Supplementary Online Content

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eAppendix. Methods, Results, Discussion, References

This supplementary material has been provided by the authors to give readers additional information about their work.

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Methods.

Outcome Measures:

The Insomnia Severity Index (ISI)[1] is a 7-item global index of self-reported insomnia symptom severity. Scores on the ISI range from 0 to 28, with higher scores indicating greater insomnia severity. Recommended cutoffs on the ISI are 0 – 7 (absence of insomnia), 8 – 14 (sub-threshold insomnia), 15 – 21 (moderate insomnia), and 22 – 28 (severe insomnia). The ISI has been shown to be valid, reliable, and sensitive to changes in insomnia treatment[1,2], as well as validated for online use[3].

Daily sleep diaries[4] were collected online, prospectively, during a 2-week period at each of the four assessment periods. The 11-item diary included the eight core consensus sleep diary questions[4]; three additional questions on napping, alcohol use, and sleep aids; and a field for comments. Although polysomnography is considered the gold-standard for objective sleep measurement, prospectively collected self-reported sleep dairies are a proven methodology to assess insomnia and track subjective treatment effects[5], and, along with global measures of insomnia severity, are considered the standard assessments for insomnia[4,5].

A semi-structured clinical telephone interview was conducted to obtain a detailed sleep and health history; screen for other sleep disorders; and assess for psychiatric co-morbidity using the Mini-International Neuropsychiatric Interview (MINI)[6] and included components of the Diagnostic Interview for Insomnia. The phone interview was administered by the project coordinator after receiving training from a PhD clinical psychologist. Ongoing supervision was provided throughout the trial, and the team met weekly to review decisions related to eligibility. For participants who required a risk assessment due to acknowledging suicidal ideation, a PhD

clinical psychologist or clinical psychology postdoctoral fellow followed up directly with the individual.

Intervention utilization and adherence was measured using three key variables in the Internet intervention for insomnia: login count, diary count, and number of Cores completed. For these purposes, logins to the system to complete either questionnaires or sleep diaries during the assessment periods were not counted as part of the intervention utilization. Logins had to be at least five minutes apart to be deemed a unique login.

Interventions:

Internet CBT-I (Sleep Healthy Using The Internet; SHUTi): SHUTi is a fully automated, interactive, and tailored web-based program (see Thorndike, 2008[7] for a more detailed description of SHUTi) that incorporates the primary tenets of face-to-face CBT-I, including sleep restriction, stimulus control, cognitive restructuring, sleep hygiene, and relapse prevention[8,9]. Intervention content is presented in six "Cores," metered out over time, with a new Core available seven days after completion of the previous Core. Each Core was developed to parallel traditional weekly sessions conducted when delivering CBT-I in a face-to-face format, following a similar general structure: 1) examination of Core objectives, 2) review and feedback on homework and sleep diary data from the previous week, 3) teaching of new intervention material, 4) summary of the main points of the Core, and 5) assignment of homework. Given this program was a self-guided intervention and did not include any clinician instructions or support, the development team purposefully decided to not include instructions on medication titration. Instead, participants were informed that if reducing or eliminating their sleep medications was a goal, they should follow-up with their prescribing physician for instructions. Intervention content was enhanced through a variety of interactive features, including personalized goal-setting, graphical feedback based on inputted symptoms, animations and illustrations to enrich comprehension, quizzes to test and enhance user knowledge, vignettes to promote identification with material, and video-

based expert explanations. Automated emails are also sent to increase engagement and encourage program adherence.

Development of the SHUTi intervention was grounded in the Model for Internet Interventions[10], and followed best practice recommendations from the field of instructional design[11], where the intervention targets the distinct needs of users; sets measurable learning objectives and performance requirements; and assesses users' achievement of the targeted outcomes.

Online Patient Education (PE): The online PE program provided non-tailored and fixed material about: insomnia symptoms; the impact, prevalence, and causes of insomnia; when to see a doctor; and basic lifestyle, environmental, and behavioral strategies to improve sleep. The content was provided in a clear and straight forward manner with web pages containing mostly text and basic images for each of the areas specified. Participants assigned to this condition were able to read the material immediately upon completion of the baseline assessments, and could log in to review the material as often as they wanted throughout the intervention period. The content for this program was informed based on a review of insomnia-focused websites at the time of development. In some areas, content between the PE and SHUTi web programs overlap; however, SHUTi differs from the PE website in important ways. In contrast to SHUTi, the PE website (1) Does not personalize or individually tailor treatment recommendations based on user input; (2) Presents content in a simple, set form, without interactive assets; and (3) Delivers content all at once, meaning the user can access full site content immediately, rather than having to wait for content to be metered, or unlocked, over time.

Procedure: In response to online posts or advertisements about the trial (e.g., Facebook, craigslist), interested adults completed a brief online eligibility screening form. Ineligible adults were notified by email, while initially eligible adults were contacted by phone to collect additional screening information, confirm eligibility, and obtain online informed consent. Eligible participants were administered the MINI

and elements of the Diagnostic Interview for Insomnia by phone. Participants then received an email with a unique login ID and password along with instructions to complete the online pre-assessment questionnaire and sleep diaries. To satisfy the baseline diary requirement, participants were instructed to complete 10 days of online sleep diaries within a 14-day window. The program only accepted diary entries about sleep periods that were entered "today," "yesterday," or "the day before that." This criterion was used to promote accuracy by reducing the ability of users to retrospectively estimate their sleep information. After completing the baseline assessment, participants immediately received an automated email informing them of their condition as well as instructions on how to begin using their randomly assigned intervention. At the end of this intervention period, all participants were instructed by email to complete the online post-assessment questionnaire and an additional 10 online sleep diaries in a 14-day window. After completing the post-assessment, individuals had continued access to their assigned online program. Both six months later, and again 1-year later, participants received emails to complete the follow-up assessments. During the intervention period, research staff did not initiate contact with participants, but did respond to technical support or study-related inquiries. During the assessment periods, study staff sent emails or made phone calls to encourage assessment completion, if needed.

Randomization and Blinding: Randomization was achieved using a random number generator, assigning equal numbers of participants to the two conditions. A study investigator (FPT) prepared the randomization chart prior to the study, and the study coordinator (CF) remained blind to the randomization scheme until she individually unlocked each participant's treatment assignment after the individual was deemed eligible and following the completion of the initial baseline assessment. Although participants technically remained blind to the randomization scheme, given the description of the two conditions in the consent form, participants likely could have deduced which arm they were assigned.

Adverse Events: Prior to the start of the study, criteria for determining whether adverse events were serious and whether they qualified as being related, or possibly related to the study, were established and

approved by the Data and Safety Monitoring Board. No participant reported a serious adverse outcome,

deemed related or possibly related to the study, during the course of the trial.

Results.

Reasons for exclusion: Of the 621 deemed ineligible, the most common reasons for exclusion were total sleep time greater than 6.5 hours (n = 125); unstable medication regimen, defined as a change to a schedule or dosage of the medication within the past three months including starting a new medication during this period (n = 73); living outside of the United States (n = 72); working the night shift (n = 61); and probable Restless Legs Syndrome (n = 55).

Comorbidities: 29.0% of participants had a medical comorbidity, including cancer, diabetes, heart disease including heart attack, high blood pressure, asthma or lung problems, or stroke; 30.7% had a psychiatric comorbidity, including current/past major depressive episode, current or past panic with or without agoraphobia, current agoraphobia without history, current social phobia, current OCD, current PTSD, or current generalized anxiety; and 49.8% had either a medical or psychiatric comorbidity, or both.

There was sufficient power (77% power to detect a small effect size in insomnia improvement between comorbid groups at α = .05; 100% power to detect a medium effect size in insomnia improvement between comorbid groups at α = .05) to conclude with confidence that the presence of medical and/or psychiatric comorbidity did not in fact moderate response to internet CBT (calculated with G*Power 3.1.9.2).

Participants lost to follow-up: The following correlations were calculated to determine whether there were differences between participants who completed assessments from those who did not. There was no significant correlation between completion of post assessment and baseline values of SOL, WASO, and ISI. Similarly, there were no significant correlations for completion of 6-month post assessment and 12-month post assessment and baseline values on these same primary variables. There was also no significant correlation between missing data at post and group type, age, race, or length of sleep

problems. However, women were found to be 10% more likely to complete the post assessment than men (p=.015).

Utilization and Adherence: In contrast to the SHUTi participants, the PE participants logged in between 0 and 12 times with a median login count of 1. Participants in both conditions were able to review content immediately on completion of the baseline assessment, and, therefore, if that was the only time the participant reviewed that content, it would have resulted in a 0 login count. This likely results in conservative estimates.

Discussion.

The responder and remitter rates found in this study are also consistent with a meta-analysis of 11 RCTs of Internet-delivered CBT-I containing a total of 1460 participants in which the effect sizes at post-treatment on insomnia severity were reported as moderate to large[12].

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