LIGHT THERAPY TREATMENT FOR DEMENTIA

By

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Abstract

The purpose of this thesis is to analyze the effects of light therapy on symptoms of dementia and to develop best practice recommendations for implementation in the healthcare setting. As dementia is a progressive condition characterized by deterioration of cerebral function and structural changes, the need for alternative therapies for symptom management is imperative. Based on current data, there are 55 million people impacted by dementia worldwide and it accounts for the seventh leading cause of death, as well as a significant cause of disability and dependency (World Health Organization [WHO], 2023). Bright light therapy is a newly studied therapy that is potentially effective in improving symptoms of dementia, including sleep disturbances, behavioral and psychological symptoms, and delirium, however, the extent of the effect on these symptoms is unclear. Implementation of light therapy is an accessible and cost-effective management method to improve symptoms for affected individuals to improve their quality of life. This is a non-invasive method that can be employed in any setting, whether in a clinical or home setting. In the fourth chapter of this thesis, a proposed plan to integrate the therapy in a memory care unit of a long-term care setting is outlined based on best practice recommendations compiled contingent on current evidence-based research.

Chapter One

The purpose of this thesis is to explore how light therapy can impact the symptoms of dementia, including sleep and behavioral disturbances. The other purpose of this thesis is to provide evidence-based recommendations for interventions to educate nurses and patients about dementia to reduce the severity of the experienced symptoms.

Background

Dementia is a progressive deterioration of cerebral functions characterized by an impairment with memory, thinking, and decision-making that causes an interference in daily activities. There are various types of dementia, including Alzheimer's disease, vascular dementia, Lewy body dementia, and fronto-temporal dementia, and mixed dementia. The most common type of dementia is Alzheimer's disease, and it accounts for 60-80% of all dementia cases (Centers for Disease Control and Prevention [CDC], 2019). It is estimated that 55 million people are affected by dementia worldwide and is the seventh leading cause of death globally (WHO, 2023). In addition to impairments in thought, decision-making, and memory, many people affected by dementia will experience disturbances in sleep and behavior. These symptoms can manifest as agitation, combativeness, wandering, nighttime arousals, and psychotic symptoms. These symptoms are referred to as behavioral and psychological symptoms of dementia, or BPSD, and describe any of these reactions in people with any form of dementia and will affect approximately 75-98% of individuals with dementia (Austrom et al., 2018).

The causes and mechanisms of dementia vary depending on the type; however, some common mechanisms are brain tissue compression, native protein accumulation in the brain, degeneration of neurons, cerebral vessel atherosclerosis, and brain trauma (Huether, 2019). Alzheimer's, the most common form, involves amyloid plaques, neurofibrillary tangles, neuron

injury, cell death, and chronic inflammation. Beta-amyloid 42 is a toxic form of protein that naturally occurs in the brain and the proteins clump together to form plaque that disrupt functions of cells and neurons. Neurons are supported by microtubules and tau proteins, however, with chemical abnormalities, the tau proteins will no longer remain attached to the microtubules and will instead stick to each other, causing tangles within the neurons. Throughout the progression of the disease, neurons become injured and will die, causing neuron networks to break down and can change the volume of various brain regions, leading to brain atrophy (National Institute on Aging [NIA], 2019).

Current treatment of dementia is aimed at symptom reduction and slowing cognitive decline as there are no methods of curing the dementia. For mild to moderate symptoms, cholinesterase inhibitors and immunotherapy medications are often prescribed. Cholinesterase inhibitors are used for cognitive and behavioral symptoms by preventing acetylcholine breakdown as acetylcholine is important for the brain's memory and thinking capabilities. An immunotherapy medication has been approved last year for treatment of early dementia caused by Alzheimer's Disease. This medication targets beta-amyloid proteins to reduce the amyloid plaques that cause the neurofibrillary tangles that disrupt neural communication. For moderate to severe forms, N-methyl-D-aspartate (NMDA) antagonists are used to regulate glutamate to prevent an excessive production of glutamate which can lead to cell death and further contribute to the dementia. For the behavioral symptoms that can occur with dementia, atypical antipsychotics can be prescribed to decrease agitation but must be used cautiously. Many medications that are used for behavioral symptoms should be used with extra caution and after non-pharmacological methods have proved to not help the condition, such as sleep aids as the side effects can make the person more confused, dizzy, and at higher risk of falling (NIA, 2023).

Due to the increased caution needed in medication administration in individuals with dementia, drugs are not preferred in reducing behavioral and sleep disturbances. Instead, interventions, such as physical activity, stress reduction, memory training, and mental and social stimulation, are preferred for managing these effects (Emmady et al., 2022). Additionally, cognitive behavioral therapy, psychotherapy, cognitive stimulation therapy, and behavioral management therapy have been recommended as psychological therapy methods. These therapeutic methods help to stimulate mental activity and memory, as well as work through behavioral issues that have developed from the onset of dementia, including anxiety, agitation, and frustration towards their condition. Additionally, various forms of psychotherapy can help an individual to establish a routine and tips to get through their day-to-day activities, such as simplifying and breaking up tasks into smaller parts to reduce agitative reactions. Moreover, art, music, and mindfulness-based therapies can be utilized to reduce agitation, anxiety, and depressive symptoms (Sukhawathanakul et al., 2021).

In recent years, light therapy has been researched as a treatment method for dementia and is not a commonly utilized method yet. Some studies very recently have focused on near-infrared light therapy, called photobiomodulation, to "change the way the brain reacts to damage that can lead to dementia" (Alzheimer's Society, 2018, para. 11). The current research has shown that photobiomodulation may improve cognitive function and improve mood and sleep patterns. For this method, individuals would use a headset made with infrared lights to transmit the near-infrared lighting into the brain through the nostril and skull. Another method is bright light therapy which is believed to improve the circadian rhythm when it has been disrupted from the effects of dementia, as well as improve mood and cognitive function. For this method, individuals are exposed to lighting that is high in density through lighting panels or lamps

(Alzheimer's Society, 2018). Although light therapy for dementia is very new overall, there is more current research worldwide on bright light therapy compared to infrared therapy. Due to this fact, this thesis will focus on this method of light therapy compared to near-infrared light therapy which has very limited research.

Significance to Nursing

In managing the change in circadian rhythm and insomnia that many individuals with dementia experience, melatonin and other sleep aid medications are not preferred because of the possible side effects that can increase the symptoms. Regulating this symptom with non-pharmacological methods can improve their quality of life despite the inability to cure dementia or its common causes. As sleep disturbances are a common symptom of dementia and dementia is noted to be one of the leading causes of death, it is crucial to alleviate the symptoms to improve the quality of life and wellbeing of those affected.

Chapter Two

In this second chapter, there will be a review of current literature regarding light therapy and dementia. The literature review will determine the efficacy of light therapy as treatment for various symptoms of dementia, including mood, circadian rhythm disturbance, and activities of daily life. To guide the collection of research articles, the question: In older adults with dementia (P), how does light therapy (I) compared to no intervention (C) affect the symptoms of dementia (O)? For this literature review, the databases PubMed Central and CINAHL with Full Text were utilized. To find current research, only articles that were published between 2018 and present time were included. Search terms and phrases utilized were dementia, light therapy, bright light therapy, and Alzheimer's. These terms resulted in multiple articles relevant to the PICO question to guide the research for the literature review.

Literature Review Results

Sleep Disturbances

A single-blind longitudinal-group experimental study sought to understand if ambient bright light would be a more effective intervention compared to general lighting in reducing sleep disturbances in older adults with dementia (Liu et al., 2021). The study was conducted in nursing homes with 35 participants and used two groups, the group with bright lighting that acted as the experimental group and the group with general lighting for a comparison group. The lighting was employed using lux, a measure of intensity for light levels and was standardized for both horizontal and vertical illuminations of panel lighting. For the experimental group, horizontal illuminations were 2,500-2,600 lux and vertical light was 4,000-4,400 lux. Horizontal illumination began at 500 lux and increased by 500 lux daily until 2,500 lux was achieved. In the comparison group of general lighting, the illuminations were 114-307 lux and 600-800 lux

respectively for horizontal and vertical. For both groups, the participants were not exposed to external lighting by use of curtains and aluminum windows for the experimental group and a room without windows for the comparison group. As a group, the participants were exposed to their respective lighting for at least 60 minutes per day between 9-10 AM on weekdays for a duration of eight weeks. A post-test was taken at the end of five weeks and another at week nine (Liu et al., 2021).

The study collected sleep measurements using an accelerometer to monitor sleep disturbances and the sleep and wake times were observed by staff in nursing homes for data on their sleeping pattern. In addition, the study analyzed physical activity and the defined daily dose (DDD), the average maintenance dose per day of a drug to monitor drug changes throughout the study. To assess dementia severity, the mini-mental state examination, or MMSE, was utilized as a pre- and post-test measurement of the severity of symptoms (Liu et al., 2021).

The study found that there was not a significant difference in sleep time, awakening time, sleep efficacy, or physical activity. There was found to be a significant difference in the number of times the participants woke up during the nighttime between the groups with an average of 5.6 times for the experimental group and 7.5 for the comparison group. For sleep efficiency and sleep duration, the experimental group experienced significant improvement between the baseline pre-test and the ninth week post-test scores. Time spent awake during the nighttime also significantly decreased in the experimental group by 108 minutes from the baseline of 236 minutes. For circadian rhythm, onset and offset of sleep was able to be significantly improved in that individuals went to sleep earlier and woke up later to increase their sleep times and improve their sleep pattern (Liu et al., 2021).

One important weakness of the study is the small sample size as there were 22 participants, with 11 in each group by the end of the study as 13 individuals withdrew throughout the study. There was also a difference in the groups in the number of men and women as there were more male participants in the comparison group than in the experimental group. Further, the random group assignments were also given based on patient preferences. Additionally, outside of the control of the researchers is the timing of sleep medications that the participants may have taken and the natural exposure to bright light as these factors may have interfered with the results (Liu et al., 2021).

The next study was conducted as a nonrandomized single-blind controlled pilot study and utilized convenience sampling (Liu et al., 2023). There was a treatment and control group to implement a parallel intervention design to compare the effects of light therapy between bright morning light and general light similarly to the first study. The study duration was five weeks with a pre-test at the start of the study period and a post-test at the end of the five weeks. There were 22 female participants included in the study with 14 in the intervention group and 8 in the control group of general light (Liu et al., 2023).

Like the previous study, there were light panels that were standardized for each group based on the horizontal and vertical illuminations. For this study, the control group used a light density of 114-307 lux horizontally and 600-800 lux vertically. In the intervention group, the light was kept at 2,500-2,600 lux horizontally and 4,000-4,400 lux vertically. The light was delivered for one hour from 9:00 to 10:00 AM five days per week for the full five-week duration, supplying 25 hours of bright morning light to the intervention group (Liu et al., 2023).

This study assessed effects on parasympathetic (PSNS) and sympathetic nervous systems (SNS), sympathovagal balance, cognitive function, and circadian rhythms. To assess the function

of the autonomic nervous system, they analyzed the low-frequency (LF) and high-frequency (HF) power of the heart rate variability (HRV). For the sympathovagal balance, they utilized the ratio of LF to HF. They tracked the HRV using a device placed over the sinus node for continuous recording between 7:00 PM to 7:00 AM for analysis during sleep duration and recorded 7 hours of lying in bed which allowed for analysis of circadian rhythms. To assess cognitive function, the Mini-Mental State Examination (MMSE) was utilized to quantify the severity of dementia (Liu et al., 2023).

The results of the study showed a significant difference in PSNS and SNS activity between the groups with an increase in PSNS activity and a decrease in SNS activity. These differences result in a more stable circadian rhythm as increased SNS activity has been linked to lower sleep quality and reduced cognitive function. Additionally, in comparison to the control group whose average scores gradually worsened, there was a significant improvement in MMSE scores in the group exposed to bright morning lighting (Liu et al., 2023).

The final article that studies sleep is a quantitative experimental study focused on determining the effect of light therapy on sleep and daily activities in patients with Alzheimer's disease, the most common type of dementia (Alparslan et al., 2019). The study took place in a nursing home that was an Alzheimer care center in Eskişehir, Turkey. This study took place over four weeks where the participants were monitored for their activities and sleep using an actigraphy device which is a watch-like device that senses sleep and activity through a light sensor. The actigraphy device was used for all four weeks and the light therapy for monitoring, however, the actigraphy device was only used during the second week. There were 15 patients included in the study with only two patients studied at a time due to constraints of access to actigraphy devices as the researchers were only able to obtain two devices due to budget

limitations. The device was able to collect data on levels of activity and inactivity, intensity of activity, and sleeping duration including naps during the daytime (Alparslan et al., 2019).

For additional collection of data, a Patient Descriptive Characteristics Form, Light Application Form, and Barthel Instrumental Activities of Daily Living Index (Barthel ADL) were used. The Light Application Form includes information of adverse effects of light phototherapy and was filled in daily while the Barthel ADL was filled out to score that determines an individual's level of dependency for daily activities. For the application of light, a density of 10,000 lux of light was exposed to the participants for 30 minutes per day at a 58–60-centimeter distance. In the analysis of sleep and activity levels, there was a significant difference in sleep duration and inactivity performance between the first and fourth weeks of the study, demonstrating an improvement in these areas. Although, there wasn't a significant difference in the intensity of activities of the patients over the duration of the study (Alparslan et al., 2019).

Like the previous studies, there were very few participants with only 15 individuals and did not achieve the number needed for power analysis which reduces the generalizability and the statistical power of the study's results. Additionally, there was a lack of actigraphy devices and only two weeks for follow-up after the light application as the devices needed to be given to the next two participants which limited analysis of long-term implications (Alparslan et al., 2019).

Psychological and Behavioral Symptoms

In a study conducted as a cluster randomized controlled trial, the researchers sought to expand on previous research by studying over a long duration of 24 weeks compared to previous research which have primarily lasted around four weeks (Kolberg et al., 2021). They investigated the effect of bright light therapy on behavioral and psychological symptoms of delirium including depression, anxiety, and agitation. There were eight nursing home units included in the

study and the units were randomized as the intervention or control groups and the treatments were utilized as a cluster (Kolberg et al., 2021).

The researchers utilized LED light panels that were mounted onto the ceilings in the living rooms of the nursing homes that were included in the intervention group. The light therapy was individualized to each nursing home based on the room size and number of windows, and the light illuminance was programmed to differ throughout the day to mimic the natural light cycle. The programming maintained a specific light sequence and the peak of the illuminance was approximately 1,000 lux in density which was delivered between 10:00 AM and 3:00 PM. To measure the symptoms of dementia, the Neuropsychiatric Inventory Nursing Home Version (NPI-NH) and Cornell Scale for Depression in Dementia (CSDD) were used to quantify the severity of psychological and behavioral symptoms (Kolberg et al., 2021).

In analysis of the effect on depression based on the CSDD, there was a significant interaction between week and condition that indicated that there was a greater reduction of depressive symptoms over the 16 weeks in the intervention group in comparison to the control group ($p=0.029$). In the mood-related section of the CSDD, there was similarly a significant week and condition interaction in which the intervention group experienced a greater reduction in symptoms at the 16^{th} week data collection ($p<0.001$), however, there were no significant interactions at the 8^{th} or 24^{th} weeks. In addition, there were no significant interactions for behavioral disturbance or cyclic functions under the CSDD. As for the NPI-NH, there was a significant interaction between week and condition for the NPI-NH total score ($p=0.031$) and the affective symptoms section ($p<0.01$) at the 16^{th} week. For the sub-syndromes of psychosis and agitation, there were no significant interactions found (Kolberg et al., 2021).

The next study was a randomized controlled trial and explored the immediate effects of bright light therapy on behavior, mood, and physiological parameters in older adults with moderate to severe dementia (Cibeira et al., 2021). As many other studies have focused on short- and long-term effects of light therapy, the researchers sought to discover if there were noticeable immediate effects in the behavioral and psychological symptoms of dementia. As for the physiological parameters, a pulse oximetry device was used to measure oxygen saturation and heart rate to see if there would be a difference as other sensory therapies such as music therapy can improve oxygen saturation and decrease heart rate (Cibeira et al., 2021).

Participants were recruited from a gerontological complex in Spain that specializes in dementia. There were 19 participants who had been randomly assigned to participate in the intervention group and 20 participants in the control group. However, there was no data collected from the control group for comparative measurements as this group would not have engaged with the intervention that was necessary to complete the Interact assessment that was used to quantify mood and behavior. The study followed a research protocol that was made based on implementation guidelines provided in a recent review. For implementation of the light therapy, they had four people in the room at a time and two lamps so that two people could sit 70 cm from each lamp. The lights used 10,000 lux illumination and the sessions were each thirty minutes and completed before noon. There was daily sessions Monday through Friday over four weeks for a total of 20 sessions. During these sessions, there was a neutral topic documentary played to prevent an influence on the participants' mood (Cibeira et al., 2021).

For the Interact assessment, the researchers evaluated the participants during the sessions as well as ten minutes before and after to have pre- and post-intervention scores. This assessment consisted of 22 Likert-scale items that assessed the frequency of different types of mood and

behavior ranging from not at all (1) to nearly all the time (5). The full version was used during the bright light session and a 12-item Interact short version was used for the pre- and post-test scores. Additionally, during the sessions the researchers wrote down any comments made by the participants and the sensations they believed the participants felt, such as leisure or stimulated (Cibeira et al., 2021).

Within the Interact short, there were four categories that had significant effects between before and after the intervention session, including tearful/sad ($p=0.044$), talked spontaneously ($p=0.035$), and two subcategories of stimulation level which were enjoying self, active, or alert ($p=0.034$) and relaxed, content, or sleeping appropriately ($p=0.001$). Moreover, the results did not differ over the four weeks and were only significant in the immediate effects. In terms of physiological parameters, there was a significant increase in oxygen saturation levels ($p<0.001$) and decrease in heart rate ($p<0.001$). Based on these findings, there is evidence that light therapy may have immediate effects in improving mood, stimulation, heart rate, and oxygen saturation (Cibeira et al., 2021).

The single-arm design of the study is a limitation as it provides no method of comparison as there was no data collected from the control group that participants were randomized into. Instead, the researchers could have used dim lighting for the control group and completed the same Interact assessment to provide a basis of comparison to see if there was a significant difference between the groups. There were also only 19 individuals that data was collected from making the sample size studied very small and limiting the applicability of the findings. Future studies employing a similar set-up should use (Cibeira et al., 2021).

Delirium

In a case-control study, researchers investigated if light therapy had an inhibitory effect on delirium for patients with dementia (Zou et al., 2022). There were 61 total participants with 34 individuals in the treatment group and 27 individuals in the control group. The control and treatment groups were both treated with medications, including cholinesterase inhibitors and NMDA receptor antagonists. For the treatment group, the participants were exposed to lighting at a peak of 14,000 lux for 30 minutes every morning beginning at 9:00 AM for four weeks. The participants were instructed to face the lights and maintained a 50 cm distance from the light source. As for the control group, their dim lighting was kept at a density of 50 lux (Zou et al., 2022).

To measure the symptoms of delirium, the researchers used the confusion assessment method (CAM) to measure symptoms of delirium which used criteria such as acute onset, psychomotor excitement, mental state volatility, and memory loss. In addition, the Neuropsychiatric Inventory (NPI) evaluated psychopathology of dementia and was used to monitor the frequency, severity, and degree of distress experienced by the patients. Another aspect measured through the Zarit Caregiver Burden Interview (ZBI) to determine the level of burden that the family caregivers experienced (Zou et al., 2022).

There were significant reductions in CAM, NPI, and ZBI scores in the treatment groups and there was a significant difference between the groups for CAM and NPI scores. Based on the results, the bright light therapy had a significant effect in reducing the incidence of delirium in people with dementia. This study had a relatively small sample size and short study duration which may have inhibited analysis of long-term effects and generalizability. Though at the time it was one of the first studies to analyze phototherapy and delirium, thus provides valuable input on the topic (Zou et al., 2022).

General Effects

To analyze a broader array of symptoms of dementia, a randomized clinical trial tested the effectiveness of a lighting intervention that was tailored to maximally affect the body's circadian system (Figueiro et al., 2019). They evaluated the effect on sleep quality, rest, activity, mood, and behavior for individuals diagnosed with Alzheimer's disease and related dementias. The study took place over 14 weeks where participants were assigned which intervention they would receive first, the active or control, as each participant received both the active and control interventions at separate times. The first and tenth weeks were used to collect baseline measurements while weeks 2-5 and 11-14 were the intervention weeks for active and control lighting. In the middle, there was a washout period during weeks 6-9 to prepare participants to receive the other treatment and reduce the influence of the previous intervention. There was a total of 46 participants that were recruited from four assisted-living facilities and four long-term care facilities (Figueiro et al., 2019).

For the active lighting intervention, the lighting aimed to provide high circadian rhythm stimulus (CS) which suppresses nocturnal melatonin. This is measured between 0.1 and 0.7 with 0.1 or higher indicating an effect in suppression of nocturnal melatonin. Based on this, the control lighting was kept at below a CS value of 0.1 while the intervention lighting was maintained at around 0.4 to have a moderate effect of melatonin suppression during the daytime. These bright lights were turned on for each participant around 6:00-8:00 AM based on their individual habitual wake up times and were switched to the facility's regular dim lighting of CS<0.1 at 6:00 PM. The goal of introducing bright light during the daytime and switching to dim lighting in the evenings is to encourage normalization of the circadian rhythm by decreasing

sleep during the daytime by suppressing melatonin producing during the day and encouraging natural melatonin production at night with dim lighting (Figueiro et al., 2019).

There were four questionnaires that were filled out by the nighttime caregivers to assess the effects of the light therapy. These included the Cornell Scale for Depression in Dementia (CSDD), the Cohen-Mansfield Agitation Inventory (CMAI), the Pittsburgh Sleep Quality Index (PSQI), and the Minimum Data Set Activities of Daily Living Scale (MDS-ADL) to assess the level of dependency in various daily activities. In addition, actigraphy devices were worn to record rhythms of rest and activity to assess interdaily stability (IS), the regularity of the sleep-wake pattern and interdaily variability (IV), the variability of the sleep pattern (Figueiro et al., 2019).

The primary outcome of the study was the effect on sleep quality which was found to be statistically significant in PSQI scores for reducing sleep disturbances but not significant in other aspects assessed regarding sleep. There was a significant difference between baseline and post-intervention PSQI scores for the active intervention ($p<0.001$), as well as a significantly greater reduction in PSQI scores after the active intervention compared to after the control intervention. Further, there were also found to be significant reductions in scores for depression ($p<0.001$) and agitation ($p=0.003$) after the active intervention compared to baseline. Like with sleep quality, there were greater reductions in scores for depression ($p=0.04$) and agitation ($p=0.02$) after the active intervention compared to the control intervention. There was, however, no significant change in quality of life measured by the MDS-ADL scale ($p>0.05$) indicating that the light therapy did not influence level of dependency for daily activities (Figueiro et al., 2019).

A possible limitation of the study is that the questionnaires were filled out by staff and not by the participants themselves. This choice, however, was made due to severity of dementia

the participants that could have influenced the ability of the participants to fill out the questionnaires. Additionally, although bias is possible, the caregivers were blinded to which intervention was received as they were completed during night shift when the bright lights were used to prevent bias (Figueiro et al., 2019).

Summary

Based on the analysis of literature related to light therapy and dementia, there is an identifiable effect of decreasing symptoms of dementia by implementing bright light therapy. Research demonstrated that with 30-60 minutes of exposure to lights with a high-density lighting of 10,000 (Cibeira et al., 2021) to 14,000 lux (Zou et al., 2022) or moderate light densities of at least 1,000 lux for greater than an hour showed significant differences compared to low density dim lighting. Regarding sleep, research found that there were improvements in multiple aspects of sleep efficacy, including increased sleep duration, decreased time spent awake at night, increased stability of circadian rhythms, and a reduction of nighttime awakenings (Figueiro et al., 2019). Moreover, there were improvements in psychological and behavioral symptoms as delirium was significantly reduced with bright light exposure and there were decreases in depressive and neuropsychiatric symptoms (Zou et al., 2022). One study tested the immediate impact of light therapy on mood and found that immediately following bright light exposure, there were significant improvements in mood (Cibeira et al., 2021). As light therapy is a newly studied intervention, future research should include larger sample sizes and can compare bright light therapy to near infrared light therapy, another light therapy recently studied for improving symptoms of dementia.

There are numerous implications to nursing practice based on this research. Nurses should frequently assess symptoms of dementia and evaluate sleep patterns as this research has

demonstrated how common sleep disturbance and impaired mood are in older adults with dementia. The clinical setting should incorporate the use of bright lights during the daytime to provide exposure to bright lighting to improve symptoms and encourage exposure to natural bright lighting outside. Patients who live at home should be educated on the importance of incorporating bright daytime lighting at home and daily exposure to natural lighting outside for the alleviating effects on their symptoms. Further, bright and near infrared light therapy should continue to be tested in the clinical setting, as well as other non-pharmacological interventions to reduce symptoms and improve quality of life as dementia is currently one of the highest causes of mortality globally.

Chapter 3

Due to the progressive nature of dementia and lack of curative treatment, new methods of management of symptoms of the condition are crucial to increasing quality of life for those with dementia. Due to the newer research of light for improving signs and symptoms of dementia, evidence-based practice recommendations (see Table 1) can provide nurses and healthcare professionals with guidelines and knowledge on implementing this newer alternative treatment method. As a more recently studied treatment, there is more research needed to understand its impacts and create more specific guidelines on implementation in a clinical setting. However, based on current research, there are recommendations to prepare nurses and healthcare professionals for managing this condition.

Table 1

Best Practice Recommendations for Light Therapy Treatment for Dementia

Recommendation	Rationale	References	Level of Evidence
Obtain a baseline quantitative assessment of cognition and behavior through the Mini-Mental State Examination (MMSE) to determine severity of symptoms and monitor progression of the condition.	Quantitative measures allow for an accurate method of determining the severity of symptoms affecting cognitive and behavioral health to create a baseline and for proper monitoring of progression. The MMSE has been determined to be an effective screening method of quantifying severity of dementia. This utilizes scores that screen for mild (≥21), moderate (11-20), and severe dementia (0-10).	Kolberg, E., Hjetland, G. J., Thun, E., Pallesen, S., Nordhus, I. H., Husebo, B. S., & Flo-Groeneboom, E. (2021). The effects of bright light treatment on affective symptoms in people with dementia: A 24-week cluster randomized controlled trial. *BMC Psychiatry*, *21*(1). https://doi.org/10.1186/s12888-021-03376-y Liu, C.-R., Liou, Y. M., & Jou, J.-H. (2021). Ambient bright lighting in the morning improves sleep disturbances of older adults with dementia. *Sleep Medicine*, *89*, 1–9. https://doi.org/10.1016/j.sleep.2021.10.011	Level II Level III
Assess sleep quality through a self-reported assessment of sleep quality (PSQI).	The PSQI measures quality, latency, duration, efficiency, and disturbances of sleep, in addition to daytime	Figueiro, M. G., Plitnick, B., Roohan, C., Sahin, L., Kalsher, M., & Rea, M. S. (2019). Effects of a tailored lighting intervention on sleep quality, rest–activity, mood, and behavior in older adults with alzheimer disease and related dementias: A randomized clinical trial. *Journal of Clinical*	Level II

	dysfunction and sleep medication usage. These provide insight into the effect of dementia on an individual's sleep pattern. Additionally, monitoring sleep quality along with other variables, such as agitation and depression, can demonstrate progression of treatment for dementia.	*Sleep Medicine*, *15*(12), 1757–1767. https://doi.org/10.5664/jcsm.8078	
Utilize an actigraphy device to monitor circadian rhythm long-term.	Using actigraphy, a baseline can be determined to understand the individual's sleep pattern in terms of their sleep and wake times, sleep time, and sleep efficiency. This can allow for a healthcare team to understand the extent of symptoms on the circadian rhythm to determine management options and compare to baseline to monitor for improvements or detriments.	Alparslan, G. B., Özkaraman, A., Özbabalık, D., & Çolak, E. (2019). The effect of light on daily life activities and sleep in patients with alzheimer's disease. *Journal of Turkish Sleep Medicine*, *6*(3), 59–64. https://doi.org/10.4274/jtsm.galenos.2019.27247 Figueiro, M. G., Plitnick, B., Roohan, C., Sahin, L., Kalsher, M., & Rea, M. S. (2019). Effects of a tailored lighting intervention on sleep quality, rest–activity, mood, and behavior in older adults with alzheimer disease and related dementias: A randomized clinical trial. *Journal of Clinical Sleep Medicine*, *15*(12), 1757–1767. https://doi.org/10.5664/jcsm.8078	Level III Level II

Utilize exposure of bright lighting of a density of at least 2,000 lux.	A minimum of 2,000 lux in density of bright lighting has shown benefits in stimulating the circadian rhythm and improving cognition and quality of life.	Figueiro, M. G., Plitnick, B., Roohan, C., Sahin, L., Kalsher, M., & Rea, M. S. (2019). Effects of a tailored lighting intervention on sleep quality, rest–activity, mood, and behavior in older adults with alzheimer disease and related dementias: A randomized clinical trial. *Journal of Clinical Sleep Medicine*, *15*(12), 1757–1767. https://doi.org/10.5664/jcsm.8078 Kolberg, E., Hjetland, G. J., Thun, E., Pallesen, S., Nordhus, I. H., Husebo, B. S., & Flo-Groeneboom, E. (2021). The effects of bright light treatment on affective symptoms in people with dementia: A 24-week cluster randomized controlled trial. *BMC Psychiatry*, *21*(1). https://doi.org/10.1186/s12888-021-03376-y Liu, C.-R., Kuo, T. B., Jou, J.-H., Lai, C.-T. L., Chang, Y.-K., & Liou, Y. M. (2023). Bright morning lighting enhancing parasympathetic activity at night: A pilot study on elderly female patients with dementia without a pacemaker. *Healthcare*, *11*(6), 793. https://doi.org/10.3390/healthcare11060793 Liu, C.-R., Liou, Y. M., & Jou, J.-H. (2021). Ambient bright lighting in the morning improves sleep disturbances of older adults with dementia. *Sleep Medicine*, *89*, 1–9. https://doi.org/10.1016/j.sleep.2021.10.011	Level II Level II Level III Level III
Assess delirium utilizing the Confusion Assessment Method (CAM) to determine	Due to factors such as increased age, cognitive impairment, and disturbed circadian rhythm in many individuals with dementia,	Zou, C., Mei, X., Li, X., Hu, J., Xu, T., & Zheng, C. (2022). Effect of light therapy on delirium in older patients with alzheimer's disease-related dementia. *Journal of Psychiatric Research*, *149*,	Level II

presence and severity of delirium.	assessing and monitoring for delirium is crucial.	124–127. https://doi.org/10.1016/j.jpsychires.2022.03.003	
Employ short intervals of exposure to high density lighting for individuals with Alzheimer's disease with presence of delirium.	One study focused on light therapy for dementia-associated delirium found a significant improvement in severity of delirium using light exposure for 30 minutes per day over 14 weeks at a density of 14,000 lux.	Zou, C., Mei, X., Li, X., Hu, J., Xu, T., & Zheng, C. (2022). Effect of light therapy on delirium in older patients with alzheimer's disease-related dementia. *Journal of Psychiatric Research*, *149*, 124–127. https://doi.org/10.1016/j.jpsychires.2022.03.003	Level II
Measure mood and behavior through Likert scales before and after lighting sessions.	Likert scales completed by faculty based on visual observations and any verbal comments made by the individuals can determine the short-term immediate effects of lighting therapy sessions, as well as be used to monitor progression long-term for changes in mood and behavior.	Cibeira, N., Maseda, A., Lorenzo-López, L., González-Abraldes, I., López-López, R., Rodríguez-Villamil, J. L., & Millán-Calenti, J. C. (2021). Bright light therapy in older adults with moderate to very severe dementia: Immediate effects on behavior, mood, and physiological parameters. *Healthcare*, *9*(8), 1065. https://doi.org/10.3390/healthcare9081065	Level II

Summary

Implementation of specific recommendations for nurses and healthcare professionals are best performed primarily in long-term care, home health, or outpatient clinical treatment settings. One of the recommended practices under the nurse's scope of practice are screenings and other tools to obtain quantitative measurements to track progression of condition and treatment. Screening patients or clients through the Mini-Mental State Examination tool provides an objective insight into the severity of dementia (Liu, 2021). Follow-up screening throughout the course of care allows for changes in cognitive health to be identified to guide the treatment regimen.

Another important measurement is quality of sleep due to neurodegeneration that impairs the circadian rhythm (Liu, 2021). This can be measured with the self-reported assessment of sleep quality (PSQI) which a nurse should provide education to the patient on and provide the questionnaire for the individual to fill out. Specific measurements of sleep include recording sleep and wake times, duration of sleep, disturbances of sleep, daytime naps (Figueiro, 2019). In a home health or long-term care setting, nursing and healthcare staff can keep track of these measurements in charting for patients and clients with dementia who suffer from dysregulation of sleep and require closer monitoring.

In these health settings, in addition to the outpatient clinical setting, actigraphy can be utilized to collect data on sleep quality and more easily monitor changes and trends in sleep patterns (Alparslan, 2019). These watch devices can be recommended by physicians to be used at home or in a long-term care facility throughout treatment if sleep is found to be dysregulated or to monitor for future disruption. Due to the cost of these devices and variability of insurance coverage, a low-cost alternative option is the use of a sleep diary. Although data from a sleep

diary is more prone to human error due to higher estimates of sleep duration on average (Lehrer, 2022), due to its negligible cost it is a viable alternative method of monitoring changes in sleep through the progression of the disease. Additionally, it can be used to determine if actigraphy is necessary to pursue in the plan of care for more accurate data collection. The role of a nurse in these cases are to educate the patient on use of actigraphy watches and sleep diaries, as well as to monitor the data as needed.

Regarding implementing the light therapy into care, some research has determined that a minimum density of 1,000 lux of light is effective to produce a stimulating effect on the circadian rhythm to improve its regulation and in improving cognition (Kolberg, 2021). On the contrary, other studies have indicated that a higher density of 2,000 lux may be the threshold for an effect, so implementing a higher density is best recommended for light therapy (Liu, 2022). For the duration of lighting, 30-minute intervals of daily bright light exposure have shown to be beneficial in improving cognition and behavior, as well has decreasing side effects of delirium (Zou, 2022). This can be integrated into the healthcare setting through lamps with high density lighting or high-density ceiling lighting in particular rooms for patients to go to for light therapy. Administering bright light therapy through lamps is most functional and cost-effective due to the lack of installation that would be required with ceiling lighting. These lamps can be utilized in home health, long-term care, as well as outpatient and inpatient clinical setting.

Chapter 4

Throughout the previous chapters of this thesis, current research was explored regarding light therapy in reducing symptoms of dementia in older adults to understand the effects of the alternative therapy and methods of implementation. Several best practice recommendations have been created in chapter three for the employment of this therapy in various clinical and non-clinical settings. These recommendations were formed based on the evidence presented in multiple research articles to synthesize specific guidelines. Chapter four will outline a proposed plan of implementation in a memory care unit of a long-term care facility. This implementation plan will be outlined utilizing the Plan-Do-Study-Act model (Minnesota Department of Health, 2022).

The Plan-Do-Study-Act model is a four-stage model used to introduce and evaluate a change for improvement in various settings, such as healthcare or a business. The first stage, the plan, consists of the details of how the practice change will be carried out, while the second stage, do, is the execution of the change. The next phase is to study the results of the change to determine how effective it was and what was learned. This will allow for better understanding of how it can be fully implemented effectively in the final phase, act (Minnesota Department of Health, 2022). If the outcomes found in the study phase are ineffective, the cycle can be repeated to modify the plan and retest the change before it is implemented into practice. This process allows for new interventions or methods of practice to be tested before they are integrated on a broader scale and is beneficial to many settings.

Plan

This phase of the model functions to create a framework for light therapy to be applied to a specific setting. For this plan, the setting will be the memory care unit of a long-term care

facility where there are healthcare professionals who are able to execute the proposed plan. To introduce this therapy to a memory care unit, an education workshop would be held to teach nurses, providers, and caregivers about the therapy so that they understand how the therapy is performed and the effects of light therapy on symptoms associated with dementia that have been found through research. To do this, the Nurse Educator and the Unit Manager would be contacted to coordinate the workshop to take place over multiple different dates to ensure all or most staff are able to attend. The workshop would be a paid experience to compensate staff for their time attending the education and training session. This will ensure that the staff is competent at the therapy and can appropriately employ the therapy. Within this workshop, an educator would present on the evidence from current research and will primarily address how the light therapy will be administered in terms of the necessary steps and supplies. Best practice guidelines, including those presented in the previous chapter of this thesis, would be expanded on to provide staff a protocol to follow.

The aim statement to guide this study is that sleep duration will increase by 20% and cognition scores will improve by 15% in residents of a memory care unit of a long-term care facility by the end of a 6-week study period. The type of bright light therapy that would be used in the unit would be utilizing light therapy boxes that produce lighting with a density of approximately 10,000 lux. As these types of lamps have become more commonly produced as a therapy method for seasonal affective disorder, these types of lights are more affordable and convenient in comparison to other lighting methods, such as a floor lamp or a light panel. Additionally, these box lamps are more often measured in lux rather than lumen which allows for easier application as no calculations or light measurements would be necessary to reduce error resulting from inequal densities of light. These lamps would require accurate measurement of the

light angle and distance to determine the lumen necessary to produce an accurate density of light. For this reason, the light boxes will be utilized instead and will be more accessible as they can be placed on a table facing the resident one foot away as this is the range that creates the 10,000-lux density. An estimated budget for this study based on average market prices of these light boxes is $250 as these lights often range between $50-125.

Baseline data should be gathered on the participant residents regarding their sleep quality utilizing the self-reported Pittsburgh Sleep Quality Index (PSQI) and durations of sleep should be assessed for one week by caregivers prior to the initial therapy. For assessment of cognition, the Mini-Mental State Examination will be utilized to measure the severity of the dementia on an objective scale. Staff would be trained on these measurements during the educational workshop with practice testing to ensure competency of the skills and accuracy in data collection. Additional background information regarding demographics of age, race, gender, and socioeconomic factors should be gathered to provide additional context.

Do

This phase of the cycle would consist of executing the intervention on the unit. This would involve either one or two staff members to set up the lamps in the resident's rooms and moving the lamp to the next rooms after the half hour of therapy. With two light boxes, there would be three rounds of therapy per day. This could either be scheduled at set times such as at 0900, 1000, and 1100 or could be arranged by the resident's request at any point in the day dependent on unit preference. This would be completed daily for six weeks and data can be collected at the end of each week to provide seven points of data to be analyzed at the end. For sleep duration, this would be collected daily with the weekly average serving as the data point for that week and a post-test assessment on the PSQI scale should be completed. As for scores of

cognition, this should be retested at the end of each week for comparison rather than a daily measure. The participants and staff would be given opportunities to provide feedback throughout the study period through feedback forms to be evaluated at the end and any issues would be reported to the Unit Manager.

Study

Within the study phase of the cycle, the data and feedback received will be analyzed to compare pre- and post-test scores. The scores from the sixth week will be compared with the baseline measures to determine if there is a statistically significant difference. If the differences are significant, then the intervention was effective in improving sleep duration and cognition. If they are not significant, feedback will be reviewed to view if there were errors with administration or suggestions for improvement. The data collected weekly would be used to visualize trends to view circumstances in which scores improved or declined weekly. By analyzing these trends, we can understand the causes of these changes, such as unintended side effects, errors in the intervention, or external influences. External factors may involve stressors for the individuals or changes in medical treatment, such as new medications that may improve or worsen symptoms. Following the end of the implementation, a focus group would be held with the staff to allow for in-person feedback on the experience and to discuss if the therapy is feasible for long-term application on the unit.

Act

The act phase of this cycle involves evaluating and modifying the intervention. After the data is interpreted and feedback is considered, the unit can determine adjustments to be made for the intervention to be integrated into common practice for the unit. This process will allow for a standardized approach to be created to form a uniform process to be used on a regular basis. If

there were insignificant results found in the previous stage and a different approach may be more beneficial, then the study design will be revised, such as increasing duration or density of light, and the cycle would be repeated. This would also be determined based on the feedback from staff and participants as if there are minor suggestions and the results are significant, completing the cycle again is not necessary. If there is negative feedback with fundamental concerns, retesting may be needed to ensure the new approach is beneficial. This phase is crucial to the process to ensure that the therapy will be effective when implemented in common practice.

Summary

The Plan-Do-Study-Act model is an essential process in planning, implementing and determining the effectiveness and applicability of light therapy interventions in a healthcare setting. This procedure allows for the intervention to be tested on a small scale before it is officially implemented into the unit to ensure that the therapy is effective when applied to the unit. Educating the nursing staff about these guidelines to the nursing staff, and teaching staff about the research findings of previous studies is vital in maintaining evidence-based practices in nursing. Alternative therapies are an undervalued asset in healthcare, particularly in healthcare facilities due to the prioritization of acute medical treatment and pharmacological methods. Providing education on this alternative therapy will promote the use of non-invasive methods in the healthcare setting and encourage staff to learn more about these types of therapies. The staff should be encouraged to seek out additional published research on a regular basis and attend continued professional development opportunities regarding this topic and many others to maintain competency and improve their own patient care.

References

Alparslan, G. B., Özkaraman, A., Özbabalık, D., & Çolak, E. (2019). The effect of light on daily life activities and sleep in patients with alzheimer's disease. *Journal of Turkish Sleep Medicine, 6*(3), 59–64. https://doi.org/10.4274/jtsm.galenos.2019.27247

Alzheimer's Society. (2018, August 31). *Light Therapy and Dementia*. Alzheimer's Society. https://www.alzheimers.org.uk/about-dementia/treatments/alternative-therapies/light-therapy-and-dementia

Austrom, M. G., Boustani, M., & LaMantia, M. A. (2018). Ongoing medical management to maximize health and well-being for persons living with dementia. *The Gerontologist, 58*(1). https://doi.org/10.1093/geront/gnx147

Centers for Disease Control and Prevention. (2019). *What is dementia?*. Centers for Disease Control and Prevention. https://www.cdc.gov/aging/dementia/index.html#:~:text=Dementia%20is%20not%20a%20specific,a%20part%20of%20normal%20aging.

Cibeira, N., Maseda, A., Lorenzo-López, L., González-Abraldes, I., López-López, R., Rodríguez-Villamil, J. L., & Millán-Calenti, J. C. (2021). Bright light therapy in older adults with moderate to very severe dementia: Immediate effects on behavior, mood, and physiological parameters. *Healthcare, 9*(8), 1065. https://doi.org/10.3390/healthcare9081065

Fong, T. G., & Inouye, S. K. (2022). The inter-relationship between delirium and dementia: The importance of delirium prevention. *Nature Reviews Neurology, 18*(10), 579–596. https://doi.org/10.1038/s41582-022-00698-7

Huether, S., McCance, K. (2019). Pathophysiology (8th ed.). Elsevier.

Emmady, P. D., Schoo, C., Tadi, P., & Pozo, E. D. (2022). *Major neurocognitive disorder (dementia) (nursing) - statpearls - NCBI ...* StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK570552/

Figueiro, M. G., Plitnick, B., Roohan, C., Sahin, L., Kalsher, M., & Rea, M. S. (2019). Effects of a tailored lighting intervention on sleep quality, rest–activity, mood, and behavior in older adults with alzheimer disease and related dementias: A randomized clinical trial. *Journal of Clinical Sleep Medicine*, *15*(12), 1757–1767. https://doi.org/10.5664/jcsm.8078

Kolberg, E., Hjetland, G. J., Thun, E., Pallesen, S., Nordhus, I. H., Husebo, B. S., & Flo-Groeneboom, E. (2021). The effects of bright light treatment on affective symptoms in people with dementia: A 24-week cluster randomized controlled trial. *BMC Psychiatry*, *21*(1). https://doi.org/10.1186/s12888-021-03376-y

Lehrer, H. M., Yao, Z., Krafty, R. T., Evans, M. A., Buysse, D. J., Kravitz, H. M., Matthews, K. A., Gold, E. B., Harlow, S. D., Samuelsson, L. B., & Hall, M. H. (2022). Comparing polysomnography, actigraphy, and sleep diary in the home environment: The study of women's health across the nation (swan) sleep study. *SLEEP Advances*, 3(1). https://doi.org/10.1093/sleepadvances/zpac001

Liu, C.-R., Kuo, T. B., Jou, J.-H., Lai, C.-T. L., Chang, Y.-K., & Liou, Y. M. (2023). Bright morning lighting enhancing parasympathetic activity at night: A pilot study on elderly female patients with dementia without a pacemaker. *Healthcare*, *11*(6), 793. https://doi.org/10.3390/healthcare11060793

Liu, C.-R., Liou, Y. M., & Jou, J.-H. (2021). Ambient bright lighting in the morning improves sleep disturbances of older adults with dementia. *Sleep Medicine*, *89*, 1–9. https://doi.org/10.1016/j.sleep.2021.10.011

National Institute on Aging. (2019). *What happens to the brain in alzheimer's disease?* National Institute on Aging. https://www.nia.nih.gov/health/what-happens-brain-alzheimers-disease

National Institute on Aging. (2023). *How is alzheimer's disease treated?* National Institute on Aging. https://www.nia.nih.gov/health/how-alzheimers-disease-treated

Pathology of alzheimer's disease 2: BioRender science templates. Pathology of Alzheimer's Disease 2 | BioRender Science Templates. (n.d.). https://www.biorender.com/template/pathology-of-alzheimer-s-disease-2

PDSA: Plan-Do-Study-Act. Minnesota Department of Health. (2022, October 3). https://www.health.state.mn.us/communities/practice/resources/phqitoolbox/pdsa.html#:~:text=More%20information-,What%20is%20PDSA?,will%20result%20in%20an%20improvement?

Sukhawathanakul, P., Crizzle, A., Tuokko, H., Naglie, G., & Rapoport, M. J. (2021). Psychotherapeutic interventions for dementia: A systematic review. *Canadian Geriatrics Journal*, *24*(3), 222–236. https://doi.org/10.5770/cgj.24.447

World Health Organization. (2023). *Dementia*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/dementia#:~:text=Key%20facts,injuries%20that%20affect%20the%20brain.

Zou, C., Mei, X., Li, X., Hu, J., Xu, T., & Zheng, C. (2022). Effect of light therapy on delirium in older patients with Alzheimer's disease-related dementia. *Journal of Psychiatric Research*, *149*, 124–127. https://doi.org/10.1016/j.jpsychires.2022.03.003