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Journal

American Journal of Geriatric Psychiatry, 26(5)

ISSN

1064-7481

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Publication Date

2018-05-01

DOI

10.1016/j.jagp.2017.11.007

Peer reviewed

HHS Public Access

Author manuscript

Am J Geriatr Psychiatry. Author manuscript; available in PMC 2019 May 01.

Published in final edited form as:

Am J Geriatr Psychiatry. 2018 May ; 26(5): 598–602. doi:10.1016/j.jagp.2017.11.007.

Bright Light as a Preventive Intervention for Depression in Late-Life: A Pilot Study on Feasibility, Acceptability, and Symptom Improvement

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Abstract

Objectives: We examined the feasibility and acceptability of a portable bright light intervention and its impact on sleep disturbance and depressive symptoms in older adults.

Methods: One-arm prevention intervention pilot study of the Re-Timer bright light device (worn 30 minutes daily for 2 weeks) in eleven older adults (65+) with subsyndromal symptoms of depression and poor sleep quality. Participants were assessed on intervention acceptability and adherence, depressive symptoms (Patient Health Questionnaire-9), and sleep (Pittsburgh Sleep Quality Index, Insomnia Severity Index, actigraphy and daily diary reports).

Results: The Re-Timer device was rated positively by participants, and on average, participants only missed 1 day of utilization. While depressive symptoms declined and self-reported sleep improved, improvement was seen largely before the start of intervention.

Conclusion: An effective preventive intervention that is targeted towards a high risk group of older adults has the potential to reduce distress and costly health service use.

Keywords

sleep disturbance; depressive symptoms; prevention; light therapy; intervention

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Conflict of interest:
None

Despite the presence of empirically validated treatments, Major Depressive Disorder is common among older adults. Older adults also have poorer response and adherence to treatments for depression compared to younger age groups (1). Consequently, research on the development of preventive interventions for later-life depression utilizing knowledge of risk and protective factors to decrease incidence of new depression, has the potential to reduce associated quality of life and disability.

Disturbed sleep is common in mid/late adulthood and considered to be a contributing factor to the development and expression of depression (2). A previous study found the incidence of depression over time was 13.1% in individuals with insomnia symptoms compared to only 4% among individuals without sleep problems (2). Underlying circadian rhythm disturbances may also play an etiological role in sleep disturbances in older adults. Healthy older adults are exposed to only approximately an hour of 1,000 lux light a day (3). Light therapy has been beneficial for older adults with insomnia and depression and is helpful for irregularities in individuals' sleep patterns (4, 5). For example, early morning light can help shift the circadian sleep phase earlier and evening light can delay the sleep phase (6). Bright light interventions thus present a promising approach to target sleep disturbance by entraining circadian rhythms.

Depression prevention efforts carry the potential to prevent more severe distress before it starts and reduce costly health service use, however few behavioral prevention approaches for older adults exist. The current pilot study used a portable bright light therapy as a *behavioral, indicated, preventive intervention* in older adults with both subsyndromal symptoms of depression and self-reported sleep disturbance. The primary aim of the current study was to assess the feasibility and acceptability of the intervention. Secondarily, we examined whether individual's sleep and depressive symptom scores would change across the intervention.

Methods

Study Design

Participants were recruited through flyers at senior centers, geriatric outpatient clinics, a university research recruitment website, and other public locations. Survey data were collected at baseline, midpoint (following two weeks of baseline sleep assessment and prior to the start of intervention), and 4 week immediately post-intervention follow-up between May 2015 and March 2016. The study received IRB approval and is posted on clinicaltrials.gov.

Study Participants

Participants were screened by phone and eligible if they were 65 years of age or older, scored in the mild symptom range on the Patient Health Questionnaire-9 scale (PHQ-9) (score of 5–9), and reported poor sleep quality (score of 6 or greater on the Pittsburgh Sleep Quality Index-PSQI). Exclusion criteria to avoid risk of harm included history or current presence of bipolar disorder, current use of a photosensitizing medication, a retinal disorder, and/or having had an eye surgery.

Intervention

The intervention consisted of utilizing the "Re-Timer" (http://re-timer.com/), a consumer health device. Re-timers emit a blue-green 500 nm dominant wavelength, UV-free light in portable, lightweight glasses. All participants wore the device at the high (506 Lux Im/m^2 and 230 μW/cm^2) setting. Participants were instructed to wear the re-timer glasses for 30 minutes a day for 14 days (with some wearing it less or more depending on follow-up interview scheduling) corresponding to the timing suggested by their sleep chronotype as assessed by the Re-Timer sleep calculator (n=1 before bed-time, n=10 after waking).

Measurement and Procedure

Study initiation included a baseline interview and two weeks of sleep tracking (daily diary and Actiwatch; full procedures found in the supplemental digital content.) At the midpoint interview, the Re-Timer was introduced and the sleep tracking continued for two weeks concluding with a follow-up interview. Depressive symptoms and self-reported sleep measures were assessed at baseline, midpoint, and post-intervention. Based on scheduling availability, data was collected over 26–29 days.

Primary Outcomes

Acceptability and Feasibility of the Re-timer.: Adherence was measured by examining the number of days participants utilized the intervention. Participants rated ease of use from very easy to very difficult (4 pt scale; acceptability). They rated feasibility (5 pt strongly disagree to strongly agree) on whether or not they felt the device fit their routine, was comfortable, and whether they would continue to wear the device if they owned one.

Secondary Outcomes

Depressive Symptoms.: Depressive symptoms were assessed with the Patient Health Questionnaire-9 item form (PHQ-9) (7).

Severity of Insomnia.: The Insomnia Severity Index (ISI) (8) classifies the severity of one's sleep disturbance.

Quality of Sleep.: Sleep quality was measured with the Pittsburgh Sleep Quality Index (PSQI) (9), actigraphy, and sleep diaries. Four sleep constructs were measured by the actigraphy and sleep diaries: sleep efficiency, wake after sleep onset, frequency of nightly awakenings, and sleep onset latency (means taken across the pre-intervention and intervention periods).

Sleep timing.: A mean of participant's pre-intervention and intervention sleep and wake times was calculated from the daily diaries.

Participant's demographic characteristics and the Morningness/Eveningness questionnaire which classifies participants based on sleep chronotype into a morning, intermediate or evening type were collected (10).

Statistical Analysis

Paired sample t-tests tested pre-post intervention differences on all continuous outcome variables. Adherence and feasibility were assessed by examining missing data on the Re-Timer device and responses regarding acceptability and ease of use of the device. IBM SPSS Statistical software version 24.0 was used for all analyses.

Results

A total of 97 individuals were screened and 13 were determined eligible (primary reasons for ineligibility included: past eye surgery [n=33] or below threshold scores on the PHQ-9 [n=44] and/or PSQI [n=27]). One eligible individual chose not to participate and one participant withdrew one day after the baseline interview (citing embarrassment regarding wearing the Actiwatch in public), leaving a study sample of 11. Supplementary Table 1 summarizes the demographic characteristics of the sample. All participants were in their mid-60s (m=66.6, sd=1.5) and 8 were female. Participants wore the Re-Timer across seasons (summer=3, fall=2, winter=3, spring=3).

All participants found the Re-Timer simple to use (n=10 very easy, n=1 somewhat easy). The device was user friendly with 82% stating the device fit their routine, 64% found it comfortable to wear, and 64% would continue to wear the device if they owned one. On average, participants missed one day of Re-Timer use (or 7% of 13.7 intervention days; 93% adherence) and wore the device for 31.3 minutes a day (sd=6.5). No adverse events were reported.

PHQ-9 scores started low (baseline mean = 5.6, sd=3.9), yet declined significantly to a mean score of 3.3 (sd=2.3) at follow-up (t=2.9, *Cohen's d*=0.88, p<.05). PSQI scores also improved from a mean of 8.3 (sd=4.1) at baseline to a mean of 7.0 (sd=3.4) at follow-up (t=2.1, *Cohen's* d= 0.64, p=.06). However, these scores declined over the two week period of baseline sleep tracking and the key time comparison of midpoint to follow-up change was not statistically significant. The only significant change across the diary and actigraphy sleep measures was an earlier sleep time in the intervention phase (t=4.2, *Cohen's d*=1.26, p<.01). Full results on change in survey, diary and actigraphy outcomes can be found in Table 1.

Conclusions

Our pilot study utilizing a portable, in-home use bright light intervention found that the Re-Timer was easy to use and adhered to by participants. We also saw improvement in depressive symptoms and self-reported sleep quality, however scale scores improved over the two-week sleep-tracking period from baseline to midpoint interview suggesting the Hawthorne Effect may have played a role in improvement. As about half of participants did not experience improvement, future research should consider characteristics of individuals most likely to benefit from preventative light therapy. A full-scale trial could examine whether individuals utilizing light therapy are less likely to develop a major depressive episode over time than individuals in a control group. A randomized control trial of light therapy in a subsyndromal population looking at the time to a depressive episode may be a fruitful direction for future prevention studies.

Findings might not apply to older adults with less education nor with eye problems. Participant selection for mild symptoms allowed little room for significant improvement over a short study period. Future work could longitudinally compare participants against a control group to assess post-treatment relapse. Validation with dim light melatonin onset may be a more precise way of assigning exact timing for Re-timer use. Sleep medication and hygiene were not controlled. Most participants had an intermediate sleep chronotype which may have resulted in less chance to see a shift in sleep timing. Future work should consider more detailed medical and psychosocial covariates, such as presence of seasonal affective disorder. Another depression inventory may have greater sensitivity than the PHQ-9 and should be considered in future work.

Despite these limitations, this pilot study suggests acceptability and feasibility of a portable light therapy for preventive intervention use by older adults. Using a behavioral prevention approach is in line with service use practices and desires of older adults, and extends beyond the utilization of common treatment models as preventive measures. With the rapid increase in the older adult population, a shift from treatment to prevention of late-life mental health issues is timely and necessary.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

Support for this work was provided by the University of Michigan Program for Positive Aging and Sleep and Circadian Rhythm Laboratory. Dr. Leggett would also like to acknowledge her undergraduate research assistants: Kristina Bortfeld, Maya Dalack, Tasia Gibson, Daniel Ignacio, Sarah Kurfess, and Mackenzie Thelen, as well as Drs. Charles Reynolds, Martha Bruce, and Steven Bartels who served as mentors during the development of this study.

Financial support:

This work was supported by the Phil Jenkins Award from the University of Michigan Depression Center.

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Table 1.

T-Tests of Change in Self-Report, Actigraphy, and Sleep Diary Measures of Depression and Sleep

	Baseline (M, SD, range)	Midpoint (M, SD, range)	Follow-Up (M, SD, range)	*t, Cohen's d, p*
PHQ-9	5.6 (3.9) 2–16	3.7 (3.2) 1–12	3.3 (2.3) 0–8	B→M 3.1, 0.95, $p<.05$ B→F 2.9, 0.88, $p<.05$ M→F *ns*
PSQI	8.3 (4.1) 5–18	7.6 (3.7) 4–16	7.0 (3.4) 3–13	B→F *ns* B→M *ns* M→F *ns*
ISI Sum	13.1 (4.8) 8–24	11.8 (5.5) 4.5–21	11.4 (5.9) 4–23	B→F *ns* B→M *ns* M→F *ns*

	Pre-intervention Period (M, SD, range)	Intervention Period (M, SD, range)	t, p
Actigraphy			
Waking after sleep onset	51.1 (14.7) 23.1–68.9	53.6 (17.7) 34.0–91.1	*ns*
Number of awakenings	22.1 (6.2) 12.1–32.0	22.4 (5.9) 12.5–30.6	*ns*
Efficiency	85.0 (4.5) 75.4–91.9	85.1 (4.0) 75.2–89.8	*ns*
Latency	11.0 (13.2) 2.6–50.3	12.5 (11.7) 3.6–39.4	*ns*
Diary			
Waking after sleep onset	38.6 (20.0) 5.9–81.2	44.3 (32.1) 4.4–103.3	*ns*

	Pre-intervention Period (M, SD, range)	Intervention Period (M, SD, range)	t, p
Number of awakenings	2.2 (1.3) 1–5.3	2.1 (1.0) .9–4.4	*ns*
Efficiency	86.7 (4.2) 79.1–90.8	87.1 (6.1) 77.2–94.4	*ns*
Latency	24.1 (17.6) 5.1–61.9	19.4 (13.6) 7.9–57.1	*ns*
Sleep Time *	24.0 (1.4) 22.5–27.8	23.8 (1.3) 22.2–27.2	4.2, 1.26, $p<.01$
Final Wake Time *	7.8 (1.8) 5.6–12.6	7.5 (1.2) 5.6–10.1	*ns*

Notes. B= baseline, M= midpoint, F= follow-up, *ns*= not significant.

* Sleep time and final wake time are in military time with the decimal reflecting the proportion of the hour on average. For example, .5 would be 30 minutes. All PHQ-9 items showed improvement from baseline to follow-up except for “feeling bad about oneself”. The specific symptoms showing greatest item improvement were sleep (mean improvement 0.64), depressed mood (mean improvement 0.46), and concentration (mean improvement 0.46). We also evaluated participant’ trends in improvement across self-report measures over time and found that 6 participants showed improvement, whereas one declined, and four stayed relatively stable over the study period.