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Cognitive Behavioral Treatment for Insomnia in Older Adults with Mild Cognitive Impairment in Independent Living Facilities: A Pilot Study

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Abstract

Objectives: Sleep disturbance is common in older adults and is one of the most frequent symptoms observed in older adults with Mild Cognitive Impairment (MCI). Older adults in residential care settings are more likely to suffer from psychiatric, medical and cognitive (i.e., MCI) impairments than those still independent in the community. Interventions targeting insomnia are ideal given the evidence that treatments are very successful for a broad range of individuals; improvements have the potential to broadly impact public health; and further, sleep represents a modifiable risk factor for a range of other disorders, such as declining cognition, depression, and functional impairment. What remains to be established is whether or not established treatments, specifically Cognitive Behavioral Therapy for insomnia (CBT-I), can be successfully used with older individuals who have both impaired sleep and MCI. This study aims to test whether CBT-I is effective in improving the sleep of older adults with insomnia and mild cognitive impairment.

Methods: A six-session, adapted version of a cognitive behavioral intervention for insomnia was administered to older adults (N=28) across two residential facilities. Participants were randomly assigned to either the sleep intervention or an active control group.

Results: The intervention had a highly significant (Cohen's d ≥ 1.9, p<0.001) effect of improving sleep outcomes for 4 of the 5 outcome variables at both follow up time points, measured by actigraphy.

Conclusions: Nonpharmacological interventions such as CBT-I may be beneficial for people with MCI. Targeting sleep has the potential to broadly impact public health, including in people with MCI.

Keywords: Insomnia; MCI; Older adults; CBT-I; Residential care

Introduction

More than 50% of adults over the age of 65 report serious problems with sleep [1]. Sleep disturbance increases with age, particularly among women and those with concurrent medical or psychiatric conditions [2]. Further, the presence of sleep disturbance is a risk factor for declining health status [3]. Specific aspects of sleep that are significantly worse in older adults with insomnia include increased sleep latency, number of awakenings after sleep onset, and overall sleep efficiency [4]. Such problems are frequently secondary to medical, psychological, environmental and behavioral causes, as well as complications that can result from prescription and non-prescription medications [5]. Notably, sleep disturbances are more prevalent and severe in those with MCI compared to those with no impairment [6,7]. Growing evidence suggests that sleep problems may reflect an intermediary state of cognitive functioning between normal and cognitive impairment, and may be predictive of progression to dementia [8,9].

Several meta-analyses of sleep interventions, such as CBT-I, support the finding that sleep disturbance is very amenable to change [10,11] with treatment resulting in robust improvements in functioning across the lifespan. Morin et al. [12] found that an 8-week CBT intervention with older adults in the community resulted in significant improvements that were maintained even a year later, including decreases in sleep latency, Wake After Sleep Onset (WASO), and early morning awakenings, as well as an increase in sleep efficiency. Discussion of 'sleep hygiene' can be useful to make sure that individuals are behaving in ways that promote good sleep, from how much alcohol they consume and when, to making sure the temperature is somewhat cool in their bedroom. The interventions also include the well-supported behavioral components, like stimulus control and sleep restriction procedures, which set a consistent rise time, designating a sleep opportunity window and recommending that patients get out

of bed if unable to sleep (instead of staying in bed and being frustrated), in addition to other instructions. CBT can also include relaxation to help manage physiological arousal and cognitive therapy (restructuring) to address the thoughts and beliefs that serve to perpetuate the insomnia such as "everyone needs 8 hours of sleep".

Residential Care Facilities for the Elderly [RCFEs] e.g., Independent Living Facilities (ILF) strive to provide an environment that allows and cultivates independence, while simultaneously providing assistance for those residents with functional and cognitive limitations. Residents may present with multiple medical and psychological co-morbid disorders, and appear to be more likely to suffer from both disturbed sleep [13] and Mild Cognitive Impairment (MCI) [14] than skilled nursing facility or home-dwelling adults. Thus, RCFEs, particularly ILFs, are an ideal and critical setting in which to develop effective interventions for sleep disturbance in residents with MCI. There is evidence that CBT-I is effective in the geriatric population although studies are limited in the area examining CBT-I and its effectiveness in a geriatric population with MCI residing in residential care facilities, specifically independent living facilities.

Is CBT effective in those with MCI?

The success of CBT relies on certain cognitive processes, including one's ability to process and incorporate new information in order to subsequently shift one's behavior and mood. Although complaints of attention and concentration are common amongst those with insomnia, complaints of memory or executive functioning are less common [15]. Sleep latency, night time awakening, duration of sleep and sleep efficiency were all compromised in patients with MCI, even when analyses were controlled for clinical levels of anxiety and depression [16]. Cognitively, deficits in executive processes (e.g., planning, problem solving), memory and language functions also occur more frequently in MCI and are particularly important to assess in light of their potential impact on treatment given the cognitive processing involved in CBT. MCI affects 15-25% of adults over the age of 70, with about 10% of this group progressing to dementia each year [17-19]. There is growing evidence that a bidirectional relationship between sleep disturbances and cognitive impairment exists [20]. Prospectively, sleep disturbance has been linked to the emergence of cognitive deficits [6], and has been identified as a risk factor and/or prodromal syndrome of various neurodegenerative diseases [21]. For example, recent work by Diem et al. [22] found that lower sleep efficiency and longer sleep latencies in older women were associated with a 1.5 and 1.4 greater odds of developing MCI or dementia within five years.

Patients with executive dysfunction, often present with MCI [23], have also been identified as poor responders to pharmacotherapy, such as anti-depressants [24], creating a need for therapeutic alternatives. Although there is evidence that those with cognitive impairment can benefit from structured psychotherapy, such as CBT [25], Interpersonal [26] or Problem Solving Therapy [27,28], much remains to be learned about how MCI may moderate the effects of CBT-I for sleep and what adaptations are needed to maximize the effects of treatment. Adaptations of CBT interventions targeting other behaviors (e.g. anxiety) among older adults with MCI have proven to be successful [29]. This study contributes new data on the degree to which adaptations to CBT, such as repetition and increased opportunities for practice, aid older adults in RCFE settings who have MCI and sleep disorders.

Our hypotheses

From baseline (T1) to the 4 month-follow-up (T3) time points, ILF residents with both sleep disturbances and MCI assigned to receive the adapted CBT-I will exhibit: 1) significant improvements in objective measures of sleep-onset latency, wake time after sleep-onset, total sleep time, and sleep efficiency, as measured by actigraphy, compared to the delayed treatment group, and 2) significant decreases in self-reported frequency and severity of insomnia symptoms, as measured by the Insomnia Severity Index (ISI), compared to the delayed treatment group.

Methods

The study employed a two-arm Individual Randomized Group Trial (IRGT) with residents from two RCFE (N=28), with randomization at the resident level to the adapted intervention or delayed treatment group. Participants were randomized to either a 6-session CBT-I intervention group or an active control nutrition class. The active control group was a nutrition class as it would not have an impact on sleep parameters and was of interest for participant recruitment.

The sample (N=28) included participants from two local Independent Living Facilities (ILF) in the Santa Cruz area from 2014-2015. Recruitment was facilitated by flyers in all resident mailboxes and at in-person talks by the PI about common sleep changes with age.

Participants were 28 older adults (24 females-4 males; mean age, 89.36 years), meeting the key inclusion criteria of meeting diagnostic criteria for insomnia according to the DSM-IV [30], and the core clinical criteria for MCI used by healthcare workers without access to advanced imaging techniques [31] (i.e., subject memory complaints, preservation of independence in functional abilities, performance on at least one of the cognitive tests at 1.5 SD below published age/educational matched normative means, and no major neurocognitive disorder). Out of the 46 potential participants identified, 18 participants were excluded from the study due to acute stressor (n=6), not meeting insomnia diagnostic criteria (n=6), unwilling to commit time to study (n=2), screened positive on apnea screen and were unwilling to treat (n=1), unwilling to do apnea screen (n=1), unable to reach/make contact (n=1), and one that was determined to be intoxicated at screening visit (n=1).

Intervention

The CBT-I intervention was administered by a behavioral sleep medicine specialist (psychologist who is certified by American Board of Sleep Medicine). The CBT-I intervention was delivered in a group format in 6 sessions spread over 7 weeks. One week break was taken between sessions 5 and 6 to give participants time implementing recommendations on their own. A phone call was completed with each participant on the off week to check-in and see if they had any questions or concerns. Adaptations to the CBT-I intervention included specific adjustments to content, including decreasing the amount of content covered and providing brief, focused rationale for the treatment components leaving time for review and repetition of content covered. Larger handouts for those with visual impairments were distributed to patients. We also provided larger writing spaces for those with deficits in fine-motor skills. In addition, changes in the delivery of the intervention benefitted from utilizing learning and memory aids to enhance understanding and retention, such as insuring sufficient time and opportunity to review material and ask questions, adjusting pace to account for changes in information processing, repeating key material and adding troubleshooting and reminder calls between intervention sessions.

Outline of the CBT-I content and sessions

Session 1: Overview of sleep regulation, changes with aging and discussion of sleep hygiene.

Session 2: Review of previous week's material. Sleep scheduling (sleep compression) and stimulus control guidelines.

Session 3: Review of previous week's material. Follow up on adherence to prescribed sleep compression window and stimulus control guidelines. Constructive worry and introduction to diaphragmatic breathing.

Session 4: Review of previous week's material. Follow up on adherence to prescribed sleep compression window and stimulus control guidelines. CBT model of thoughts, feelings, and behaviors. Introduction to progressive muscle relaxation.

Session 5: Review of previous week's material. Follow up on adherence to prescribed sleep compression window and stimulus control guidelines. CBT model of thoughts, feelings, and behaviors and cognitive restructuring. Introduction to visualization.

Session 6: Review of previous week's material. Follow up on adherence to prescribed sleep compression window and stimulus control. Review of class CBT-I components and what was helpful.

Sleep compression was utilized rather that sleep restriction and included assessing the average amount of time in bed each week and incrementally delaying bedtime by 30 minutes or awakening 30 minutes earlier. This serves to compress the time in bed window to bring window closer to actual sleep time. Stimulus control guidelines were modified to include staying in bed to rest if there was risk of fall or if being in bed due to chronic pain was more comfortable versus other location. Cognitive components included constructive worry time and cognitive restructuring for dysfunctional beliefs and attitudes about sleep.

All participants underwent a detailed assessment on all outcomes at three time points (baseline-T1, post-intervention-T2 and a 4 month follow-up-T3), including sleep, cognitive, mood, physical performance, health QOL, pain and demographic measures. Additionally, sleep apnea was screened with in-home ambulatory equipment (RESMED Apnea Link Plus) and patients were referred out for treatment before randomization if they had an apnea hypopnea index ≥ 30 and/or were not utilizing CPAP treatment.

Primary outcome measures

Insomnia Severity Index (ISI) [32] is given at baseline (T1), post-intervention (T2), and at 4 month follow up (T3). The ISI is a brief screening questionnaire used to assess severity of insomnia symptoms. It consists of 7 questions each rated using a Likert-type scale ranging from 0-4 with higher scores indicating more acute symptoms of insomnia. ISI has an internal consistency of 0.74.

Objective sleep parameters of total sleep time sleep latency (SL), wakefulness after sleep onset (WASO), total sleep time (TST), and sleep efficiency (SE) were measured using Actigraph wGT3x (Actigraph Corporation Pensacola, FL) which records continuous physical activity and sleep/wake estimates using an accelerometer and light sensor. The participants wore the device on their non-dominant hand for a week at time points baseline (T1), post-intervention (T2), and at 4 month follow up (T3). The Velcro strap was chosen over a typical watch like band due to dexterity and fine motor skill issues for some of the participants and reports of skin sensitivity. The raw actigraphy data, with recordings of 3 to 8 days in duration, was first downloaded and reviewed to eliminate technical and situational (e.g., for example, periods where no activity or light were recorded or periods that software recognizes as device being "off-wrist"; the device failed, battery died before sufficient data was recorded, the device was removed) artifacts, prior to scoring the variables of interest with validated software. The data was analyzed by a sleep expert who used standard methodology of self-reported sleep logs and actigraphic recordings were used for establishing bedtimes and rise times. Actigraphs were initialized to start recording, at one minute epochs/intervals, when they were placed on the participant's wrist by research personnel. Sleep log noted 'bedtimes' and 'out of bed' times were used as 'scored' times. If there were no sleep log notation available for a time point, we marked the time closest to the time that light and activity levels decreased/increased for a given day. If there was a significant discrepancy between the sleep log times and the visual review of data (i.e., signs of extended or protracted light and activity recordings during a time designated as 'sleeping'),

adjustments were made to bring the marker within 5 minutes of the shift in activity level. Total sleep time, sleep latency, wakefulness after sleep onset, and sleep efficiency (time in bed/total sleep time) were then calculated using ActiLife 5 Software that uses Cole and Kripke's 1992 sleep scoring algorithm. Actigraph data was reviewed and scored separately from all other data and randomized group assignment reports, with the exception of sleep logs and subject ID (which was a consecutive, temporally assigned number).

Data analysis

Multilevel analyses were used to provide estimates of the intervention's effect on the outcomes of interest, adjusting for the correlation between residents within the same treatment delivery groups. Stata was used to conduct the multilevel analyses. In these analyses the outcome variable was regressed, using linear multilevel regression models (all outcomes are continuous variables), against the following independent variables: indicator variable denoting intervention condition, baseline measure of the dependent variable; and covariates that were imbalanced across arms. Cohen's d was computed from the regression coefficient t-statistics as a measure of effect size [33,34], and p-values were from the Wald test for significance of a regression coefficient.

Results

Table 1 includes baseline means for selected demographic, covariates and primary outcomes by treatment arm for all participants. The table also displays the p-values for independent sample t-tests for baseline differences between treatment and control group means. There were no statistically significant differences in any factors across arms, so randomization efforts were successful in balancing the groups on a wide range of characteristics. The only variable that was close to significance is the SF-36 Physical quality of life rating, with a p=0.11; therefore it was included as the only covariate besides baseline outcome in the regression analyses (a cutoff of p<0.15 was used for concluding covariates were "imbalanced") [35]. Table 2 shows the means and standard deviations for all of the sleep parameters as measure for both T1 and T3. The effect of the intervention on the secondary neuropsychological outcome variables are reported elsewhere [36].

Table 3 shows that the intervention had a highly significant (p<0.005) effect in the desired direction of improving sleep outcomes for 4 of the 5 outcome variables at both follow up time points. In other words, sleep latency; wake after sleep onset, sleep efficiency, and insomnia severity all were improved significantly in the treatment groups relative to the control groups. Effect sizes were large, with absolute values of Cohen's d greater than 1.

Discussion

Results of our current investigation, utilizing an adapted CBT-I intervention with older adults in ILFs who suffer from sleep disturbance and MCI, indicate that we have been able to improve both objective and subjective ratings of sleep quality. At this stage it appears that this 6-session CBT-I group intervention

Table 1: Selected Baseline Characteristics (means) by Treatment Condition

	Intervention (n=14) Mean (SE)	Active Control (n=13) Mean (SE)	Independent samples t-test p-value
Age	89.36 (1.23)	88.69 (1.35)	0.72
Body Mass Index (BMI)	23.91(1.02)	24.66 (1.06)	0.61
Education (years)	15.58 (0.43)	15.5 (0.42)	0.89
Apnea-Hypopnea Index (AHI)	12.86 (2.86)	7.92 (2.50)	0.21
Takes Sleep Medication	0.57 (0.14)	0.42 (0.15)	0.45
Number of Prescription Medications	5.36 (0.85)	6.46 (1.58)	0.54
Number of chronic medical conditions	3 (0.36)	3.38 (0.81)	0.67
Activities of daily living (ADLs)	5.85 (0.15)	5.92 (0.08)	0.70
Instrumental activities of daily living (IADLs)	5.15 (0.60)	5.92 (0.42)	0.31
Montreal Clinical Assessment (MoCA)	23.64 (0.80)	23.5 (1.01)	0.91
Insomnia Severity Index (ISI)	15.29 (0.62)	14.85 (1.07)	0.72
Reduced scale of morningness-eveningness Q	17.5 (0.83)	17.95 (0.89)	0.71
Geriatric Depression Scale	2.85 (0.79)	2.75 (0.82)	0.93
Geriatric Anxiety Inventory	2.88 (1.09)	3.38 (0.90)	0.74
Grip Strength Left Hand (pounds)	37.48 (4.72)	33.07 (3.78)	0.48
Grip Strength Right Hand (pounds)	38.91 (4.05)	34.99 (3.36)	0.47
Short Physical Perf. Battery Total (SPPB)	5 (0.88)	3.83 (0.98)	0.39
SF36-Physical health	49.77 (2.20)	44.08 (2.66)	0.11*
SF36-Mental health	51.92 (2.72)	54.92 (1.69)	0.37
Rating of Pain Now	0.58 (0.37)	0.92 (0.45)	0.56
Sleep latency (minutes)	11.03 (3.53)	11.23 (2.62)	0.96
Total sleep time (minutes)	434.61 (15.54)	422.22 (17.74)	0.61
Wake after sleep onset (minutes)	104.24 (11.52)	104.42 (19.60)	0.99
Sleep Efficiency (percent)	79.20 (2.24)	78.94 (3.33)	0.95

*added as covariate to outcome regression model

Table 2: Primary Sleep Outcomes: Means and Standard Deviations by Treatment Relative to Active Control

	Time 1				Time 3			
	Treatment		Control		Treatment		Control	
Variable	*n*	*Mean (SD)*	*n*	*Mean (SD)*	*n*	*Mean (SD)*	*n*	*Mean (SD)*
ISI	14	15.29 (2.33)	13	14.85 (3.85)	12	3.25 (2.05)	11	12 (3.11)
LATENCY	11	11.03 (11.69)	13	11.23 (9.45)	12	1.93 (3.57)	10	12.52 (9.84)
WASO	11	104.24 (38.21)	13	104.42 (70.68)	12	46.95 (25.09)	10	81.70 (44.49)
TST	11	434.61 (51.53)	13	422.22 (63.97)	12	379.50 (75.13)	10	432.15 (46.82)
EFFICIENCY	11	79.20 (7.44)	13	78.94 (12.02)	12	88.04 (7.19)	10	82.30 (7.82)

Table 3: Primary Sleep Outcomes: Results of Multilevel Regression Analyses

Variable	*n*	*Beta*	*Std Error*	*p*[1]	Cohen's d[2]
ISI	21	-9.412	0.930	**<.001**	-4.22
LATENCY		-1.137	0.287	**<.001**	-1.73
WASO		-2.921	0.550	**<.001**	-2.32
TST		-47.632	20.486	**.02**	-1.02
EFFICIENCY		1381.257	319.021	**<.001**	1.89

[1]p-value is for Wald test of regression coefficient
[2]Cohen's d guidelines: 0.2 small ES, 0.5 medium ES, 0.8 large ES

has led to significant improvements in sleep parameters in older adults in residential settings who also frequently suffer from mild cognitive deficits. This study was a small pilot study and future research should include a randomized controlled study. Further limitation is the sample overall included healthy and highly educated participants and further study should examine additional demographics. Future study is needed to further explore the possible impact on cognitive functioning that result from CBT-I.

This study examined whether or not CBT-I, an effective nonpharmacological intervention, is effective at improving the sleep of older adults experiencing insomnia and mild cognitive impairment. These promising results support the need for more work with individuals suffering from mild cognitive impairment to explore the extent that sleep treatments could result in improved health. Nonpharmacological interventions that may extend the functional window experienced by older adults exhibiting mild cognitive impairment have the potential to profoundly impact quality of life.

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