

Sleep Disturbances in Individuals with Alcohol-Related Disorders: A Review of Cognitive-Behavioral Therapy for Insomnia (CBT-I) and Associated Non-Pharmacological Therapies

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ABSTRACT: Sleep disturbances are common among alcohol-dependent individuals and are often associated with relapse. The utility of behavioral therapies for sleep disturbances, including cognitive-behavioral therapy for insomnia (CBT-I), among those with alcohol-related disorders is not well understood. This review systematically evaluates the evidence of CBT-I and related behavioral therapies applied to those with alcohol-related disorders and accompanying sleep disturbances. A search of four research databases (PubMed, PsycINFO, Embase, and CINAHL Plus) yielded six studies that met selection criteria. Articles were reviewed using Cochrane's Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) scoring system. A majority of the studies demonstrated significant improvements in sleep efficiency among behavioral therapy treatment group(s), including but not limited to CBT-I. While behavioral sleep interventions have been successful in varied populations, they may not be utilized to their full potential among those with alcohol-related disorders as evidenced by the low number of studies found. These findings suggest a need for mixed-methods research on individuals' sleep experience to inform interventions that are acceptable to the target population.

KEY WORDS: alcoholism, alcohol disorders, sleep disturbances, insomnia, cognitive-behavioral therapy for insomnia, CBT-I

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Introduction

Insomnia is defined at the most basic level as difficulty falling or staying asleep.¹ Estimates suggest that up to one-third of the U.S. population is currently sleep deprived.² Nearly 40% of respondents of the national behavioral risk factor surveillance system (BRFSS) survey indicated that they had unintentionally fallen asleep during the day at least once in the past month. Inadequate sleep can affect multiple aspects of a person's health and well-being, thus making it a major "quality of life" concern. Furthermore, poor sleep quality can precede unhealthy behaviors such as drowsy driving, which have the potential to cause serious injury or death.³

Sleep Disturbances and Chronic Disease

Individuals suffering with chronic diseases may be at an increased risk of sleep disturbances, which for the purposes of this paper are interchangeable with the term *impaired sleep quality*. Cardiovascular disease and mental health problems are just two of many chronic diseases associated with sleep problems.^{4,5} Depression, heart disease, and chronic pain are associated with more prevalent symptoms of insomnia, while obesity, arthritis, and osteoporosis are associated with other sleep-related problems including snoring, restless legs, or daytime sleepiness. Individuals suffering with chronic diseases who have abnormalities of sleep duration (sleeping too much



or too little), which is independent of, but related to insomnia as a clinical diagnosis, are at increased risk of obesity, mental distress, coronary heart disease, stroke, and diabetes.⁶ Specifically, insomnia with short sleep duration has been associated with increased risk of hypertension,⁷ diabetes,⁸ and for men, overall mortality.⁹ Chronic diseases are frequently accompanied by a range of complex comorbidities and health-related quality of life (HRQOL) issues; thus, sleep quality may be particularly important for clinicians and researchers to consider in these populations.

Sleep Disturbances Among Alcoholics

Alcoholism is a chronic and typically progressive disease¹⁰ with the potential to severely compromise individual and societal well-being. The nature of alcoholism calls for a “sustained recovery management model”¹¹ that is holistic in nature, taking into account associated comorbidities and overall quality of life. Alcohol misuse and sleep disturbances often occur simultaneously, but their relationship is not well understood.¹² Among alcoholics, sleep disturbances are common during phases of active drinking, withdrawal, and abstinence.¹³

Sleep problems may originate prior to the development of clinical alcoholism, as evidenced by insomnia that persists for weeks or months following abstinence.¹⁴ However, whether or not one consistently precedes the other has yet to be established. Ford and Kamerow demonstrated that individuals who met the Diagnostic and Statistical Manual of Mental Disorders, 3rd edition (DSM-III) criteria for alcohol abuse and dependence were more likely to report ever experiencing a period of two or more weeks of insomnia compared to non-dependent individuals.¹⁵ Weissman and colleagues demonstrated that those with insomnia (and no other psychiatric condition) in the past year were more than twice as likely to *develop* alcohol abuse problems over the subsequent year compared to those without either condition.¹⁶ Some evidence indicates that sleep problems originating in early childhood may increase the risk for early onset alcohol use.¹⁷

Any level of drinking has the potential to negatively impact sleep. Sleep disturbances are particularly common among those who are alcohol dependent during the early stages of recovery and are even more common among those with comorbid depression.¹⁸ Insomnia can persist in patients despite abstinence. Alcohol use can negatively affect sleep composition and lead to increased nightmare frequency, snoring, and other sleep interruptions.¹⁹ Despite causal mechanisms remaining unclear, the association between poor sleep and alcohol consumption is supported by a growing body of evidence.^{15,20,21}

The Role of Quality Sleep in Preventing Relapse

Getting quality sleep is not only an important component of a healthy lifestyle but may also prevent relapse in recovering alcoholics. Both objectively- and subjectively-measured sleep disturbances among alcoholics in various phases of recovery

have the potential to increase the risk of relapse.^{19,22} Among treatment-seeking alcohol-dependent individuals, baseline sleep problems upon entering treatment may predict subsequent relapse to drinking.²² Sleep disturbances after detoxification are also common. Many alcoholics report sleep disturbances following abstinence, which may persist for up to 5 weeks of abstinence.²³ Some research suggests that abnormal sleep may persist for months to years during the recovery and abstinence process.^{24,25} The role and implications of insomnia in various phases of alcoholism (drinking, withdrawal, early/prolonged abstinence) are not yet clear, but one clinical trial currently underway seeks to elucidate this concept (NCT02181569: Sleep Disturbance and Relapse in Individuals with Alcohol Dependence: An Exploratory Mixed Methods Study). Thus, improving sleep among alcohol-dependent individuals is increasingly of interest to researchers, clinicians, and patients alike.

Cognitive-Behavioral Therapy for Insomnia (CBT-I)

Behavioral sleep interventions addressing underlying beliefs and behaviors have been successful in varied populations and have fewer side effects than pharmacological treatments.²⁶ However, when sleep restriction is included as part of the non-pharmacological regimen, providers should be vigilant for any untoward side effects.²⁷ A review of the use of CBT for primary insomnia revealed that CBT is superior to any single-component treatment and can improve sleep efficacy, sleep-onset latency, and wake after sleep onset, in addition to reducing sleep medication use.²⁸ CBT-I targets behaviors, cognitions, and associations that negatively affect sleep, and it is undoubtedly the most common and well-accepted non-pharmacological treatment for insomnia.²⁹ CBT-I interventions can vary, but may include education on sleep information, sleep hygiene and relaxation techniques, sleep scheduling, developing strong sleep patterns, and cognitive techniques designed to change mental approaches to sleep.³⁰ Sleep restriction (limiting time spent awake in bed), stimulus control, and addressing distorted beliefs about sleep can also be included.^{30,31} CBT-I has been utilized to improve sleep for individuals with various conditions, including moderate-to-severe chronic pain.³² CBT-I has also reduced the extent to which pain interfered with daily functioning among chronic pain sufferers.³³ A version of CBT-I combined with sleep hygiene education has demonstrably improved sleep and decreased cognitive arousal over time.³⁴ Another study wherein patients received progressively reduced 4-week pharmacotherapy or a combination of self-help and pharmacotherapy found that those utilizing self-help showed significantly more improvements in sleep quality and negative sleep-related cognitions. Regular appointments and sleep logs had a positive influence on sleep outcomes for these participants.³⁵ Although one review article concluded that CBT-I is a promising treatment for individuals with medical and psychiatric comorbidities,³⁶ evidence on the efficacy of these types of interventions specifically among patients with alcohol-related disorders is scarce.



Treatment Options for Individuals with Alcohol-related Disorders and Comorbid Sleep Disturbances

Both pharmacological and behavioral treatment options exist for individuals with alcohol-related disorders suffering from sleep disturbances, although pharmacological interventions are used more often. A survey of members of the American Society of Addiction Medicine (ASAM) revealed that 64% of physicians have recommended some type of pharmacological treatment (prescription or over-the-counter) to an alcoholic patient suffering from insomnia within 3 months of their detoxification, although a much smaller proportion do so consistently for the majority of their patients.³⁶ Despite the utilization of pharmacological treatment, non-pharmacological therapies may also be effective and should be given careful consideration in this population.³⁷ Non-drug treatments for insomnia, specifically CBT-I, may have long-term benefits as opposed to pharmacologic sleep aids, which often have side effects and are only recommended for short-term use.^{38,39} The benefits of CBT-I may extend beyond treatment of insomnia, providing benefits to non-sleep issues, such as overall well-being and depressive symptom severity.⁴⁰ In general, mind-body interventions, including tai chi, music therapy, yoga, relaxation, and CBT, may improve sleep quality and reduce the need for hypnotic drugs.⁴¹ The purpose of this review is to describe the available behavioral treatments for individuals with alcohol-related disorders suffering with various sleep disturbances and to elucidate the gaps that exist in the literature and research knowledge-base related to behavioral sleep interventions.

Methods

The GRADE system, adopted by the World Health Organization (WHO) and Cochrane, was utilized for this review.⁴²

We conducted a search in PubMed, PsycINFO, Embase, and CINAHL Plus between September 2013 and June 2014 for peer-reviewed journal articles written in English and published since January 1998. We sought to identify research studies that examined non-pharmacological interventions for sleep among individuals with alcohol-related disorders. After first searching for all sleep initiation and maintenance interventions, we discovered that fewer than half of all search results that included sleep interventions or therapies were non-pharmacological in nature. A considerable number of CBT-I articles were found in varying populations (not specific to alcoholism, $n = 365$). When we limited the search to interventions only in alcohol-related disorders, 20 articles were retrieved (PubMed search terms: (“sleep initiation and maintenance disorders/th OR sleep initiation and maintenance disorders/dt) & alcohol-related disorders [mh]”). To further develop a comprehensive evidence base, reference lists of relevant articles were hand searched by the authors. Refer to Figure 1 for a flowchart of the process resulting in the articles reviewed herein. All behavioral sleep interventions, including CBT-I and/or progressive relaxation training, among individuals with alcohol-related disorders are included in Table 2, which illustrates pertinent study details including sample size, demographic characteristics of participants, and basic methodological approach for each study ($n = 6$).

Results

The GRADE system for review was utilized to assess each article’s quality of evidence (see Table 1 for an explanation of each level). In our assessment, “high” ratings were reserved for well-conducted randomized trials or very strong

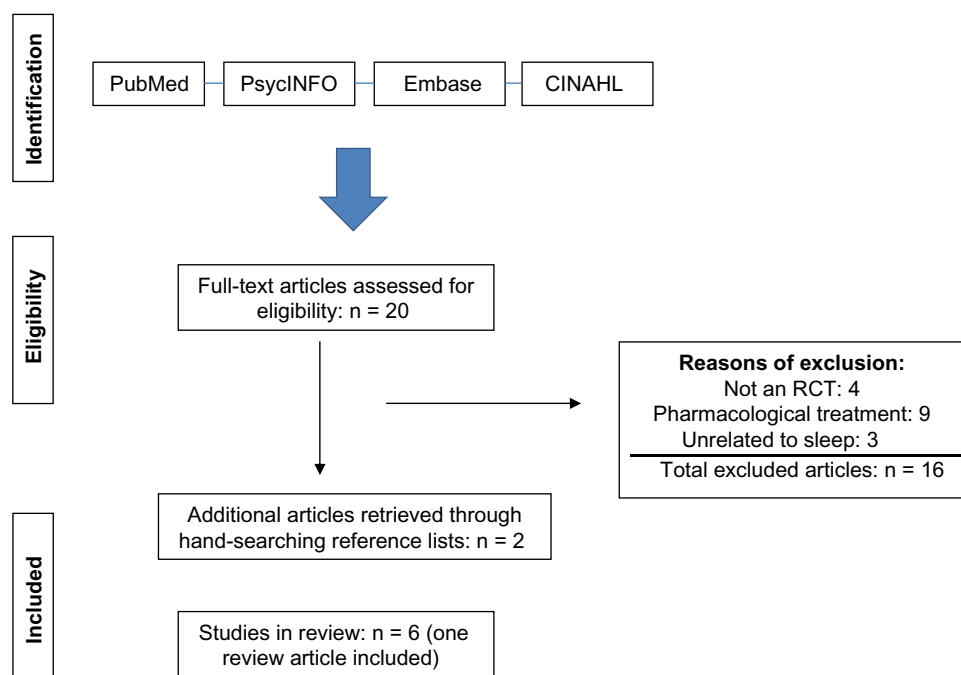


Figure 1. Flowchart of literature search.



Table 1. Levels of quality of a body of evidence in the GRADE approach.

UNDERLYING METHODOLOGY	QUALITY RATING
Randomized trials; or double-upgraded observational studies.	<i>High</i>
Downgraded randomized trials; or upgraded observational studies.	<i>Moderate</i>
Double-downgraded randomized trials; or observational studies.	<i>Low</i>
Triple-downgraded randomized trials; or downgraded observational studies; or case series/case reports.	<i>Very low</i>

Note: Adapted from: http://handbook.cochrane.org/chapter_12/table_12_2_a_levels_of_quality_of_a_body_of_evidence_in_the.htm

observational studies, “moderate” ratings were reserved for randomized trials with some methodological weaknesses or strong observational studies, “low” ratings were reserved for very weak randomized trials or observational studies, and “very low” ratings were reserved for weak observational studies or case reports. No articles were ranked as “very low.” In total, two articles were rated as “low,” three articles were rated as “moderate,” and only one article was rated as “high.” One randomized controlled trial (RCT) assessed the effectiveness of CBT on improving sleep and reducing relapse in recovering alcohol-dependent patients. Diary-rated sleep efficiency, wake after sleep onset, and daytime ratings of general fatigue improved more in the treatment group compared to the control.⁴³ Another RCT assessed the effectiveness of progressive relaxation training, and the treatment group experienced improved sleep quality.³⁶ Four of the five studies demonstrated significant improvements in sleep efficiency for the CBT-I treatment groups.^{43–46} When sleep was examined more comprehensively in 2005 by Bootzin and Stevens⁴⁵ and in 2011 by Arnedt and colleagues⁴⁶ and Britton and colleagues,⁴⁷ sleep-onset latency, wake after sleep onset, and measures of general fatigue were significantly lower in treatment groups. Other outcomes achieved in the studies included decreased depression, anxiety, and fatigue as well as higher subjective quality of life.

Methods of non-pharmacological sleep intervention delivery. To expand our search and examine the use of behavioral sleep interventions in other populations, we examined several other factors with regard to intervention delivery. As with any population suffering with a complex chronic disease, consideration of the feasibility and acceptability of an intervention among the individuals struggling with alcohol dependence is imperative. In addition to a call for more behavioral sleep intervention research and resources comes a call for “alternative” and integrated delivery methods (brief protocols, self-help, Internet, etc.) to increase access to and acceptability of these highly effective treatments.⁴⁸ See Table 3 for selected examples of methods of delivery for non-pharmacological sleep interventions.^{49–59}

Alternative delivery of health interventions. Psychosocial and health behavior therapies have been successfully implemented in populations with alcoholism and other conditions. Ecological momentary interventions (EMI), which are a real-time intervention delivery mechanism, have been effectively implemented and are acceptable to patients for a variety of health behaviors, and physical and psychological symptoms.⁶⁰ Behavior change interventions delivered via text message or the Internet have been successfully implemented in “hard-to-reach” populations including socially disadvantaged men,⁶¹ those with comorbid alcohol use disorder and depression,⁶² and those in the criminal justice system.⁶³ One smartphone application designed to support sustained recovery from alcoholism was successful in reducing risky drinking days among individuals recently discharged from residential treatment.⁶⁴ These interventions can be based on existing health behavior theories or incorporated into evidence-based models of treatment.

With the exponential growth in communication technology, landline telephones, computers, and smartphones all have the potential to serve as vessels for the delivery of non-pharmacological sleep interventions and may be considered viable mechanisms for transitioning care from inpatient to outpatient among alcoholics in a patient-centered way. For example, telephone-delivered CBT-I intervention sessions may decrease the need for physical presence of a therapist which has the potential to increase patient access to this treatment. This finding could be particularly relevant for hard-to-reach populations, such as rural-dwelling individuals.⁶⁵ Some researchers and clinicians posit that the key feature that makes computerized (and other forms of) CBT-I promising is decreased reliance on a therapist, but further research is necessary. Recovering alcoholics who are unable to attend outpatient meetings following inpatient treatment, as we have experienced in our own clinic, may be more amenable to interventions delivered via phone or Internet.

Discussion

The studies in this systematic review of the literature provide substantial evidence for non-pharmacological sleep interventions being effective and largely accepted when tailored appropriately. While CBT-I is undoubtedly the most common type of treatment both prescribed and investigated, its utilization among those with alcohol-related disorders is not extensive and therefore remains relatively inconclusive. Small sample sizes and methodological weaknesses of the behavioral sleep interventions reviewed limit conclusions regarding intervention efficacy and highlight the need for patient-centered, formative work. Larger sample sizes and following individuals through the transition from inpatient to outpatient could also benefit alcoholic patients with sleep disturbances and their varying needs post-discharge. Exploring this issue of improving sleep during treatment

**Table 2.** Non-pharmacologic sleep interventions for individuals with alcohol-related disorders: selected articles and findings.

AUTHOR/YEAR	SAMPLE	INTERVENTION	SLEEP MEASURES	METHOD OF DELIVERY	KEY FINDINGS	LIMITATIONS	RATING
Arnedt et al., 2007	n = 7, 43% female, 38.6 years (\pm 10.8), 85.7% Caucasian, alcohol-dependent (based on DSM-IV)	8 individual CBT-I sessions	Daily sleep diaries, Insomnia Severity Index	In-person	Improvements in depression / anxiety, fatigue, sleep efficiency, QOL	No control group, no follow-up assessments	Low
Arnedt et al., 2011	n = 17, 35% female, 46.2 years (\pm 10.1), 77.8% Caucasian, alcohol-dependent	9 individual CBT-I for AD treatments	Daily sleep diaries, Insomnia Severity Index	In-person	Sleep efficiency, WASO, general fatigue improved in treatment group	40% attrition, moderate self-reported data	Moderate
Bootzin and Stevens, 2005 (and Britton et al., 2010)*	n = 55, 38% female, 16.35 years (\pm 1.23), 2/3 Caucasian, recent completers of OP substance abuse treatment programs	6 therapy sessions including MBSR, CBT-I components, bright light therapy	Daily sleep diaries, actiwatches during baseline and posttreatment, dim light melatonin onset (in lab)	In-person	Improved SE, SOL, WASO, total sleep time, and diary ratings on quality / soundness of sleep among those who completed 4+ sessions - mindfulness meditation practice frequency associated with improvements in sleep, emotional distress, reduced substance use	No control condition, conducted among adolescents only, bright light therapy's effect on <i>sleep-related</i> outcomes unclear	Low
Currie et al., 2004	n = 60, 30% female, 43.3 years (\pm 10.9), diagnosed with alcohol dependence, variation in length of remission	3 treatment conditions which included a CBT-I arm (5 one-hour sessions of individual therapy)	Sleep diaries, PSQI, SII, actigraphy	In-person	Improved sleep quality, sleep efficiency, SOL, and WASO maintained for 6 months post-treatment; not corroborated by actigraphy	30% had 12 months or more of pre-treatment abstinence, improvements in sleep still put people in dysfunctional range even after 6 months	High
Greeff and Conradie, 1998	n = 37, 0% female, 45.5 years (\pm 9.5), diagnosed with alcoholism (DSM-III-R?)	10 sessions of progressive relaxation training offered by a psychologist	Questionnaire designed by Tworetzky (1975) - assessing history and treatment for sleep problems, sleep diary	In-person	Treatment group had significant difference in sleep quality pre- and post-treatment	Only men, no follow-up assessments, did not control for possible effects of other treatments	Moderate

Notes: *Given the paucity of literature on behavioral sleep interventions, we included this study in our review despite the fact that the sample was younger than that of the other studies, so interpretation of results may differ. Additionally, the participants in this study were in treatment for *general* substance abuse (many were multi-drug users, though virtually all reported *ever* using alcohol).

and sustaining improved sleep through discharge may have unique implications for relapse prevention. Emergent therapies should be evidence based with established feasibility and acceptability to patients.

An area for future work to move closer to understanding feasibility and acceptability of sleep interventions may be conducting mixed-methods research wherein patient perspectives are sought and explored in-depth. Peer-reviewed, published studies using mixed-methods to examine sleep are few in number, but contribute to our knowledge of disease- or population-specific sleep issues and patient preferences for interventions.⁶⁶⁻⁷¹ Qualitative data provide a deeper understanding of the individual experience. In order to understand

complex phenomena such as sleep disturbances and alcohol dependence from treatment into recovery, qualitative research that is naturalistic and subjective in nature combined with deductive quantitative techniques moves beyond traditional approaches and has the potential to increase our knowledge-base.⁷² One study, which utilized qualitative methods, found some evidence that building trust and improving the program functionality can improve adherence to computerized CBT-I.⁷³

Patient preference for the use of technology in their treatment and recovery is arguably not well understood. Given the success of varying methods of delivery particularly for CBT-I, these could be particularly useful and relevant

**Table 3.** Methods of non-pharmacologic sleep intervention delivery.

METHOD	AUTHORS / YEAR	RESULTS
Telephone-delivered CBT-I	Troxel, Germain, and Buysse, 2012	Developed briefer alternative to standard CBT-I intervention including two phone sessions to address barriers to widespread dissemination of the therapy ⁴⁴
	Arnedt et al., 2013	CBT-I delivered by phone was more beneficial than information (pamphlet) control; more CBT-I phone participants showed improvements in unhelpful sleep-related cognitions and were classified as "in remission" from insomnia at follow-up ⁴⁵
Computerized therapy for insomnia	Cheng and Dizon, 2012	Meta-analysis concluded that computerized CBT-I (cCBT-I) is a "mildly to moderately effective" self-help therapy for short-term treatment of insomnia; average number of sessions needed for treatment was 3.59; estimated that one in every four patients treated with computerized CBT-I will recover from chronic insomnia ⁴⁶
	Ritterband et al., 2009	Internet intervention for insomnia group experienced significantly better sleep compared to control group; internet has potential for delivery of structured behavioral programs for insomnia ⁴⁷
	Ritterband et al., 2012	Internet-based CBT-I program to improve insomnia symptoms (among cancer survivors) using components of CBT-I including sleep restriction, stimulus control, cognitive restructuring, sleep hygiene, and relapse prevention; intervention significantly improved insomnia severity, sleep efficiency, sleep onset latency, general fatigue ⁴⁸
	Riley et al., 2010	Designed automated program delivering stimulus control and sleep restriction strategies; well-accepted and well-utilized by patients with primary insomnia ⁴⁹
	Espie et al., 2012	Web-based CBT course delivered via virtual therapist with automated support & a community forum; effective in improving sleep and associated daytime functioning of adults with insomnia; improvements maintained over time ⁵⁰
	Lancee et al., 2012	Assessed self-help for insomnia program and found that electronic and paper/pencil treatment conditions significantly better than control group on insomnia symptoms, daily sleep measures, depression, and anxiety; improvements maintained over 48-week follow-up ⁵¹
Smartphones for behavioral sleep interventions	Vincent and Lweycky, 2009	5-week online CBT-I course for adults with chronic insomnia consisting of psychoeducation, sleep hygiene, stimulus control, sleep restriction, relaxation training, cognitive therapy, and medication tapering assistance; online treatment group experienced significant improvements in sleep quality, insomnia severity, and daytime fatigue ⁵²
	Vincent and Walsh, 2009	Hyperarousal and time awake in bed partially mediated impact of computerized CBT on sleep at follow-up; pre-sleep arousal more significant in explaining change associated with computerized CBT-I ⁵³
	Behar et al., 2013	Smartphone "apps" offer digital versions of questionnaires about sleep, infer nighttime wakefulness from body movement measured through accelerometer, monitor sound of snoring, help with sleep apnea; "powerful tools that offer both computational and communication opportunities which can be leveraged for the benefit of healthcare" ⁵⁴

for individuals undergoing the transition from inpatient to outpatient status during alcohol rehabilitation, but thorough pilot work is required to assess the efficiency of these technologies and approaches. Future interventions should consider unique challenges associated with the delivery of these behavioral treatments among individuals with alcohol-related problems (social and economic barriers, issues related to access to care, legal implications such as incarceration), which might only be brought to light by in-depth, pilot, mixed-method studies.

Conclusions and Future Research

The results of studies discussed in this paper provide the framework for a fundamentally homogenous message: evidence-based non-pharmacological sleep interventions can be effective and largely accepted when tailored appropriately. Despite considerable evidence for CBT-I efficacy with various methods of delivery, very few are specific to those with alcohol-related disorders and even fewer are specific to those with alcohol dependence. The potential importance of mind-body interventions and cognitive-behavioral strategies should not be overlooked



among individuals with chronic diseases such as alcoholism given the comorbidities and disease burden that accompany this complex disease. Further studies of behavioral therapies with larger sample sizes and well-designed interventions are necessary, especially to elucidate the potential for these therapies to reduce relapse rates among alcoholics. Understanding the individual's experience with sleep throughout recovery is important to explicate the acceptability of established, effective behavioral interventions that reflect sustainable and individualized care.

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Author Contributions

Conceived and designed the experiments: ATB. Analyzed the data: ATB, GRW. Wrote the first draft of the manuscript: ATB. Contributed to the writing of the manuscript: ATB, GRW. Agreed with manuscript results and conclusions: ATB, GRW. Jointly developed the structure and arguments for the paper: ATB, GRW. Made critical revisions and approved the final version: ATB, GRW. Both authors reviewed and approved the final manuscript.

REFERENCES

1. National Heart, Lung, and Blood Institute (NHLBI), X. *What Is Insomnia?* Available at: <http://www.nhlbi.nih.gov/health/health-topics/topics/inso/>. Accessed September 13, 2013, 2011.
2. Colten HR, Altevogt BM. Sleep disorders and sleep deprivation: an unmet public health problem. *Institute of Medicine (US) Committee on Sleep Medicine and Research*. Washington DC: National Academic Press; 2006.
3. Centers for Disease Control and Prevention (CDC), X. *Sleep*. Available at: <http://www.cdc.gov/features/dssleep/>. Accessed October 3, 2013, 2013.
4. Ayas NT, White DP, Al-Delaimy WK, et al. A prospective study of self-reported sleep duration and incident diabetes in women. *Diabetes Care*. 2003;26:380–4.
5. Stine TW, Chapman DP. Associations of frequent sleep insufficiency with health-related quality of life and health behaviors. *Sleep Med*. 2005;6:23–7.
6. Foley D, Ancoli-Israel S, Britz P, Walsh J. Sleep disturbances and chronic disease in older adults: results of the 2003 National Sleep Foundation Sleep in America Survey. *J Psychosom Res*. 2004;56:497–502.
7. Vgontzas AN, Liao D, Bixler EO, Chrousos GP, Vela-Bueno A. Insomnia with objective short sleep duration is associated with a high risk for hypertension. *Sleep*. 2009;32(4):491–7.
8. Vgontzas AN, Liao D, Pejovic S, Calhoun S, Karataraki M, Bixler EO. Insomnia with objective short sleep duration is associated with type 2 diabetes: a population-based study. *Diabetes Care*. 2009;32(11):1980–5.
9. Vgontzas AN, Liao D, Pejovic S, et al. Insomnia with short sleep duration and mortality: the Penn State cohort. *Sleep*. 2010;33(9):1159–64.
10. The Mayo Clinic, X. *Alcoholism*. Available at <http://www.mayoclinic.org/diseases-conditions/alcoholism/basics/definition/con-20020866>. Accessed February 21, 2014, 2009.
11. White WL, Boyle M, Loveland D. Alcoholism/addiction as a chronic disease: from rhetoric to clinical reality. *Alcohol Treat Q*. 2003;3/4:107–30.
12. Benca RM. Sleep in psychiatric disorders. *Neurol Clin*. 1996;14:739–64.
13. Gillin JC, Drummond SP. Medication and substance abuse. In: Kryger MH, Roth T, Dement WC, eds. *Principles and Practice of Sleep Medicine*. 3rd ed. Philadelphia, PA: WB Saunders; 2000:1176–95.
14. Brower KJ. Insomnia, alcoholism and relapse. *Sleep Med Rev*. 2003;7:523–39.
15. Ford DE, Kamerow DB. Epidemiologic study of sleep disturbances and psychiatric disorders. An opportunity for prevention? *JAMA*. 1989;262:1479–84.
16. Weissman MM, Greenwald S, Niño-Murcia G, Dement WC. The morbidity of insomnia uncomplicated by psychiatric disorders. *Gen Hosp Psychiatry*. 1997;19:245–50.
17. Wong M, Brower K, Fitzgerald H, Zucker R. Sleep problems in early childhood and early onset of alcohol and other drug use in adolescence. *Alcohol Clin Exp Res*. 2004;28:578–87.
18. Gillin JC, Smith TL, Irwin M, Kripke DF, Schuckit M. EEG sleep studies in “pure” primary alcoholism during subacute withdrawal: relationships to normal controls, age, and other clinical variables. *Biol Psychiatry*. 1990;27:477–88.
19. Foster JH, Peters TJ. Impaired sleep in alcohol misusers and dependent alcoholics and the impact upon outcome. *Alcohol Clin Exp Res*. 1999;23(6):1044–51.
20. Currie SR, Clark S, Rimac S, Malhotra S. Comprehensive assessment of insomnia in recovering alcoholics using daily sleep diaries and ambulatory monitoring. *Alcohol Clin Exp Res*. 2003;27:1262–9.
21. Smith N, Hill R, Marshall J, Keaney F, Wanigaratne S. Sleep related beliefs and their association with alcohol relapse following residential alcohol detoxification treatment. *Behav Cogn Psychother*. 2013;28:1–12.
22. Brower KJ, Aldrich MS, Robinson EA, Zucker RA, Greden JF. Insomnia, self-medication, and relapse to alcoholism. *Am J Psychiatry*. 2001;158:399–404.
23. Alling C, Balldin J, Bokström K, Gottfries CG, Karlsson I, Langström G. Studies on duration of a late recovery period after chronic abuse of ethanol. A cross-sectional study of biochemical and psychiatric indicators. *Acta Psychiatr Scand*. 1982;66:384–97.
24. Drummond SP, Gillin JC, Smith TL, DeModena A. The sleep of abstinent pure primary alcoholic patients: natural course and relationship to relapse. *Alcohol Clin Exp Res*. 1998;22(8):1796–802.
25. Adamson J, Burdick JA. Sleep of dry alcoholics. *Arch Gen Psychiatry*. 1973;28(1):146–9.
26. Morin CM. Combined therapeutics for insomnia: should our first approach be behavioral or pharmacological? *Sleep Med*. 2006;S1:S15–9.
27. Kyle SD, Miller CB, Rogers Z, Siriwardena AN, Macmahon KM, Espie CA. Sleep restriction therapy for insomnia is associated with reduced objective total sleep time, increased daytime somnolence, and objectively impaired vigilance: implications for the clinical management of insomnia disorder. *Sleep*. 2014;37(2):229–37.
28. Wang MY, Wang SY, Tsai PS. Cognitive behavioural therapy for primary insomnia: a systematic review. *J Adv Nurs*. 2005;50:553–64.
29. Lund HG, Rybarczyk BD, Leszczyszyn D, Stepanski E. The discrepancy between subjective and objective measures of sleep in older adults receiving CBT for comorbid insomnia. *J Clin Psychol*. 2012;69:1108–20.
30. Morin CM, Espie CA. *Insomnia: A Clinical Guide to Assessment and Treatment*. New York, NY: Kluwer Academic/Plenum Publishers; 2003.
31. Fucito LM, Redeker NS, Ball SA, Toll BA, Ikomi JT, Carroll KM. Integrating a behavioral sleep intervention into smoking cessation treatment for smokers with insomnia: a randomized pilot study. *J Smok Cessat*. 2014;9(1):31–8.
32. Jungquist CR, Tra Y, Smith MT, et al. The durability of cognitive behavioral therapy for insomnia in patients with chronic pain. *Sleep Disord*. 2012.
33. Jungquist CR, O'Brien C, Matteson-Rusby S, et al. The efficacy of cognitive-behavioral therapy for insomnia in patients with chronic pain. *Sleep Med*. 2010;11:302–9.
34. Gellis LA, Arigo D, Elliott JC. Cognitive refocusing treatment for insomnia: a randomized controlled trial in university students. *Behav Ther*. 2013;44:100–10.
35. Katofsky I, Backhaus J, Junghans K, et al. Effectiveness of a cognitive behavioral self-help program for patients with primary insomnia in general practice – a pilot study. *Sleep Med*. 2012;13:463–8.
36. Friedmann PD, Herman DS, Freedman S, Lemon SC, Ramsey S, Stein MD. Treatment of sleep disturbance in alcohol recovery: a national survey of addiction medicine physicians. *J Addict Dis*. 2003;22:91–103.
37. Bracken BK, Penetar DM, Maclean RR, Lukas SE. Kudzu root extract does not perturb the sleep/wake cycle of moderate drinkers. *J Altern Complement Med*. 2011;17(10):961–6.
38. Sivertsen B, Omvik S, Pallesen S, et al. Cognitive behavioral therapy vs zopiclone for treatment of chronic primary insomnia in older adults: a randomized controlled trial. *JAMA*. 2006;295(24):2851–8.
39. Jacobs GD, Pace-Schott EF, Stickgold R, Otto MW. Cognitive behavior therapy and pharmacotherapy for insomnia: a randomized controlled trial and direct comparison. *Arch Intern Med*. 2004;164(17):1888–96.
40. Manber R, Bernert RA, Suh S, Nowakowski S, Siebern AT, Ong JC. CBT for insomnia in patients with high and low depressive symptom severity: adherence and clinical outcomes. *J Clin Sleep Med*. 2011;7:645–52.
41. Kozasa EH, Hachul H, Monson C, et al. Mind-body interventions for the treatment of insomnia: a review. *Rev Bras Psiquiatr*. 2010;32:437–43.



42. The Cochrane Collaboration. *Cochrane Handbook for Systematic Reviews of Interventions*. Available at http://handbook.cochrane.org/front_page.htm. Accessed March 20, 2014, 2011.
43. Arnedt JT, Conroy D, Rutt J, Aloia MS, Brower KJ, Armitage R. An open trial of cognitive-behavioral treatment for insomnia comorbid with alcohol dependence. *Sleep Med*. 2007;8:176–80.
44. Currie SR, Clark S, Hodgins DC, El-Guebaly N. Randomized controlled trial of brief cognitive-behavioural interventions for insomnia in recovering alcoholics. *Addiction*. 2004;99:1121–32.
45. Bootzin RR, Stevens SJ. Adolescents, substance abuse, and the treatment of insomnia and daytime sleepiness. *Clin Psychol Rev*. 2005;25:629–44.
46. Arnedt JT, Conroy DA, Armitage R, Brower KJ. Cognitive-behavioral therapy for insomnia in alcohol dependent patients: a randomized controlled pilot trial. *Behav Res Ther*. 2011;49:227–33.
47. Britton WB, Bootzin RR, Cousins JC, Hasler BP, Peck T, Shapiro SL. The contribution of mindfulness practice to a multicomponent behavioral sleep intervention following substance abuse treatment in adolescents: a treatment-development study. *Subst Abuse*. 2010;31:86–97.
48. Williams J, Roth A, Vatthauer K, McCrae CS. Cognitive behavioral treatment of insomnia. *Chest*. 2013;143:554–65.
49. Troxel WM, Germain A, Buysse DJ. Clinical management of insomnia with brief behavioral treatment (BBTI). *Behav Sleep Med*. 2012;10:266–79.
50. Arnedt JT, Cuddihy L, Swanson LM, Pickett S, Aikens J, Chervin RD. Randomized controlled trial of telephone-delivered cognitive behavioral therapy for chronic insomnia. *Sleep*. 2013;36:353–62.
51. Cheng SK, Dizon J. Computerised cognitive behavioural therapy for insomnia: a systematic review and meta-analysis. *Psychother Psychosom*. 2012;81:206–16.
52. Ritterband LM, Thorndike FP, Gonder-Frederick LA, et al. Efficacy of an Internet-based behavioral intervention for adults with insomnia. *Arch Gen Psychiatry*. 2009;66:692–8.
53. Ritterband LM, Bailey ET, Thorndike FP, Lord HR, Farrell-Carnahan L, Baum LD. Initial evaluation of an Internet intervention to improve the sleep of cancer survivors with insomnia. *Psychooncology*. 2012;21:695–705.
54. Riley WT, Mihm P, Behar A, Morin CM. A computer device to deliver behavioral interventions for insomnia. *Behav Sleep Med*. 2010;8:2–15.
55. Espie CA, Kyle SD, Williams C, et al. A randomized, placebo-controlled trial of online cognitive behavioral therapy for chronic insomnia disorder delivered via an automated media-rich web application. *Sleep*. 2012;35:769–81.
56. Lancee J, van den Bout J, van Straten A, Spoormaker VI. Internet-delivered or mailed self-help treatment for insomnia? A randomized waiting-list controlled trial. *Behav Res Ther*. 2012;50:22–9.
57. Vincent N, Lewycky S. Logging on for better sleep: RCT of the effectiveness of online treatment for insomnia. *Sleep*. 2009;32:807–15.
58. Vincent N, Walsh K. Hyperarousal, sleep scheduling, and time awake in bed as mediators of outcome in computerized cognitive-behavioral therapy (cCBT) for insomnia. *Behav Res Ther*. 2013;51:161–6.
59. Behar J, Roebuck A, Domingos JS, Geder E, Clifford GD. A review of current sleep screening applications for smartphones. *Physiol Meas*. 2013;34:R29–46.
60. Heron KE, Smyth JM. Ecological momentary interventions: incorporating mobile technology into psychosocial and health behavior treatments. *Br J Health Psychol*. 2010;15:1–39.
61. Irvine L, Falconer DW, Jones C, Ricketts IW, Williams B, Crombie IK. Can text messages reach the parts other process measures cannot reach: an evaluation of a behavior change intervention delivered by mobile phone? *PLoS One*. 2012;7(12):e52621.
62. Agyapong VI, McLoughlin DM, Farren CK. Six-months outcomes of a randomized trial of supportive text messaging for depression and comorbid alcohol use disorder. *J Affect Disord*. 2013;151(1):100–4.
63. Walters ST, Ondersma SJ, Ingersoll KS, et al. MAPIT: development of a web-based intervention targeting substance abuse treatment in the criminal justice system. *J Subst Abuse Treat*. 2014;46(1):60–5.
64. Gustafson DH, McTavish FM, Chih MY, et al. A smartphone application to support recovery from alcoholism: a randomized clinical trial. *JAMA Psychiatry*. 2014;71(5):566–72.
65. Holmgvist M, Vincent N, Walsh K. Web- vs. telehealth-based cognitive behavioral therapy for insomnia: a randomized controlled trial. *Sleep Med*. 2014;15:187–95.
66. Owens JA, Stahl J, Patton A, Reddy U, Crouch M. Sleep practices, attitudes, and beliefs in inner city middle school children: a mixed-methods study. *Behav Sleep Med*. 2006;4:114–34.
67. Papp KK, Stoller EP, Sage P, et al. The effects of sleep loss and fatigue on resident-physicians: a multi-institutional, mixed-method study. *Acad Med*. 2004;79:394–406.
68. Andrews LK, Coviello J, Hurley E, Rose L, Redeker NS. “I’d eat a bucket of nails if you told me it would help me sleep:” perceptions of insomnia and its treatment in patients with stable heart failure. *Heart Lung*. 2013;42:339–45.
69. Chen WT, Shiu CS, Yang JP, et al. Fatigue and sleep disturbance related to perceived stress in Chinese HIV-positive individuals: a mixed-methods study. *J AIDS Clin Res*. 2013.
70. Barbour VL, Mead GE. Fatigue after stroke: the patient’s perspective. *Stroke Res Treat*. 2012.
71. Davy Z, Middlemass J, Siriwardena AN. Patients’ and clinicians’ experiences and perceptions of the primary care management of insomnia: qualitative study. *Health Expect*. 2013.
72. Newman I, Ridenour CS, Newman C, DeMarco GMP. A typology of research purposes and its relationship to mixed methods. In: Tashakkori A, Teddlie C, eds. *Handbook of Mixed Methods in Social & Behavioral Research*. Thousand Oaks, CA: Sage Publications; 2003:167–88.
73. Middlemass J, Davy Z, Cavanagh K, et al. Integrating online communities and social networks with computerized treatment for insomnia: a qualitative study. *Br J Gen Pract*. 2012;62:840–50.
74. Greeff AP, Conradie WS. Use of progressive relaxation training for chronic alcoholics with insomnia. *Psychol Rep*. 1998;82:407–12.