Journal of Dementia

Ditucalan et al., J Dement 2024, 8:2

Review Article Open Access

A Systematic Review on the Effect of Light Therapy in Sun downing Behavior of Patients with Dementia

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Abstract

Dementia is a cognitive disorder that affects daily living of every individual.1 According to DSM V criteria; it is defined as the evidence of significant cognitive decline from a previous level of performance in one or more cognitive domains which interferes in everyday activity with no other structural, metabolic or psychiatric cause. However, during the course of dementia, 90% of patients suffer from behavioral and psychological symptoms of dementia (BPSD). The sundowning or nocturnal delirium is a form of BPSD which can affect patients with dementia particularly those of advanced stage. Presently, there are no established guidelines for the management of symptoms of sundowning in patients with dementia and efficacy of pharmacologic and nonpharmacologic treatments are not yet established. One of the nonpharmacologic treatment is bright light therapy utilizing the standard 10,000 lux lamp among dementia patients in nursing homes however upon review of two randomized controlled trials, these trials showed no significant effect on the sundowning behavior.

Keywords: Light therapy; Sun downing behavior; Dementia

Introduction

Dementia is becoming a highly prevalent cognitive disorder that affects daily living of every individual.1 Diagnostic and Statistical Manual of Mental Disorders (DSM) V defined it as the evidence of significant cognitive decline from a previous level of performance in one or more cognitive domains which interferes in everyday activity with no other structural, metabolic or psychiatric cause.2 This disorder has doubled its global incidence and between 2015-2050, the increase is predicted to be 223% in lower to middle income countries such as the Philippines. Further, in terms of death rates, dementia has become the 5th leading cause of death globally accounting for 2.4million deaths per year. Reports also indicate that aside from symptoms of cognitive decline and decline in performance of cognitive domains; approximately 90% of patients with dementia suffer from behavioral and psychological symptoms of dementia (BPSD) [1].

The sundowning or nocturnal delirium is a form of BPSD which can affect patients with dementia particularly those of advanced stage. During sundowning, symptoms such as confusion, agitation and aggression typically emerge in the late afternoon when light exposure is diminished as well as during winter months when there is less sunlight [2]. It is also believed that sundowning hastens the progression of cognitive impairment causing hospitalization and caregiver burnout [3]. It is a multifactorial phenomenon from degeneration of the suprachiasmatic nucleus, decrease melatonin production, disruption of circadian rhythms, impaired cholinergic neurotransmission and dysregulation of the hypothalamic-pituitary axis [4]. Presently, there are no established guidelines for the management of symptoms of sun downing in patients with dementia. Pharmacological interventions were used however their effectiveness was limited and the risk of interaction to other medications is high [5].

Currently, non-pharmacological interventions emerged as a safer alternative, harmless, cost effective and one of it is light therapy but the efficacy is not well known or established. The benefit of light stimulation decreases as the cornea ages and in patients with dementia, limited mobility and exposure to sunlight further disrupts their biological clock. This clock is located in the suprachiasmatic nuclei (SCN) that generates and regulates circadian rhythms and the daily light–dark pattern reaching the retina is the main input to synchronize the biological clock to the solar day. The hormone melatonin also plays an important role in regulating circadian rhythm since it signals the time to sleep approximately hours from dim light exposure. Lighting hence affects the circadian rhythm by acute melatonin suppression allowing good sleep-wake pattern causing less behavioral symptoms [6]. Hence this review, seeks to know the effects of light therapy in sundowning behavior of patients with dementia.

Methodology

A protocol was developed in conducting this systematic review comprising of a step-by-step procedure using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram to identify and appraise all relevant studies. Identification of relevant studies with the help of the following databases, PubMed and Google Scholar was done (Figure 1). The inclusion criteria which comprises patients diagnosed with dementia, >60 years old, with sundowning behavior and had undergone standard light therapy at >10,000 lux lamp as nonpharmacologic treatment were included in the study. The exclusion criteria were those patients <60 years old, not demented, with no sundowning behavior and light therapy. Studies whose population had comorbid conditions causing memory loss (e.g. traumatic brain injuries or seizures) were excluded as well as articles that discussed other forms of light therapy not as defined such as color

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Received: 28-Feb-2024, Manuscript No: dementia-24-128152, **Editor assigned:** 04-Mar-2024, PreQC No: dementia-24-128152 (PQ), **Reviewed:** 18-Mar-2024, QC No: dementia-24-128152, **Revised:** 22- Mar-2024, Manuscript No: dementia-24-128152 (R), **Published:** 28-Mar-2024, DOI: 10.4172/dementia.1000203

Citation: Ditucalan LG (2024) A Systematic Review on the Effect of Light Therapy in Sun downing Behavior of Patients with Dementia. J Dement 8: 203.

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therapy, heliotherapy, and wave therapy. Further, studies included were on randomized controlled trial (RCT) design, published in English and peer-reviewed. The search terms such as dementia, light therapy, sundowning behavior and its keyword combinations were used (Figure 1).

Risk of bias was also included to establish transparency of evidence synthesis results and findings of the studies who met the inclusion criteria by using the Revised Cochrane risk-of-bias tool for randomized trials. The reviewers compiled recorded findings into a descriptive table detailing nine categories: design type, quality of evidence, study population, intervention and sample size, outcomes, measurement tools, point estimate, clinical significance, and statistical significance.

Results

Analysis of the included literature

The database searches retrieved a total of 902 articles. There were 73 articles that met pre-established inclusion criteria and were subsequently reviewed. Of the analyzed studies, 32 of the studies followed a randomized controlled study design, involving the application of the intervention without random assignment of participants to conditions or orders of conditions. Further review was done in order to eliminate duplicates and only two studies with RCT were determined through a process of randomization. RCTs are considered level I evidence, one of the highest levels of evidence in intervention studies.

Table 1 below shows the summary of results from the two studies included in this review including details about the sample size, bright light condition, and study outcomes. It also includes the evaluation using the Cochrane risk-of-bias tool for randomized trials (Table 1).

The size of the studies reviewed was between 15 and 48 subjects, with a total of 63 subjects with dementia, assigned randomly to both the intervention and control groups. All the people in the trials stayed in nursing homes specializing in the care of dementia patients. Burns et al. initially determined the dementia subjects using the Mini- Mental Status Examination (MMSE) and were stratified as low those with MMSE score of <10 and high with MMSE score of >10. The subjects were randomized, one group (n=22) was exposed to BLT of 10,000 lux for 2 hours around 10am to 12 noon while the other group (n=26) was exposed to a standard fluorescent tube light at 100 lux for 2 hours between 10am to 12 noon for a duration of 2 weeks. Re-assessment of neurocognitive function was done at 4th and 8th weeks [7]. On the other hand, Lyketsos, et al, evaluated 15 dementia patients with agitations and were randomized for BLT 10,000 lux for 1 hour per day while the other group was exposed to dim light as control group. The duration of the study was 4 weeks and re-assessment was done after a week [8].

Risk of bias analysis

The risk of bias for both studies was low across all five domains. Shown in Table 2 is the summary of risk of bias analysis (Table 2).

Table 1: Summary of findings of included studies.

Author & Year Published	Population (N)	Bright Light Condition	Outcomes Assessment	Study Outcomes
Lyketsos et al. (1999)	15	BLT for 1h q AM 10,000 lux lamp at 3ft	(i) hours of sleep (ii) Behave-AD (iii) CSDD	slight improvement in nocturnal sleep, slight improvement in mean Behave-AD scores; not statistically significant
Burns et al. (2009)	48	BLT for 2h q AM 10,000 lux lamp	(i) CMAI (ii) CRBRS (iii) MOUSEPAD (iv) MMSE (v) CSDD	improved CMAI, CRBRS, CSDD but no statistically significant difference with control group

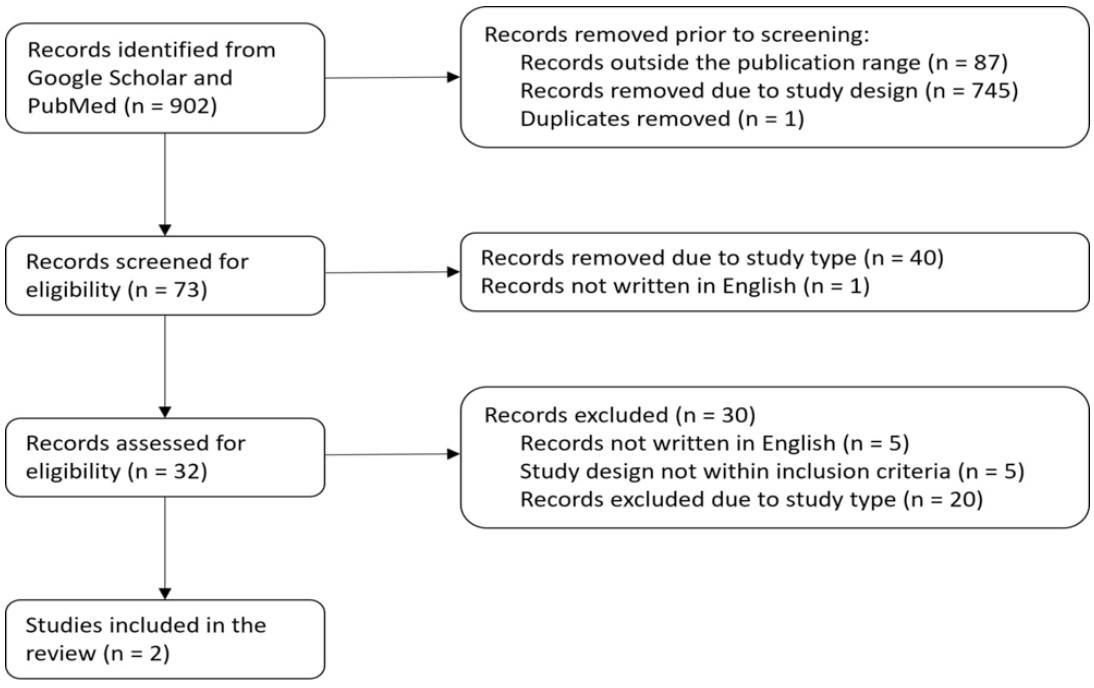

Figure 1: Prisma Flow Diagram.

Table 2: Summary of risk of bias analysis using the RoB 2 Method.

Author	Domain 1 Randomization	Domain 2.1 Effect of Assignment	Domain 2.2 Effect of Adherence	Domain 3 Attrition	Domain 4 Detection	Domain 5 Reporting
Lyketsos et al. (1999)	low	low	low	low	low	low
Burns et al. (2009)	low	low	low	low	low	low

Discussion

The randomized, controlled, crossover clinical trial of Lyketsos et al. was the first to test the efficacy of BLT at 10,000 lux intensity. The researchers enrolled 15 patients with dementia, all of whom met the DSM-V criteria for dementia with a score of >4 on the Behavioral Pathology in Alzheimer Disease scale (Behave-AD) and have shown BPSD such as agitated behaviors. Of the 15 patients enrolled, 8 completed the entire trial. Of the 7 early dropouts, two requested to withdraw from the study due to lack of efficacy and desire for a trial medication for agitation. Patients were randomized to either the bright light therapy (BLT), in which they were exposed to 10,000 lux full spectrum lamps at 3 feet for 1 hour while the control, in which the patients were exposed to a dim, digital, low-frequency blinking light. This is a standard control used in studies of BLT for seasonal affective disorders. The outcomes of the study were measured by: (1) mean nocturnal hours of sleep; (2) the Behave-AD; and (3) the Cornell Scale for Depression and Dementia (CSDD).The results of this study showed improvements in nocturnal sleep hours are possible for patients when treated with bright light therapy from a mean of 6.4 hours/night to 8.1 hours/night for 4 weeks later ($p<0.05$). This is due to the fact that light can facilitate resetting of the sleep-wake cycle by its action to suppress melatonin production and suprachiasmatic nucleus [4]. There was also slight improvement on the mean Behave-AD scores. However, there were no findings that indicate significant benefit of BLT for the behavior or mood of the patients enrolled in the study most especially those with non-disturbed sleep cycles. The slight change but not statistically significant improvements noted may have been attributable to the fact that all patients received a considerable amount of attention from the study staff, as well as their practiced of better sleep hygiene [7].

In a similar study of Burns et al., 48 patients diagnosed with dementia were enrolled, in which 22 patients were randomly given to bright light therapy while 26 patients were randomly given the standard light conditions. Of the 48 enrolled, one patient withdrew from treatment after three days as the BLT which triggered her memories from World War II. Another patient was hospitalized three days after receiving treatment due to unrelated cause. The remaining patients were then exposed to full spectrum BLT 10,000 lux for two hours between 10 AM and 12 noon, while the control was exposed to standard fluorescent tube light at 100 lux for two hours in the same time frame. Patients wore an actigraph device to monitor sleep activity and dementia assessment scales were used such as Mini Mental Status Examination (MMSE), Cornell Scale for Depression in Dementia (CSDD), Crichton Royal Behavioral Rating Scale (CRBRS), Manchester and Oxford Universities Scale for the Psychopathological Assessment of Dementia (MOUSEPAD), and Cohen-Mansfield Agitation Inventory (CMAI) on week 4 and week 8, while any change in the psychotropic medication was noted. Of the 48 patients enrolled, 43 patients (90%) tolerated light exposure for a minimum of 90 minutes per day, four (8%) tolerated a minimum of 60 minutes per day, and one (2%) tolerated 30-60 minutes per day. Two patients, both of whom received placebo, died between week 4 and week 8. The results of the study showed that there were no significant differences between the BLT group and the placebo group. All of the patients had at least one agitated behavior, as rated on the CMAI at baseline, and 25 (52%) experienced sleep disturbance, according to the MOUSEPAD settings. Between-group comparison of agitation as measured by CMAI was also not significant. Moreover, the CRBRS change score showed a significantly greater increase in the placebo than in the BLT group at week 4 but not at week 8. In addition, the difference between the groups on the MOUSEPAD, MMSE, and CSDD measurements were also not statistically significant [8].

Further, evidence from randomized controlled clinical trials on bright light therapy for patients with dementia is limited most particularly on using the standardized BLT at 10,000 lux since most of the trials uses sunlight exposure alone or a much less intensity. As such, recommendations which can be made from the evidence found is also limited. However limited, the risk of bias in the studies included is low [9,10].

Conclusion

This systematic review shows that BLT has no significant effect and may not be an effective treatment for sundowning behavior in patients with dementia. Evidence of slight improvement was consistent more on improvement of sleep; however, for sundowning behaviors, they were not statistically significant. Although study limitations exist, utilizing BLT to treat sundowning symptoms would be weakly recommended.

Disclosure

The authors report no disclosures relevant to the manuscript.

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