unemployment (%)
79. Galovski et al., 2009	Women sexual assault survivors suffering from PTSD	108	100	84.3	-	-	-	-	33 (10.)	15 (2)	≤ $20,000 : 29.6	-	-
80. Gutner et al., 2013	Women rape victims with PTSD	171	100	71.6	-	25.4	-	3	ITT sample 32 (10)	14.4 (2.3)	-	-	-
Complementary and Alternative Therapy													
55. Innes & Selfe, 2012	Older women	20	100	75	-	25	-	20	Tx: 58.4 (2); Ctrl: 58.9 (2.9)	<4 years C: 35%	-	-	35
56. Irwin et al., 2017	Breast cancer Survivors with insomnia	90	100	85.6	-	-	-	-	Tx: 59.6 (7.9); Ctrl: 60 (9.3)	Tx: 15.8 (1.2); Ctrl: 15.7 (1.4)	-	-	38.9
61. Jamison et al., 2019	Veterans with current or recent PTSD	80	12.5	43.8	-	22.5	7.5	26.3	53.1 (10.8)	-	-	-	-
57. Nakamura et al., 2017	Veterans with Gulf War Illness Symptoms	60	10	85	8.3	6.7	0	5	50.7 (7.3)	-	-	-	-
58. Nakamura et al., 2011	Veterans with self-reported sleep disturbance	63	4.8	-	-	-	-	-	Tx: 49.9 (10.3); Ctrl: 53.8 (10.4)	-	-	-	-
59. Nidich et al., 2016	Men in prison	181	0	52.5	6.6	16	-	24.9	29	-	-	-	-
62. Porter et al., 2019	Women with metastatic breast cancer	63	100	74	-	-	-	-	57.3(11.5)	17(6.9); HS/SC: 28.6	≤ $50,000 : 39.7	-	71.4
60. Stoerkel et al., 2018	Women with breast cancer for whom surgery would be their initial treatment	100	100	54	14	20	4	-	31–35: 1%; 36–45: 11%; >45: 81%	<HS:0; HS: 10%	-	-	-
Eclectic Therapy													
85. Alschuler et al., 2018	Adults with multiple sclerosis that causes disability	28	92.9	82.1	-	7.1	3.6	3.6	Tx: 59.8 (7.7); Ctrl: 59.8 (6.5)	HS or GED: 7.1%	-	100	-
86. Church et al., 2016	Veterans with PTSD	21	33.0	-	-	-	-	-	56	-	-	-	-
87. Kahn et al., 2016	Veterans	160	18.8	52.5	25.4	11.6	5	7.7	33.4 (6.6)	< HS: 0; HS or GED: 11	-	-	-
Imagery Rehearsal Therapy													

Article	Underserved population	N	Women (%)	White (%)	Latino (%)	Black (%)	Asian (%)	Other (%)	Age M (SD)	Education M (SD); %)[a]	Income (%)	Disability (%)	Unemployment (%)
89. Cook et al., 2010	Male veterans with chronic, severe PTSD	124	0	41.9	-	51.6	-	6.4	59.4 (3.6)	<HS: 15.3; HS: 39.5	-	-	30.3
90. Harb et al., 2019	Veterans	108	13.9	58.3	-	37	-	4.6	37.1	≤ HS 34.3	-	-	56.5[e]
88. Krakow et al., 2001	Women sexual assault survivors with PTSD	168	100	62.5	-	-	-	37.5	Tx: Completer 40 (11.2), Noncompleter 37 (12.7); Ctrl: Completer 36 (9.3), Noncomple	< C: 62	≤ $10,000 : 45 ter 31 (10.5)	-	-
Mindfulness-based Stress Reduction													
81. Cash et al., 2015	Women with fibromyalgia	91	100	-	-	-	-	-	-	-	-	-	-
82. Lengacher et al., 2015	Women diagnosed with breast cancer	79	100	73.4	11.4	10.1	-	5.1	57 (9.7)	<HS: 20	< $10,000 : 11.7 $10,000 - $20,000 : 20.8	-	-
83. Shapiro et al., 2003	Women with Stage II breast cancer who were cancerfree at the time of the study	63	100	85.7	7.9	3.2	-	-	57 (9.7)	HS: 49.2	-	14.3	-
84. Witek Janusek et al., 2019	Women with breast cancer	164	100	76.8	4.3	14	1.2	1.8	55.1	-	$10,000 - $29,000 : 17.7	-	-
Problem-solving Therapy													
91. Bedford et al., 2018	College student veterans with at least mild depression	24	20.8	70.8	29.2	-	-	-	32.7 (7.5)	-	-	-	45.8

Note: Separate values for treatment and control condition were reported if an overall value was not reported; Reference number precedes author name in Article column. PTSD= Post-Traumatic Stress Disorder; MDD=Major Depressive Disorder

[a]HS: High School, SC: Some College, C: College graduate

[b]Income refers to median annual income

[c]Values reported are from Berger et al., 2009b

[d] Lee et al., 2020 was the only article to report percentage gender minority characteristics: Transgender 4%

[e] Lee et al., 2020: unemployed included people who were unemployed, retired, and/or had a disability; Hard et al., 2019: unemployed included people who were unemployed and/or retired

[f] Manber et al., 2019 reported 24.02% of participants received treatment in Spanish.

Table 2.

Trial Characteristics of Psychological Interventions for Prevalent Sleep-Wake Disorders (N =56)

Article	Primary Intervention	Sleep disorder or disturbance	Determination	Delivery Modality	Comparator	N Tx/Ctrl	Trial Design	Duration (Intervention/ FU)
Acceptance and Commitment Therapy								
75. Herbert et al., 2017	VTC-ACT	-	Potential	Video teleconferencing	In person ACT	64/65	2 arm RCT	8w/6m
76. Lang et al., 2017	ACT	-	Probable	In Person (1:1)	Present-Centered Therapy	80/80	2 arm RCT	12w/ 3,6,9,12m
77. Mosher et al., 2018	ACT	-	Probable	Telephone	Education/ Support	23/24	2 arm RCT	6w/8,12w post-baseline
Behavioral Therapy								
63,64. Berger et al., 2009a,b[1]	BT	-	Potential	In Person (1:1)	Healthy Eating	88/85	2 arm RCT	1m/90,365d
69. Gebara et al., 2019	BBTI	Insomnia	Definite	In Person (1:1) and telephone sessions	Wait-list	6/5	2 arm RCT	4w/4w
65. Germain et al., 2012	BT,IRT	Nightmares + Poor Sleep Quality	Definite	In Person (1:1) and telephone sessions	Medication Arms (Placebo or Prazosin)	17/ Ctrl.1 18, Ctrl.2 15	3 arm RCT	8w/4m
66. Germain et al., 2014	BT	Insomnia	Definite	In Person (1:1) and telephone sessions	Sleep Education	20/20	2 arm RCT	4w/6m
67. Johnson et al., 2016	M-BET	Nocturia	Definite	In person or telephone (1:1)	Standard drug therapy for nocturia (α-blocker) and combined M-BET + α-blocker	23 / Ctrl.1 25, Ctrl.2 24	3 arm RCT	10w/12w post-baseline
70. Lee et al., 2020	BT	-	Potential	In Person (1) and telephone sessions	Attention control group (dietary strategies)	25/26	2 arm RCT	4w/1,2,3m
68. Martin et al., 2017	BT	-	Potential	-	Sleep Education	21/21	2 arm RCT	4w/4m
Cognitive Behavioral Therapy								
71. Brenes et al., 2016	CBT	-	Probable	Telephone and workbook	Nondirective Supportive TherapyTelephone	70/71	2 arm RCT	11w/4,9,15m post-randomization
72. Heapy et al., 2017	IVR-CBT	-	Potential	Telephone	In-person CBT	62/63	2 arm RCT	10w/3,6,9m
73. Stanley et al., 2016	CBT	-	Probable	In person (1:1 first session) and patient preference (telephone or in person)	Community Resources and Emotional Support	20/20	2 arm RCT	3m/-
74. Stanley et al., 2018	CBT	-	Probable	Patient preference (telephone or in person) and telephone booster sessions	Enhanced Community Care with Resource Counseling	70/64	2 arm RCT	6m/9m
Cognitive Behavioral Therapy for Insomnia								

Article	Primary Intervention	Sleep disorder or disturbance	Determination	Delivery Modality	Comparator	N Tx/Ctrl	Trial Design	Duration (Intervention/ FU)
35. Alessi et al., 2016	CBT-I	Insomnia	Definite	In person (smallgroups of 3–5 ppl or 1:1)	Sleep Education	106/53	2 arm RCT	6w/6,12m
50. Cain et al., 2019	CBT-I	Insomnia	Definite	In Person (Group) and online	Group prenatal visits	27/26	2 arm RCT	7w/-
51. Chakravorty et al., 2019	CBT-I	Insomnia	Definite	In Person (1:1)	Usual Care	11/11	2 arm RCT	8w/3,6m
36. Drake et al., 2019	CBT-I	Insomnia	Definite	In person	Sleep Hygiene, Sleep Restriction	50/50,50	3 arm RCT	6w/6m
37. Edinger & Sampson, 2003	CBT-I	Insomnia	Definite	In Person (1:1) and take-home audiocassettes and educational materials	Sleep Hygiene	10/9	2 arm RCT	2w/3m after treatment
38. Edinger et al., 2009	CBT-I	Insomnia	Definite	In Person (1:1)	Sleep Hygiene	41/40	2 arm RCT	8w/6m
39. Epstein & Dirksen, 2007	CBT-I	Insomnia	Definite	In Person (Group) and telephone sessions	Sleep Education and Hygiene	34/38	2 arm RCT	6w/2w posttreatment
40. Fiorentino et al., 2010	CBT-I	Insomnia	Definite	In Person (1:1)	Delayed Treatment	6/8	2 arm RCT	6w/6w posttreatment
41. Fung et al., 2016	CBT-I	Insomnia	Definite	In Person (1:1 and Group)	Sleep Education	-	2 arm RCT	6w/6m and 12m post-baseline
52. Kalmbach et al., 2019	CBT-I	Insomnia	Definite	In Person (1:1)	Sleep Hygiene, Sleep Restriction	50/50	3 arm RCT	6w/2w,6m
42. Laurel Franklin et al., 2018	Telephone based CBT-I	Insomnia	Definite	Telephone	In person CBT-I	11/7	2 arm RCT	8w/1,3m
54. Manber et al., 2019	CBT-I	Insomnia	Definite	In Person (1:1)	Modified Pseudo Desensitization Therapy for Insomnia	89/90	2 arm RCT	5w/-
43. Margolies et al., 2013	CBT-I, IRT	Insomnia	Definite	In Person (1:1)	Wait-list	20/20	2 arm RCT	6w/-
44. Matthews et al., 2014	CBT-I	Insomnia	Definite	In Person (1:1)	Behavioral Placebo Treatment	30/26	2 arm RCT	6w/3,6m
45. McCurry et al., 2016	Telephonebased CBT-I	Insomnia	Definite	Telephone (first session in person or telephone)	Menopause Education	53/53	2 arm RCT	8w/8,24w posttreatment
46. Palesh et al., 2018	BBT-CI	Insomnia	Definite	In person and telephone	Health Eating Education Learning	37/37	2 arm RCT	3–4w/1m
47. Pigeon et al., 2017	Brief CBT-I	Insomnia	Definite	In person and telephone	Sleep Hygiene	13/14	2 arm RCT	4w/3m posttreatment
53. Pigeon et al., 2019	Brief CBT-I	Insomnia	Definite	In Person (1:1)	Usual Care	24/26	2 arm RCT	6w/-

Article	Primary Intervention	Sleep disorder or disturbance	Determination	Delivery Modality	Comparator	N Tx/Ctrl	Trial Design	Duration (Intervention/ FU)
48. Scogin et al., 2018	Integrated CBTD+CBT-I	Insomnia	Definite	Video teleconferencing	Usual C are	22/18	2 arm RCT	10w/3m
49. Ulmer et al., 2011	CBT-I, IRT	Insomnia	Definite	In Person (1:1)	Usual Care	12/9	2 arm RCT	12w/10y
Cognitive Processing Therapy								
78. Galovski et al., 2016	CPT,H	Insomnia	Definite	In Person (1:1)	Symptom monitoring control condition before beginning standard CPT	44/48	2 arm RCT	15w/3m posttreatment
79. Galovski et al., 2009	CPT	-	Probable	In Person (1:1)	Prolonged Exposure	54/54	2 arm RCT	6w/2w, 9m posttreatment
80. Gutner et al., 2013	CPT	-	Probable	In Person (1:1) and home practice assignments	Prolonged Exposure	81/90	2 arm RCT	6w/3,9m, longterm: 5 to 19y
Complementary and Alternative Therapy								
55. Innes & Selfe, 2012	Y	RLS	Definite	In Person (Group) and home practice assignments	Educational film	10/10	2 arm RCT	8w/-
56. Irwin et al., 2017	TCC	Insomnia	Definite	In Person (Group)	CBT-I	45/45	2 arm RCT	3m/6,15m
61. Jamison et al., 2019	CART	-	Probable	In Person (1:1)	Wait-list	47/33	2 arm RCT	4w/1,6m
58. Nakamura et al., 2011	MBB	Poor sleep quality	Definite	-	Sleep Hygiene	35/28	2 arm RCT	2w/-
57. Nakamura et al., 2017	MBB	Poor sleep quality	Definite	In Person (Group)	Sleep Education	33/27	2 arm RCT	3w/3m
59. Nidich et al., 2016	TM	-	Potential	In Person (Group)	No-treatment	90/91	2 arm RCT	4m/4m
62. Porter et al., 2019	Y	-	Potential	In Person (1:1)	Social Support Group	43/20	2 arm RCT	8w/6m
60. Stoerkel et al., 2018	SCT	-	Potential	Audio-files	Usual Care	51/49	2 arm RCT	2w/2w
Elective Therapy								
85. Alschuler et al., 2018	RI	-	Potential	Teleconference for groups and take-home materials	Wait-list	12/16	2 arm RCT	6w
86. Church et al., 2016	TAU,EFT	-	Probable	In Person (1:1)	Treatment as usual wait-list	12/9	2 arm RCT	6m/3,6m
87. Kahn et al., 2016	MR	-	Potential	Internet and mobile	MR + PREP for Strong Bonds program, PREP only, waitlist	40/ MR+PREP 40; PREP 40; Waitlist Control 40	4 arm RCT	16w/8,16
Imagery Rehearsal Therapy								

Article	Primary Intervention	Sleep disorder or disturbance	Determination	Delivery Modality	Comparator	N Tx/Ctrl	Trial Design	Duration (Intervention/ FU)
89. Cook et al., 2010	IRT	Nightmares+ Poor sleep quality	Definite	In Person (Group)	Sleep and Nightmare Management Treatment	61/63	2 arm RCT	6w/1,3,6m
90. Harb et al., 2019	IRT, CBT-I	Nightmares + Poor sleep quality	Definite	In Person (1:1)	CBT-I	53/55	2 arm RCT	6w3,6m
88. Krakow et al., 2001	IRT	Nightmares + Insomnia	Definite	In Person (Group)	Wait-list	88/80	2 arm RCT	6w/3,6m
Mindfulness-based Stress Reduction								
81. Cash et al., 2015	MBSR	-	Potential	In Person (Group) and home practice assignments	Wait-list	51/40	2 arm RCT	8w/2m
82. Lengacher et al., 2015	MBSR	-	Potential	-	Usual Care	38/41	2 arm RCT	6w/12w
83. Shapiro et al., 2003	MBSR	-	Potential	In Person (Group)	Stress management	31/32	2 arm RCT	6w/3,9m
84. Witek Janusek et al., 2019	MBSR	-	Potential	In Person (Group)	Active Control	84/80	2 arm RCT	8w/1,6m
Problem-solving Therapy								
91. Bedford et al., 2018	ePST	-	Potential	Online	Minimal contact	12/12	2 arm RCT	6w/12 following the initial treatment session

Note: Determination refers to the likelihood of the sleep disorder or disturbance based on review of the participant inclusion and exclusion criteria. Reference number precedes author name in Article column. ACT=Acceptance and Commitment Therapy; BBT-CI=Brief Behavioral Therapy for Cancer-Related Insomnia; BT=Behavioral Therapy; BTI-MV=Brief Behavioral Treatment of Insomnia; CBT=Cognitive Behavioral Therapy; CBT-I=Cognitive Behavioral Therapy for Insomnia; CPT=Cognitive Processing Therapy; EFT=Clinical Emotional Freedom Techniques; ePST=computer guided Problem-Solving Treatment; H=Hypnosis; IRT=Imagery Rehearsal Therapy; Integrated CBT-D+CBT-I= Integrated CBT (CBT for depression and CBT for insomnia); IVR-CBT=Interactive voice response-based cognitive behavioral therapy; MBB=Mind-body Bridging; M-BET=Multicomponent behavioral combined with exercise therapy; MBSR=Mindfulness-based stress reduction; MR=Mission Reconnect program; RI=Resilience intervention; SCT=Self-care toolkit; TAU=Treatment as usual ; TCC=Tai Chi Chih; TM=Transcendental Meditation; VTC-ACT=Video teleconferencing Acceptance and Commitment Therapy; Y=Yoga.

Definite= directly assessed for and confirmed the existence of a sleep disorder or sleep disturbance and included this in the inclusion criteria; Probable=directly assessed for any sleep disturbance but did not include endorsement of a sleep disturbance as part of the inclusion criteria. Potential= sleep did not assess for a sleep disturbance but based on the scientific literature would likely have a sleep disturbance concomitant with the co-morbid health or mental health condition.

[1] Values reported are from Berger et al., 2009b.

Table 3.

Risk of Bias Assessment of Included Studies of Psychological Interventions for Sleep-Wake Disorders

Article	Selection Bias: Random Sequence Generation	Selection Bias: Allocation Concealment	Performance Bias	Detection Bias	Attrition Bias	Reportin' Bias
75. Herbert et al., 2017	Low	Low	High	Low	Low	Low
76. Lang et al., 2017	Low	Low	Unclear	Unclear	Low	Unclear
77. Mosher et al., 2018	Low	Unclear	Unclear	Low	Low	Unclear
63,64. Berger et al., 2009a,b	Low	Low	High	Unclear	Low	Unclear
69. Gebara et al., 2019	Unclear	Unclear	High	Unclear	Low	Unclear
65. Germain et al., 2012	Low	Unclear	Unclear	High	Low	Low
66. Germain et al., 2014	Low	Unclear	High	Unclear	Low	Low
67. Johnson et al., 2016	Low	Low	Unclear	Low	High	Low
70. Lee et al., 2020	Low	Unclear	Unclear	Unclear	Low	Low
68. Martin et al., 2017	Low	Low	Low	Low	Low	Low
71. Brenes et al., 2016	Unclear	Unclear	Unclear	Low	High	Low
72. Heapy et al., 2017	Low	Low	High	High	Low	Low
73. Stanley et al., 2016	Low	Unclear	Unclear	Low	Low	Low
74. Stanley et al., 2018	Low	Low	Unclear	Unclear	Low	Low
35. Alessi et al., 2016	Low	Low	Low	Low	Low	Low
50. Cain et al., 2019	Low	Low	High	High	Low	High
51. Chakravorty et al., 2019	Low	Low	High	Unclear	Low	Low
36. Drake et al., 2019	Low	Low	Low	Low	Low	Low
37. Edinger & Sampson, 2003	Unclear	Unclear	High	Unclear	Low	Unclear
38. Edinger et al., 2009	Low	Unclear	High	Unclear	Unclear	Low
39. Epstein & Dirksen, 2007	Low	Unclear	High	Unclear	High	Unclear
40. Fiorentino et al., 2010	Low	Unclear	High	Unclear	High	Unclear
41. Fung et al., 2016	Low	Low	Low	Low	High	Unclear
52. Kalmbach et al., 2019	Unclear	Unclear	Low	Low	Unclear	High
42. Laurel Franklin et al., 2018	Low	Unclear	Low	Low	High	Low
54. Manber et al., 2019	Low	Low	Low	Low	High	Low
43. Margolies et al., 2013	Unclear	Unclear	High	High	Low	Unclear
44. Matthews et al., 2014	Low	Low	Low	Unclear	Low	Unclear
45. McCurry et al., 2016	Unclear	Unclear	Low	Low	Low	Low
46. Palesh et al., 2018	Unclear	Unclear	Unclear	Unclear	Low	Unclear
47. Pigeon et al., 2017	Low	Unclear	Unclear	Low	High	Unclear
53. Pigeon et al., 2019	Low	Low	High	Low	Low	Low
48. Scogin et al., 2018	Unclear	Unclear	Unclear	Low	High	Unclear
49. Ulmer et al., 2011	Unclear	Unclear	Unclear	High	Low	Unclear
78. Galovski et al., 2016	Low	Low	Unclear	Unclear	Low	Unclear
79. Galovski et al., 2009	Unclear	Unclear	Unclear	Low	Low	Unclear
80. Gutner et al., 2013	Unclear	Unclear	Unclear	Unclear	Low	Unclear

Article	Selection Bias: Random Sequence Generation	Selection Bias: Allocation Concealment	Performance Bias	Detection Bias	Attrition Bias	Reportin' Bias
55. Innes & Selfe, 2012	Low	Low	High	Low	Unclear	Unclear
56. Irwin et al., 2017	Low	Low	Low	Low	Low	Low
61. Jamison et al., 2019	Unclear	Unclear	High	High	Low	Low
58. Nakamura et al., 2011	Low	Low	Unclear	Unclear	Low	Unclear
57. Nakamura et al., 2017	Low	Unclear	High	Low	Low	Low
59. Nidich et al., 2016	Unclear	Unclear	Unclear	Unclear	High	Unclear
62. Porter et al., 2019	Low	Low	Low	Low	High	Unclear
60. Stoerkel et al., 2018	Low	Unclear	High	Unclear	Low	Low
85. Alschuler et al., 2018	Low	Unclear	High	Unclear	Low	Low
86. Church et al., 2016	Low	Low	High	High	Low	Unclear
87. Kahn et al., 2016	Low	Low	High	High	Low	Low
89. Cook et al., 2010	Low	Low	Unclear	Low	Low	Unclear
90. Harb et al., 2019	Low	Low	Low	Low	Low	Low
88. Krakow et al., 2001	Low	Unclear	High	Low	Low	Unclear
81. Cash et al., 2015	Low	High	High	Unclear	Low	Low
82. Lengacher et al., 2015	Low	Low	Low	Unclear	Low	Low
83. Shapiro et al., 2003	Unclear	High	High	Unclear	Unclear	Unclear
84. Witek Janusek et al., 2019	Low	Low	Low	Unclear	Low	Low
91. Bedford et al., 2018	Low	Low	High	High	Low	Unclear

Note: Reference number precedes author name in Article column.

Table 4.

Types of Cultural Adaptations of Psychological Interventions for Prevalent Sleep-Wake Disorders (N=56)

Article	Underserved Population	Primary Intervention	Cultural adaptation[a]	Surface adaptation	Deep adaptation
Acceptance and Commitment Therapy					
75. Herbert et al., 2017	Veterans with chronic, nonterminal pain condition	VTC-ACT	Surface	Delivery modality (video conferencing)	-
76. Lang et al., 2017	Veterans	ACT	None	-	-
77. Mosher et al., 2018	Women with Stage IV breast cancer	ACT	Both	Delivery modality (telephone)	Content (inclusion of cancer related experiences)
Behavioral Therapy					
63,64. Berger et al., 2009[a],b	Women with breast cancer	BT	Both	Setting (safe location: Treatment took place in a location of patient's preference or at home)	Core component (relaxed sleep hygiene guidelines, usual sleep time plus one hour in response to chemotherapy); Content (inclusion of patient reported symptoms after chemotherapy)
69. Gebara et al., 2019	Older veterans	BBTI	None	-	-
65. Germain et al., 2012	Veterans with sleep complains	BT,IRT	Deep	-	Core component (combined BT elements and IRT)
66. Germain et al., 2014	Combat-exposed Military Veterans	BTI-MV	Deep	-	Content (included information about military specific factors relating to sleep)
67. Johnson et al., 2016	Veteran men with nocturia	M-BET	None	-	-
70. Lee et al., 2020	Adults diagnosed with HIV/AIDS with fatigue and unemployed, retired or on disability	BT	Surface	Other (provision of hands on activities and materials)	-
68. Martin et al., 2017	Veterans 60 yrs or older	BT	Both	Treatment dose (duration; length of sessions)	Core component (substitution of sleep compression in place of sleep restriction therapy and modifications of standard stimulus control instructions)
Cognitive Behavioral Therapy					
71. Brenes et al., 2016	Rural older adults	CBT	Surface	Delivery modality (telephone)	-
72. Heapy et al., 2017	Veterans with chronic back pain	IVR-CBT	Surface	Delivery modality (interactive voice response)	-
73. Stanley et al., 2016	Older adults from lowincome, or minority communities with anxiety or worry	CBT	Both	Delivery modality (telephone or in person); Setting (at home or a community partner site); Treatment dose	Sociocultural strategies and cultural values (incorporated religion and/or spirituality coping skills)

Article	Underserved Population	Primary Intervention	Cultural adaptation[a]	Surface adaptation	Deep adaptation
				(duration; number of sessions)	
74. Stanley et al., 2018	Older adults from low income, or minority communities with anxiety or worry	CBT	Both	Constituent-involving strategies (delivery modality by nonclinicians); Delivery modality (telephone or in person); Setting (at home or a community partner site); Treatment dose (duration; inclusion of monthly booster sessions for up to 3months)	Linguistic (adjustment of materials to literacy level); Sociocultural strategies and cultural values (incorporated religion and/or spirituality coping skills)
Cognitive Behavioral Therapy for Insomnia					
35. Alessi et al., 2016	Older veterans with insomnia disorder	CBT-I	Surface	Constituent-involving strategies (delivery modality by nonclinicians)	-
50. Cain et al., 2019	Pregnant women	CBT-I	Both	Setting (delivered at gynecological clinics); Delivery modality (online); Constituent-involving strategies (intervention delivered by specialists in obstetrics and gynecology)	Core component (sessions addressed sleep hygiene during pregnancy and the postpartum period; sleep restriction was excluded from weekly discussions but remained in the online information and participants were advised not to utilize this method during pregnancy); Content (newborn care)
51. Chakravorty et al., 2019	Alcohol-dependent veterans	CBT-I	Surface	Setting (safe location: Veterans hospital)	-
36. Drake et al., 2019	Postmenopausal women with insomnia	CBT-I	None	-	-
37. Edinger & Sampson, 2003	Veterans	CBT-I	None	-	-
38. Edinger et al., 2009	Veterans with primary/ secondary insomnia	CBT-I	None	-	-
39. Epstein & Dirksen, 2007	Women with breast cancer	CBT-I	Surface	Delivery modality (group setting)	-
40. Fiorentino et al., 2010	Breast cancer survivors	CBT-I	Deep	-	Content (Inclusion of thoughts and fears of occurrence of cancer)
41. Fung et al., 2016	Older veterans	CBT-I	None	-	-
52. Kalmbach et al., 2019	Postmenopausal women	CBT-I	None	-	-
42. Laurel Franklin et al., 2018	Rural veterans with PTSD	Telephonebased CBT-I	Surface	Delivery modality (telephone)	-
54. Manber et al., 2019	Pregnant women	CBT-I	Both	Linguistic (intervention delivered in Spanish)	Core component (sleep restriction therapy modified for pregnancy with initial time in bed recommendations equal to average total sleep time plus 30min and

Article	Underserved Population	Primary Intervention	Cultural adaptation[a]	Surface adaptation	Deep adaptation
					never less than 5.5h, and tips to improve postpartum sleep); Content (education about infant sleep development)
43. Margolies et al., 2013	Veterans with PTSD	CBT-I, IRT	Both	Setting (safe location: Veterans hospital)	Core component (combined CBT-I elements and IRT)
44. Matthews et al., 2014	Women breast cancer survivors with chronic insomnia	CBT-I	None	-	-
45. McCurry et al., 2016	Postmenopausal women with insomnia symptoms and hot flashes	Telephonebased CBT-I	Both	Constituent-involving strategies (use of role models: sleep coaches were Women); Delivery modality (telephone)	Content (sleep changes during menopause)
46. Palesh et al., 2018	Female with Stage I-III breast cancer undergoing chemotherapy	BBT-CI	Both	Delivery modality (telephone); Treatment dose (duration; shortened session duration); Treatment dose (timing; intervention sessions scheduled based on the participant's chemotherapy regime); Setting (delivered in the clinic while patients are undergoing chemotherapy infusion)	Content (education about cancerassociated circadian disruption)
47. Pigeon et al., 2017	Veterans with a diagnosis of MDD and sleep problems	Brief CBT-I	Surface	Delivery modality (telephone); Setting (primary care)	-
53. Pigeon et al., 2019	Veterans	Brief CBT-I	Surface	Setting (safe location: Veterans hospital)	-
48. Scogin et al., 2018	Rural middle-aged and older adults	Integrated CBTD+CBT-I	Both	Delivery modality (video conferencing)	Linguistic (adjustment of materials to literacy level); Sociocultural strategies and cultural values (research psychotherapists also participated in a cultural sensitivity workshop)
49. Ulmer et al., 2011	Veterans with PTSD	CBT-I, IRT	Both	Setting (safe location: veterans hospital)	Content (trauma-related sleep disturbances)
Cognitive Processing Therapy					
78. Galovski et al., 2016	Women interpersonal assault survivors	CPT,H	None	-	-
79. Galovski et al., 2009	Women sexual assault survivors suffering from PTSD	CPT	None	-	-
80. Gutner et al., 2013	Women rape victims with PTSD	CPT	None	-	-
Complementary and Alternative Therapy					

Article	Underserved Population	Primary Intervention	Cultural adaptation[a]	Surface adaptation	Deep adaptation
55. Innes & Selfe, 2012	Older women	Y	Both	Constituent-involving strategy (use of role models: designed and taught by a senior Iyengar yoga instructor with over 30 years of experience)	Core component (designed for older, sedentary adults)
56. Irwin et al., 2017	Breast cancer survivors with insomnia	TCC	None	-	-
61. Jamison et al., 2019	Veterans with current or recent PTSD	CART	Surface	Treatment dose (intensity; respiration rate of nine breaths per minute)	-
58. Nakamura et al., 2011	Veterans with selfreported sleep disturbance	MBB	Surface	Setting (safe location: Veterans hospital)	-
57. Nakamura et al., 2017	Veterans with Gulf War Illness Symptoms	MBB	None	-	-
59. Nidich et al., 2016	Men in prison	TM	None	-	-
62. Porter et al., 2019	Women with metastatic breast cancer	Y	Deep	-	Core component (designed mindful yoga program to meet the needs of women with MBC)
60. Stoerkel et al., 2018	Women with breast cancer for whom surgery would be there initial treatment	SCT	None	-	-
Eclectic Therapy					
85. Alschuler et al., 2018	Adults with multiple sclerosis that causes disability	RI	Surface	Delivery modality (telephone, group setting)	-
86. Church et al., 2016	Veterans with PTSD	TAU,EFT	None	-	-
87. Kahn et al., 2016	Veterans	MR	Both	Delivery modality (online)	Involvement of family (veteranpartner dyads)
Imagery Rehearsal Therapy					
89. Cook et al., 2010	Male veterans with chronic, severe PTSD	IRT	Both	Delivery modality (group setting); Setting (safe location: Veterans hospital)	Content (addressed combat-related nightmares)
90. Harb et al., 2019	Veterans	IR,CBT-I	Both	Setting (safe location: Veterans hospital)	Core component (no sleep restriction; combined CBT-I elements and IRT)
88. Krakow et al., 2001	Women sexual assault survivors with PTSD	IRT	None	-	-
Mindfulness-based Stress Reduction					
81. Cash et al., 2015	Women with fibromyalgia	MBSR	None	-	-
82. Lengacher et al., 2015	Women diagnosed with breast cancer	MBSR	Both	Delivery modality (group settings); Treatment duration (shortened number of sessions)	Content (fear of recurrence, physical emotional symptoms)

Article	Underserved Population	Primary Intervention	Cultural adaptation[a]	Surface adaptation	Deep adaptation
83. Shapiro et al., 2003	Women with Stage II breast cancer who were cancer-free at the time of the study	MBSR	Surface	Treatment dose (timing; intervention delivered after completion of cancer treatment due to peak in stress)	-
84. Witek Janusek et al., 2019	Women with breast cancer	MBSR	Surface	Setting (safe location: Cancer wellness center)	-
Problem-solving Therapy					
91. Bedford et al., 2018	College student veterans with at least mild depression	ePST	None	-	-

Note: Reference number precedes author name in Article column. ACT=Acceptance and Commitment Therapy; BBT-CI=Brief Behavioral Therapy for Cancer-Related Insomnia; BT=Behavioral Therapy; BTI-MV=Brief Behavioral Treatment of Insomnia; CBT=Cognitive Behavioral Therapy; CBT-I=Cognitive Behavioral Therapy for Insomnia; CPT=Cognitive Processing Therapy; EFT=Clinical Emotional Freedom Techniques; ePST=computer guided Problem-Solving Treatment; H=Hypnosis; IRT=Imagery Rehearsal Therapy; Integrated CBT-D+CBT-I= Integrated CBT (CBT for depression and CBT for insomnia); IVR-CBT=Interactive voice response-based cognitive behavioral therapy; MBB=Mind-body Bridging; M-BET=Multicomponent behavioral combined with exercise therapy; MBSR=Mindfulness-based stress reduction; MDD=Major Depressive Disorder; MR=Mission Reconnect program; PTSD=Post-traumatic stress disorder; RI=Resilience intervention; SCT=Self-care toolkit; TAU=Treatment as usual ; TCC=Tai Chi Chih; TM=Transcendental Meditation; VTC-ACT=Video teleconferencing Acceptance and Commitment Therapy; Y=Yoga.

[a]Both refers to the conduct of surface-level and deep-level cultural adaptations.

Table 5.

Summary of Results of Effectiveness of Cultural Adaptations and Psychological Interventions on Primary Sleep Outcomes Organized by Participant Population (N=56)

Article	Primary Intervention	Comparator	Cultural adaptation	Sleep Disorder or Disturbance	Analysis	Insomnia	Nightmare Frequency	Sleep duration	Sleep efficiency	Sleepiness	Sleep quality
Participant Population with Definite Sleep Disorder or Disturbance Diagnosis											
Behavioral Therapy											
69. Gebara et al., 2019	BBTI	Wait-list	None	Insomnia	Pre-Tx vs 4w	n.s.					
65. Germain et al., 2012	BT,IRT	Medication Arms (Placebo or Prazosin)	Deep	Nightmares + Poor Sleep Quality	Pre-Tx vs 8w; PostTx vs 12w FU	n.s.;** (Ctrl 2)	n.s.	n.s.^{b}	n.s.^{b}		n.s.
66. Germain et al., 2014	BT	Sleep Education	Deep	Insomnia	Pre-Tx vs 4w	*	n.s.				*
67. Johnson et al., 2016	M-BET	Standard drug therapy for nocturia (α-blocker) and combined M-BET + αblocker	None	Nocturia	Pre-Tx vs 12w FU			n.s.^{a}	*^{a}	n.s.	n.s.
Cognitive Therapy for Insomnia											
35. Alessi et al., 2016	CBT-I	Sleep Education	Surface	Insomnia	Pre-Tx vs 6w; PreTx vs 6,12m FU	***; ***; ***			n.s.^{a},* ^{b};n.s.^{a},*^{b}, n.s.^{a},*^{b}		***; ***; ***
50. Cain et al., 2019	CBT-I	Group prenatal visits	Both	Insomnia	Pre-tx vs. 2nd tri, 3rd tri, postpartum	n.s.; *; **					n.s.^{b}; n.s.^{b}; n.s.^{b}
51. Chakravorty et al., 2019	CBT-I	Usual Care	Surface	Insomnia	Pre-Tx vs 8w; PreTx vs 3,6m FU	*;*;*		n.s.^{b};n.s.^{b} ; n,s,^{b}		n.s.;n.s.;n,s,	
36. Drake et al., 2019	CBT-I	Sleep Hygiene, Sleep Restriction	None	Insomnia	Pre-Tx vs PostTx,6m FU	***;***		n.s. ^{b}; n.s. ^{b}	* ^{b}; n.s. ^{b}		***; ***
37. Edinger & Sampson, 2003	CBT-I	Sleep Hygiene	None	Insomnia	2w vs 3m FU	***		n.s.^{b}	*^{b}		*
38. Edinger et al., 2009	CBT-I	Sleep Hygiene	None	Insomnia	Pre-Tx vs 8w; Post- Tx vs 6m FU	*; *			*^{b}		

Article	Primary Intervention	Comparator	Cultural adaptation	Sleep Disorder or Disturbance	Analysis	Insomnia	Nightmare Frequency	Sleep duration	Sleep efficiency	Sleepiness	Sleep quality
39. Epstein & Dirksen, 2007	CBT-I	Sleep Education and Hygiene	Surface	Insomnia	Pre-Tx vs 2w Post- Tx			**b	n.s.b		***
40. Fiorentino et al., 2010	CBT-I	Delayed Treatment	Deep	Insomnia	Pre-Tx vs 6w; Post- Tx vs 6w FU	*; *		*a n.s.b	**b		**; *
41. Fung et al., 2016	CBT-I	Sleep Education	None	Insomnia	No SDB: Pre-Tx vs 6,12m FU; SDB: Pre-Tx vs 6,12m FU				n.s.a,b, n.s.a,b, n.s.a,*b, n.s.a,*b		*,*; **,**
52. Kalmbach et al., 2019	CBT-I	Sleep Hygiene, Sleep Restriction	None	Insomnia	Pre-Tx vs 6w; Pre- Tx vs 6m FU					n.s.e,n.s.f;n.s.e,**f	
42. Laurel Franklin et al., 2018	Telephonebased CBT-I	In person CBT-I	Surface	Insomnia	Pre-Tx vs Post-Tx, 1,3m FU						n.s. d
54. Manber et al., 2019	CBT-I	Modified pseudodesen sitization therapy for insomnia	Both	Insomnia	Pre-Tx vs 5w	**					
43. Margolies et al., 2013	CBT-I, IRT	Wait-list	Both	Insomnia	Pre-Tx vs 6w	***		n.s.a	***a		**
44. Matthews et al., 2014	CBT-I	Behavioral Placebo Treatment	None	Insomnia	Pre-Tx vs 6w; PreTx vs 3,6m FU	*		**b; *b	n.s.b; **b		
45. McCurry et al., 2016	Telephonebased CBT-I	Menopause Education	Both	Insomnia	Pre-Tx vs 8w FU; Pre-Tx vs 24w FU	***;***		n.s.; n.s.	***; **		***;**
46. Palesh et al., 2018	BBT-CI	Health Eating Education Learning	Both	Insomnia	Pre-Tx vs Post-Tx, 1m FU	*; *					
47. Pigeon et al., 2017	Brief CBT-I	Sleep Hygiene	Surface	Insomnia	Pre-Tx vs 4w; Pre- Tx vs 3m FU	n.s.; n.s.		n.s.b; n.s.b	*b; n.s. b		
53. Pigeon et al., 2019	Brief CBT-I	Usual Care	Surface	Insomnia	Pre-Tx vs 6w	***					
48. Scogin et al., 2018	Integrated CBTD+CBT-I	Treatment as usual	Both	Insomnia	Pre-Tx vs Post-Tx; 3m FUc	*;*		n.s.b, c	*b;-		**;-d

Article	Primary Intervention	Comparator	Cultural adaptation	Sleep Disorder or Disturbance	Analysis	Insomnia	Nightmare Frequency	Sleep duration	Sleep efficiency	Sleepiness	Sleep quality
49. Ulmer et al., 2011	CBT-I, IRT	Usual Care	Both	Insomnia	Pre-Tx vs 12w	**	*	* *b*			***
Cognitive Processing Therapy											
78. Galovski et al., 2016	CPT,H	Symptom monitoring control condition before beginning standard CPT	None	Insomnia	Pre-Tx vs 15w	*	n.s.	n.s. *b*			*
Complementary and Alternative Therapy											
55. Innes & Selfe, 2012	Y	Educational film	Both	RLS	Pre-Tx vs 8w	*		*** *b*			*
56. Irwin et al., 2017	TCC	CBT-I	None	Insomnia	Pre-Tx vs 3m Post- Tx; PreTx vs 6, 15m FU	n.s.; n.s.; n.s.		n.s. *b*; n.s. *bb* ; n.s.	n.s. *b*; * *b*; n.s. *b*	n.s.	n.s.; n.s.; n.s.
58. Nakamura et al., 2011	MBB	Sleep Hygiene	Surface	Poor sleep quality	Pre-Tx vs 2w						*; *
57. Nakamura et al., 2017	MBB	Sleep Education	None	Poor sleep quality	Pre-Tx vs 2,3-w; Pre-Tx vs 3w; Pre- Tx vs 3m FU						n.s.; n.s.; *
Imagery Rehearsal Therapy											
89. Cook et al., 2010	IRT	Sleep and Nightmare Management Treatment	Both	Nightmares+ Poor sleep quality	Pre-Tx vs 6w		n.s.				n.s.
90. Harb et al., 2019	IR,CBT-I	CBT-I	Both	Nightmares + Poor sleep quality	Pre-Tx vs 6m FU		n.s.				n.s.
88. Krakow et al., 2001	IRT	Wait-list	None	Nightmares + Insomnia	Pre-Tx vs 3 or 6m FU		**				**
Participant Population with Probable or Potential Sleep Disorder or Sleep Disturbance Diagnosis											
Acceptance and Commitment Therapy											
75. Herbert et al., 2017	VTC-ACT	In person ACT	Surface	-	Pre-Tx vs 8w; Pre- Tx vs 6m FU						n.s.; n.s.
76. Lang et al., 2017	ACT	PresentCentered Therapy	None	-	Pre-tx vs 12w	*					

Article	Primary Intervention	Comparator	Cultural adaptation	Sleep Disorder or Disturbance	Analysis	Insomnia	Nightmare Frequency	Sleep duration	Sleep efficiency	Sleepiness	Sleep quality
77. Mosher et al., 2018	ACT	Education/S upport	Both	-	Pre-Tx vs 8,12w FU				n.s.[b]; n.s.[b]		
Behavioral Therapy											
63,64. Berger et al., 2009a,b	BT	Healthy Eating	Both	-	Post-Tx vs 30,90,36 5d FU						*;**; n.s.
70. Lee et al., 2020	BT	Attention control group (dietary strategies)	Surface	-	Pre-Tx vs. Post- Tx			n.s.[b]	*[b]		*[b]
68. Martin et al., 2017	BT	Sleep Education	Both	-	Pre-Tx vs 4w; Pre- Tx vs 4m FU	n.s.; n.s.		n.s.[a]; n.s.[a]	**[a]. [a]; *		n.s.; n.s.
Cognitive Behavioral Therapy											
71. Brenes et al., 2016	CBT	Nondirective Supportive TherapyTelephone	Surface	-	Pre-Tx vs 4,9,15m FU	**;**;**					
72. Heapy et al., 2017	IVR-CBT	In-person CBT	Surface	-	Pre-Tx vs 3,6,9m FU						n.s.; n.s.; n.s.
73. Stanley et al., 2016	CBT	Community Resources and Emotional Support	Both	-	Pre-Tx vs 3m	n.s.					
74. Stanley et al., 2018	CBT	Enhanced Community Care with Resource Counseling	Both	-	Pre-Tx vs 6,9m FU	n.s.; n.s.					
Cognitive Processing Therapy											
79. Galovski et al., 2009	CPT	Prolonged Exposure	None	-	Pre-Tx vs 6w			n.s. [b]	n.s. [b]		n.s.
80. Gutner et al., 2013	CPT	Prolonged Exposure	None	-	Pre-Tx vs 6w; 6w vs 6y FU	n.s.; n.s.	n.s.; n.s.				n.s.; n.s.
Complementary and Alternative Therapy											
61. Jamison et al., 2019	CART	Wait-list	Surface	-	Pre-Tx vs 4w			n.s.[b]			n.s.[b]
59. Nidich et al., 2016	TM	No- treatment	None	-	Pre-Tx vs 4m FU						***
62. Porter et al., 2019	Y	Social Support Group	Deep	-	Pre-Tx vs 8w; PreTx vs 3,6m FU						ns, *, ns

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Article	Primary Intervention	Comparator	Cultural adaptation	Sleep Disorder or Disturbance	Analysis	Insomnia	Nightmare Frequency	Sleep duration	Sleep efficiency	Sleepiness	Sleep quality
60. Stoerkel et al., 2018	SCT	Treatment as usual	None	-	Pre-Tx vs Preoperat ive, 2w after surgery FU						n.s.; n.s. *c*
Eclectic Therapy											
85. Alschuler et al., 2018	RI	Wait-list	Surface	-	Pre-Tx vs Post-Tx						n.s.
86. Church et al., 2016	TAU,EFT	Treatment as usual wait- list	None	-	Pre-Tx vs 6m	**					
87. Kahn et al., 2016	MR	MR + PREP, PREP, waitlist	Both	-	Ctrl.1: Pre-Tx vs 8,16-w FU; Ctrl.2: Pre-Tx vs 8,16-w FU; Ctrl.3: Pre-Tx vs 8,16-w FU;						**,*; **, n.s.; *,*
Mindfulness-based Stress Reduction											
81. Cash et al., 2015	MBSR	Wait-list	None	-	Pre-Tx vs 8w; 8w vs 2m FU						*; n.s.
82. Lengacher et al., 2015	MBSR	Usual Care	Both	-	Pre-Tx vs 6w; 6w vs 12w FU			n.s.*a,b*;n.s. *a,b*	n.s. *a,b*; **a*, n.s.*b*		n.s.; n.s.
83. Shapiro et al., 2003	MBSR	Stress Management	Surface	-	Pre-Tx vs 6w				n.s.*b*		n.s.
84. Witek Janusek et al., 2019	MBSR	Active control	Surface	-	Pre-Tx vs 8w-6m FU						*
Problem-solving Therapy											
91. Bedford et al., 2018	ePST	Minimal contact	None	-	Pre-Tx vs 6w	***					

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CPT=Cognitive Processing Therapy; EFT=Clinical Emotional Freedom Techniques; ePST=computer guided Problem-Solving Treatment; H=Hypnosis; IRT=Imagery Rehearsal

Therapy; Integrated CBT-D+CBT-I= Integrated CBT (CBT for depression and CBT for insomnia); IVR-CBT=Interactive voice response-based cognitive behavioral therapy;

MBB=Mind-body Bridging; M-BET=Multicomponent behavioral combined with exercise therapy; MBSR=Mindfulness-based stress reduction; MR=Mission Reconnect program; RI=Resilience intervention; SCT=Self-care toolkit; TAU=Treatment as usual ; TCC=Tai Chi Chih; TM=Transcendental Meditation; VTC-ACT=Video teleconferencing Acceptance and Commitment Therapy; Y=Yoga.

Definite= directly assessed for and confirmed the existence of a sleep disorder or sleep disturbance and included this in the inclusion criteria; Probable=directly assessed for any sleep disturbance but did not include endorsement of a sleep disturbance as part of the inclusion criteria. Potential= sleep did not assess for a sleep disturbance but based on the scientific literature would likely have a sleep disturbance concomitant with the co-morbid health or mental health condition.

[1] Values reported are from Berger et al., 2009b

[a] Objectively-measured sleep (i.e., actigraphy)

[b] Subjectively-measured sleep (i.e., self-reported)

[c] Group by time interaction instead of between group differences

[d] Sleep quality measured using the PROMIS sleep disturbance scale

[e] ESS daytime sleepiness

[f] Diary-based sleepiness