A Systematic Review: Light Therapy for Individuals with Dementia and Implications for Practice

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INTRODUCTION

Sundowning describes an array of neuropsychiatric symptoms and is a common occurrence among individuals with dementia. The highest prevalence occurs in community-dwelling and institutionalized older adults (Canevelli et al., 2016; Gnanasekaran, 2015). During sundowning, symptoms such as confusion, agitation, and aggression typically emerge in the late afternoon when light exposure is diminished (Canevelli et al., 2016). A higher incidence of sundowning has been reported in individuals with advanced stages of dementia, as well as during the winter months when there is less sunlight (Canevelli et al., 2016). It is believed that sundowning hastens the progression of cognitive impairment and increases the rates of hospitalization, institutionalization, and caregiver burnout (Canevelli et al., 2016).

Sundowning has been recognized by medical professionals for over 70 years; yet, it is not included in the Diagnostic and Statistical Manual of Mental Disorders (DSM–5) (Gnanasekaran, 2015). Presently, there are no established guidelines for the management of symptoms associated with sundowning syndrome. Although pharmacological interventions have been used for treatment of sundowning, their effectiveness is limited and the risk of interacting with other medications is high (Gnanasekaran, 2015).

Non-pharmacological interventions, such as environmental modifications, have emerged as safer alternatives to medication; however, their efficacy is still unknown (Gnanasekaran, 2015). One of these emerging alternatives to traditional treatment is light therapy (Gnanasekaran, 2015). The effects of light therapy on sundowning have not been widely studied. Nevertheless, the limited research available has suggested its potential to improve symptoms (Gnanasekaran, 2015). This systematic review seeks to answer the question: is light therapy an effective intervention for sundowning symptoms experienced by individuals who have dementia?

METHODS

A protocol was developed prior to conducting a comprehensive systematic review (Appendix A). The protocol is a step-by-step procedure to identify and appraise all relevant studies.

Identification of Relevant Studies:
A comprehensive and systematic search for relevant studies was conducted in February and March of 2019, using the following databases: PsychINFO, OT Search, OT Seeker, CINAHL,
Health & Medical Complete, Cochrane, and PubMed. The inclusion and exclusion criteria included: (1) quantitative study (2) published in English and (3) peer-reviewed. The search terms used, keyword combinations, and subject headings relative to each database can be found in the protocol (Table 3).

To be included in the systematic review, studies retrieved during the search met the following criteria: (1) population with a diagnosis of dementia, (2) light therapy used as the primary means of intervention, (3) the outcome measured at least one of three predetermined characteristics of sundowning (agitation, confusion, and aggression). Studies whose population had comorbid conditions causing memory loss (e.g. traumatic brain injuries or seizures) were excluded. Also excluded were articles that discussed other forms of light therapy not as defined in Text Box 1 (e.g. color therapy, heliotherapy, wave therapy, etc.). A complete list of inclusion and exclusion criteria was established in the protocol (Table 5).

A group of six reviewers and six research assistants independently assessed articles retrieved from the selected databases using the predetermined inclusion and exclusion criteria. The title and abstract of each study were screened by two reviewers to determine article eligibility. When a determination from these sections alone could not be reached, the full article was assessed.

Following independent assessment, the two assigned reviewers compared their findings of each article and discussed and resolved any discrepancies until a consensus was reached. When necessary, a third reviewer was utilized to assist with resolving discrepancies between the two assigned reviewers. All the articles included or excluded were summarized in a flowchart (Figure 1).

**Appraisal of Included Studies:**

After all inclusion and exclusion criteria were applied and the authors came to a consensus there were 16 articles (Figure 1). In compliance with the protocol, two independent reviewers appraised each article to determine the quality of evidence (Text Box 2) by using predetermined, study design-specific criteria. Each pair of reviewers compared individual ratings of the quality of evidence for each study (Table 6). Discrepancies between reviewers were resolved through discussion until a consensus was reached. A third party reviewer was consulted when an agreement could not be agreed upon.

Collaboratively, the two 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 (Table 7). Relevant statistical terminology is defined in Text Box 2. In cases with no reported clinical significance, a manual calculation of the minimally detectable difference (MDD) was performed when possible. Practice recommendations and clinical implications were generated from findings.

<table>
<thead>
<tr>
<th>TEXT BOX 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistical Significance:</strong> A term indicating that the results of a study are unlikely to be the result of chance. (Portney &amp; Watkins, 2009)</td>
</tr>
<tr>
<td><strong>Level of Evidence:</strong> A ranking system used to show the strength of a study based on predetermined criteria.</td>
</tr>
<tr>
<td><strong>Quality of Evidence:</strong> the degree to which the study being analyzed is deemed reliable.</td>
</tr>
<tr>
<td><strong>Point Estimate:</strong> numerical data presented as mean scores with standard deviations.</td>
</tr>
<tr>
<td><strong>Minimally Detectable Differences (MDD):</strong> the smallest amount of change that can be detected to reflect the true difference. (Portney &amp; Watkins, 2009)</td>
</tr>
<tr>
<td><strong>Minimally Clinically Important Difference (MCID):</strong> the smallest difference detected that the patient perceives to be beneficial. (Portney &amp; Watkins, 2009)</td>
</tr>
</tbody>
</table>

**RESULTS**

The database searches retrieved a total of 701 articles. There were 16 articles that met pre-established inclusion criteria and were subsequently reviewed. The flowchart provides a detailed breakdown of the study identification process (Figure 1).
Of the analyzed studies, seven of the studies followed a quasi-experimental study design, involving the application of the intervention without random assignment of participants to conditions or orders of conditions. Two studies were single case research designs, where participants serve as their own control while also receiving the intervention. In this case, repeated measures are recorded at multiple phases: baseline, intervention, and follow-up or withdrawal. Seven studies were randomized control trials (RCTs), in which group allocation (control or intervention) was determined through a process of randomization. RCTs are considered level I evidence, one of the highest levels of evidence in intervention studies.

The level of evidence of the studies analyzed in this systematic review ranged from level I to IV with levels I and III being the most frequently represented. The quality of individual studies ranged from low to high and can be found on the quality of evidence table (Table 6). A total of 11 studies ranged from moderate to high-quality evidence, while five were found to be of low quality (Table 6). Four studies presented with high quality, meeting 70% or more of design specific criteria and seven studies presented with moderate quality ranging from 40% to 70% of criteria being met. Five articles were low quality, meeting less than 40% of design specific criteria (Table 6). The included studies measured at least one of three identified outcomes related to sundowning: (1) agitation, (2) aggression or (3) confusion.

Agitation
Of the 16 included studies, 15 evaluated the efficacy of light therapy when utilized as an intervention to treat agitation. In regards to level of evidence, five of these studies provided level I evidence, four provided level III, and four provided level IV (Table 6). The quality of evidence ranged from low to high. Four studies presented with low quality, six with moderate quality, and three with high quality (Table 6).

There were 10 outcome measures utilized to evaluate agitation across the 15 identified studies; with some studies utilizing more than one outcome measure to estimate agitation (Table 8). There were 10 studies that utilized six of the identified outcome measures and found light therapy to be effective in treating agitation (p<0.05; Table 8). Three studies, through three outcome measures, found no statistical significance and two studies which utilized the outcome measures of observation and the Confusion Rating Scale (CRS) did not provide information regarding statistical significance (Table 8).

In regards to clinical significance, 11 studies using eight outcome measures found no clinical significance when utilizing light therapy as an intervention to decrease agitation (Table 8). Two studies, which both utilized the Cohen-Mansfield Agitation Inventory (CMAI) as an outcome measure, found light therapy to be a clinically significant intervention and two studies did not provide information regarding clinical significance nor provide sufficient data for significance to be calculated by reviewers (Table 8).

Aggression
Five of the studies included in the systematic review evaluated the efficacy of light therapy for treating aggression. Two of these studies provided level I evidence, with one being high-quality evidence and one being low-quality evidence (Table 8). The remaining three studies provided low-quality, level III evidence (Table 8). There were six outcome measures utilized across the five identified studies which measured agitation (Table 8). Three studies, using four of the identified outcome measures among them, found light therapy to be effective in decreasing aggression (p<0.05; Table 8). One study, which utilized both the Gedragsobservatieschaal voor Intramurale Psychogeriatrie (GIP) and the Social Dysfunction and Aggression Scale (SDAS-9) as outcome measures for aggression, found mixed results in regard to statistical significance and one study did not provide information regarding statistical significance (Table 8).

In determining the clinical significance of utilizing light therapy as an intervention to decrease aggression, one study that utilized the Behavioral Pathology in Alzheimer Disease Scale (BEHAVE-
AD) as an outcome measure found clinical significance. Two studies found no clinical significance and one study did not provide information regarding clinical significance nor sufficient data for significance to be calculated by reviewers (Table 8). The remaining study which utilized both the GIP and SDAS-9 to estimate aggression found no clinical significance among the results of the GIP, and did not provide information regarding clinical significance from the results of the SDAS-9 (Table 8).

**Confusion**
Five out of the 16 included studies evaluated the efficacy of light therapy as an intervention to treat the sundowning symptoms of confusion. Three of these studies provided level I evidence, and two studies provided level IV evidence (Table 8). The quality of evidence among the five identified studies ranged from low to high. Two studies had high quality evidence, two studies had moderate quality evidence, and one study had low-quality evidence (Table 8).

Within the five relevant studies, there were five outcome measures utilized to evaluate confusion (Table 8). One study which utilized the GIP as an outcome measure, found light therapy to be effective in decreasing confusion (p<0.05; Table 8). Three studies found no statistical significance, and one study, which utilized the CRS to estimate confusion did not provide information regarding statistical significance (Table 8). In regards to clinical significance, two studies found light therapy to have clinically significant results in treating symptoms of confusion, while three studies did not (Table 8).

**PRACTICE RECOMMENDATIONS**

**Agitation**
There were 15 studies that met this systematic review inclusion criteria addressed the effectiveness of light therapy in the treatment of agitation. The level of evidence ranged from Level I to level III, with a preponderance of level I studies. Using a modified Grading of Recommendations Assessment, Development and Evaluation (GRADE) system, this outcome demonstrated low quality due to many of the studies yielding mixed results regarding clinical and statistical significance. As well as the individual studies having low quality of evidence regardless of level of evidence. Further research will most likely impact the reviewers’ confidence in the estimate of effect and more organized and structured study designs with larger study populations are suggested for more evidence. (Guyatt et al, 2011).

**Aggression**
Five studies analyzed in this systematic review addressed the use of light therapy in reducing sundowning symptoms, specifically aggression. The level of evidence ranged from level I to level III with a preponderance of level III studies. Using a modified GRADES classification system, this outcome demonstrated low quality because only one of the six studies resulted in high quality of evidence (Guyatt et al, 2011). This indicates that further research will most likely impact confidence in the estimate of effect. Higher level studies with better quality levels are suggested in order to increase the validity and reliability of research evidence (Guyatt et al, 2011).

**Confusion**
Five of the 16 studies analyzed in this systematic review addressed the use of light therapy in reducing the sundowning symptoms related to confusion. A preponderance of these studies were RCTs, which are considered level I evidence. However, due to discrepancies in both the levels of quality of evidence and the clinical and statistical significance results, this outcome is considered of moderate quality based on the GRADES classification system (Guyatt et al, 2011). Further research is likely to have an impact on confidence in the estimate of effect. Rigorous study methods and designs are suggested for future studies with the expectation that improved research validity is produced.

**CLINICAL IMPLICATIONS**
The 16 included studies in this systematic review evaluated the efficacy of light therapy on sundowning symptoms in individuals with dementia. The three outcomes addressed—agitation, aggression, and confusion—were considered to have low and moderate quality based on the GRADES classification system (Guyatt et al, 2011).
Confusion was considered to have a moderate quality designation from the modified GRADES system which suggests that further research is necessary and may impact clinical understanding of light therapy and its effect on sundowning symptoms in the future. However, agitation and aggression were both found to have low-quality based on the GRADES classification system, which suggests that further research is necessary and will impact clinical understanding of light therapy and its effect on sundowning symptoms in the future.

This systematic review shows that currently, the preponderance of evidence provided in these studies had moderate to low clinical significance and p-values that demonstrated low statistical significance. The benefits of utilizing light therapy as an intervention to reduce sundowning symptoms are unclear. Clinicians must analyze each case, taking into consideration the cost and burden of specialized lighting equipment, as well as the lengthy administration time and supervision needed for the intervention. Although study limitations exist, utilizing bright light therapy to treat sundowning symptoms is an option that would be weakly recommended when addressing aggression, agitation, and confusion in individuals with dementia. This is due to the low to moderate clinical significance of the three outcomes analyzed. The significance of the outcomes were further limited by multiple lower level studies and limited sample sizes. Therefore, it is suggested that clinicians discuss the potential risks and benefits, as well as the unknown effectiveness, with clients and their families before implementing this intervention.

REFERENCES


ACKNOWLEDGMENTS

We thank Dr. Mary Ferraro for her guidance at each step of the systematic review process. Daniel Verbit for his assistance with navigating the databases in which we conducted our search and Lindsay Finnegan, Maddie Scuder, Natalie Long, Zach Mullen, Alisha Chacko and Julia Norkitis for assisting with article appraisal.
<table>
<thead>
<tr>
<th>PICO question</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P</strong> - Individuals with dementia</td>
<td><strong>I</strong> - Light therapy</td>
</tr>
</tbody>
</table>
Table 2. List of the Databases to be Searched:

<table>
<thead>
<tr>
<th>Databases Included in SR Search</th>
<th>Planned the Search</th>
<th>Will conduct the Search</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Person 1</td>
<td>Person 2</td>
</tr>
<tr>
<td>PubMed</td>
<td>group</td>
<td>group</td>
</tr>
<tr>
<td>Cinahl</td>
<td>Alyssa</td>
<td>Amanda</td>
</tr>
<tr>
<td>PsychINFO</td>
<td>Christine</td>
<td>Erica</td>
</tr>
<tr>
<td>OT Seeker</td>
<td>Vivian</td>
<td>Erica</td>
</tr>
<tr>
<td>OT Search</td>
<td>Alyssa</td>
<td>Amanda</td>
</tr>
<tr>
<td>Health and Medical Complete</td>
<td>Vivian</td>
<td>Elise</td>
</tr>
<tr>
<td>Cochrane</td>
<td>Elise</td>
<td>Christine</td>
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</tbody>
</table>
### Table 3. List of Search Terms:

<table>
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<tr>
<th>Database</th>
<th>Construct 1</th>
<th>Construct 2</th>
<th>Limits (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health and Medical Complete</strong></td>
<td><strong>Dementia</strong> (all subjects &amp; indexing-SU), “neurocognitive dis”* (all subjects &amp; indexing-SU), Alzheimer* (all subjects &amp; indexing-SU)</td>
<td>Light therapy</td>
<td>*light treatment has to be utilized as a keyword for this database as it retrieves relevant results that are not included when searched without it.</td>
</tr>
<tr>
<td></td>
<td>A cross search was run using keywords in all fields vs keywords in SU and the remaining results were irrelevant</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PsycINFO</strong></td>
<td>Dementia, Alzheimer*, “Neurocognitive Dis”*</td>
<td>Phototherapy</td>
<td>Subject headings found in apa thesaurus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“light treatment”- not included as it did not effect relevant</td>
<td></td>
</tr>
<tr>
<td>Database</td>
<td>Query Details</td>
<td>Search Results</td>
<td></td>
</tr>
<tr>
<td>----------</td>
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<td>----------------</td>
<td></td>
</tr>
<tr>
<td>CINAHL</td>
<td>Dementia [MeSH] OR &quot;neurocognitive disease [MeSH]&quot;</td>
<td>Dementia OR &quot;Neurocognitive dis&quot; [MeSH]</td>
<td>&quot;Light Therap*&quot; OR &quot;Phototherap *&quot;</td>
</tr>
<tr>
<td>OT Seeker</td>
<td><strong>no subject headings recognized</strong></td>
<td><strong>no subject headings recognized</strong></td>
<td><strong>Tried phototherapy, came up with 3 results, 2 of which were same as light therapy, one was irrelevant.</strong></td>
</tr>
<tr>
<td>OT Search</td>
<td><em>This site does not utilize subject headings</em></td>
<td>Dementia, Alzheimer, neurocognitive disease</td>
<td><em>This site does not utilize subject headings</em></td>
</tr>
<tr>
<td>Cochrane</td>
<td>Not necessary to include subject heading as keyword search returns only 4 results (1 relevant)</td>
<td>Dementia OR &quot;neurocognitive disorder&quot;</td>
<td>Not necessary to include subject heading as keyword search returns only 4 results (1 relevant)</td>
</tr>
<tr>
<td>PubMed</td>
<td>Dementia</td>
<td>Dementia, Neurocognitive</td>
<td>Phototherapy</td>
</tr>
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<td></td>
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<tr>
<td><strong>Note:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● <strong>Cochrane Library:</strong> Use search category “title, abstract, keywords”</td>
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</table>
Table 4. Boolean Sentence for each database:

<table>
<thead>
<tr>
<th>Database Name</th>
<th>Boolean Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>PsycINFO</td>
<td>(IndexTermsFilt: &quot;Phototherapy&quot; OR Any Field: <em>phototherapy</em> OR Any Field: <em>(light therap</em>)<em>)AND (IndexTermsFilt: &quot;Dementia&quot; OR Any Field: <em>dementia</em> OR Any Field: <em>alzheimer</em> OR Any Field: <em>(neurocognitive dis</em>)</em>)</td>
</tr>
<tr>
<td>Health and Medical</td>
<td>MAINSUBJECT.EXACT(&quot;Dementia&quot;) OR su(&quot;<em>neurocognitive dis</em>&quot;) OR su(dementia) OR su(<em>alzheimer</em>) AND (MAINSUBJECT.EXACT(&quot;Light therap&quot;) OR <em>Phototherapy</em> OR &quot;Light therapy&quot;) OR &quot;Light treatment&quot;)</td>
</tr>
<tr>
<td>Complete</td>
<td>(&quot;Dementia [MeSH]&quot; OR &quot;Dementia&quot; OR &quot;Neurocognitive disease [MeSH]&quot; OR &quot;Neurocognitive dis&quot;) AND (&quot;Phototherapy [MeSH]&quot; OR &quot;<em>Phototherapy</em>&quot; OR &quot;<em>Light therap</em>&quot;)</td>
</tr>
<tr>
<td>OT Seeker</td>
<td>(Alzheimer’s OR dementia) AND (&quot;Light therapy&quot;) <strong>Tried phototherapy, came up with 3 results, 2 of which were same as light therapy, one was irrelevant.</strong></td>
</tr>
<tr>
<td>OT Search (POWER SEARCH)</td>
<td>(&quot;Dementia&quot; OR &quot;Alzheimer&quot; OR &quot;neurocognitive disease&quot;) AND (&quot;light therapy&quot; OR &quot;phototherapy&quot;)</td>
</tr>
<tr>
<td>Cochrane</td>
<td>*(Dementia OR “neurocognitive disorder”) AND (“Light therapy” OR <em>Phototherapy</em>)</td>
</tr>
<tr>
<td>Inclusion Criteria</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Population</td>
<td>Intervention and Comparison</td>
</tr>
<tr>
<td>Dementia</td>
<td>Light therapy (The treatment of medical or psychiatric conditions by the controlled application of light.)</td>
</tr>
<tr>
<td>Any type of dementia</td>
<td></td>
</tr>
<tr>
<td>All races, ethnicities, genders, socioeconomic statuses</td>
<td></td>
</tr>
<tr>
<td>Any stage of dementia</td>
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</table>

<table>
<thead>
<tr>
<th>Exclusion Criteria</th>
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<tbody>
<tr>
<td>Population</td>
<td>Intervention and Comparison</td>
<td>Outcome</td>
<td>Other</td>
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<tr>
<td>Not memory loss due to other conditions ex. TBI or seizures</td>
<td>Not color therapy</td>
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<tr>
<td>Not heliotherapy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not wave therapy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not low-level light therapy</td>
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</tbody>
</table>
(Defined as Low-level laser therapy is a form of alternative medicine that applies low-level lasers or light-emitting diodes to the surface of or in orifices of the body)
Table 6. Quality of Evidence Worksheet

<table>
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<tr>
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<th>Type of design</th>
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<td>Population (including age)</td>
<td>Intervention/ Comparison/ N in each group</td>
<td>Outcome(s)</td>
<td>Measurement (include units &amp; direction of difference)</td>
<td>Point estimate (Mean &amp; SD)</td>
<td>Clinical Significance</td>
<td>Statistical Significance</td>
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<td>Ansol et al., 2009</td>
<td>RCT</td>
<td>8/10 Moderate</td>
<td>Dementia</td>
<td>Age 65+</td>
<td>1. 10 days of Tc 2 groups: 7-cm Bright Light; 5-cm Dark Light, 30 min/day</td>
<td>1. Agitation</td>
<td>1. ABRG (observed), reported in mean scores as well as change from baseline, N=33</td>
<td>2. 1 month of follow-up</td>
<td>No change in ABRG</td>
<td>p&lt;0.01</td>
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<td>RCT</td>
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<td>Dementia</td>
<td>Age 65+</td>
<td>1. 4 BLT conditions: AD-BLPT (n=43)</td>
<td>2. Agitation</td>
<td>1. CMAS, 20-item, scale of 1-7; n=43</td>
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<td>Burrell et al., 2010</td>
<td>RCT</td>
<td>8/10 High</td>
<td>Dementia</td>
<td>Mean Age: 65.3</td>
<td>1. BLT (light box, 10000 lux), n=22</td>
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<td>1. CMAS, 20-items, n=22</td>
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<td>Deeming, Gattr, Hubbard, &amp; Llouveng, 2007</td>
<td>RCT</td>
<td>7/10 High</td>
<td>Dementia</td>
<td>Mean Age: 64 (SD=10), range 50-90</td>
<td>1. Clustering</td>
<td>1. NPH-H: 12 items, n=50</td>
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</table>

### Table 7. Study Description Table
### Figures et al., 2014

**Quality Expertise**: rT2H 
**Depression**

- **Dementia**
  - Mean Age: 85.9 (SD 4.9 y)
- **Light therapy**: 200-400 lux, 8-10 hours per day for 4 weeks
- **CIBIS**:
  - Mean (SD)
  - E: 12.6 (1.16)
  - A: 8.8 (1.05)
- **CMAR**
  - Mean (SD)
  - 37.2 (5.1)
  - 39.2 (5.1)
- **BDI**
  - Mean (SD)
  - 12.6 (1.16)
  - 8.8 (1.05)
  - 37.2 (5.1)
  - 39.2 (5.1)

### Hoffmann et al., 2001

**RCT**: 4/10 
**Moderate**

- **Dementia**
  - Mean Age: 72.1
- **B&L & M&L**
  - vs. B&L & Placebo
  - n=10 (per group)

### Lovell et al., 1995

**Single Case Design**: 7/6 
**High**

- **Dementia**
  - Mean Age: 83.2
- **Light (CIBIS)**
  - administered for 2 baselines, in morning for two Friday periods
  - per 6

### Uddelands et al., 1998

**RCT**: 4/10 
**Moderate**

- **Dementia**
  - Mean Age: 83.8 (SD 8.7)
- **Morning B&L vs Dim Light (control group)
  - Total n=11 (not labeled per group)

### Meisch et al., 2017

**Quality Expertise**: rT2H 
**Moderate**

- **Dementia**
  - Mean Age: 78.4 (SD= 6.9; Range=55-95)
- **Dyson**
  - vs. B&L
  - vs. Dim Light
  - vs. Control

### Definitions

- **MMSE**: 0-30 points
- **B&L**: High light group (44% 17 years and 27 women)
- **CIBIS**: Mean score of 232 points
- **CMAR**: Mean score of 19, 19 female
- **BDI**: Mean (SD)
  - E: 12.6 (1.16)
  - A: 8.8 (1.05)
  - 37.2 (5.1)
  - 39.2 (5.1)
- **CMAR**: Mean (SD)
  - 37.2 (5.1)
  - 39.2 (5.1)
- **BDI**: Mean (SD)
  - 12.6 (1.16)
  - 8.8 (1.05)
  - 37.2 (5.1)
  - 39.2 (5.1)
- **CMAR**: Mean (SD)
  - 37.2 (5.1)
  - 39.2 (5.1)
- **CMAR**: Mean score of 19, 19 female
- **BDI**: Mean (SD)
  - E: 12.6 (1.16)
  - A: 8.8 (1.05)
  - 37.2 (5.1)
  - 39.2 (5.1)
- **CMAR**: Mean score of 19, 19 female
- **BDI**: Mean (SD)
  - E: 12.6 (1.16)
  - A: 8.8 (1.05)
  - 37.2 (5.1)
  - 39.2 (5.1)

### Activities

- **Activity Monitor**
  - 1: high light group
  - 2: low light group
  - 3: control group
  - 4: both groups

### Summary

- **Negative Outcome**: Reduced mood, behavior, and sleep quality
- **Positive Outcome**: Improved mood, behavior, and sleep quality

### Conclusion

- **Summary**: Overall, the use of B&L can significantly improve mood, behavior, and sleep quality in individuals with dementia.
Schneider et al., 2002
Single Case Design
2/6
Low
Dr. Dementia (Kuusinen’s type)
Mean age: 81.8
BLT (2,000 lux) administered for 2
first daily for 8 am-10 am
on 14
days
Baseline DSQ
Agitation subscore
SD
1. Agitation
2. Delusion
1. CRIS
2. CRIS
p < .05
Mean changes in CRIS subscore
SD
Prior to BLT. 1.5 < 1.6 (MDD)?
 sig.
Diaging BLT: 2 < 1.6 (MDD)? N.S.
Change in CRIS subscore: 0.45
p < 1.6 (MDD)? N.S.
Baseline DSQ: 3.8 ± 4.2 (MDD)?
N.S.
Previews were not given for this study and statistical
significance was not stated.

Sjövall et al., 2004
Guava Export slain.
2/6
Low
Dr. Alzheimer’s (Kuusinen’s dementia)
Mean Age: 79.4
BLT (500 lux) for 4
week
n = 10
Behavioral disturbances
CRIS: 2-week scale of
SD
1. CRIS: 24-hour scale of
2. Behave AD: +2 (better)
SD
1. CRIS:
1.2 ± 1.2 (48)
2. Behave AD
2. Behave AD
6 ± 4 (56)
4. CRIS: P = 0.01 2.
2. Behave AD
P = 0.06

Thorsen et al., 2006
Guava Export slain.
2/6
Low
Dr. Dementia (Kuusinen’s type)
Mean Age: 60-69
Light administered
through Day-Light
Box: 30 min/day
n = 5
Agitation
2. Delusion
3. Positive behaviors
4. Sleep
1. Agitation
2. CRIS
3. EBC
4. Highly
3. Agitation
4. Sleep
3. Agitation
4. Sleep
1. Total score: 0.9 < p = .05.
2. Three days: scores from baseline to
3. Change: 0.9 < p = .05.
4. Positive behavior: +4 change
5. Change: 0.9 < p = .05.
6. Sleep: 0.9 < p = .05.
MDD calculated: 0.5
1. Total Scores p = 0.54
2. Seasonal pattern results p = 0.32
3. Depression behavior: 0.55 positive behaviors
p = 0.48

Wohlfahr et al., 2017
Guava Export slain.
2/6
Moderate
Dr. Dementia (Kuusinen’s type)
Mean Age: 79.1
Dynamic lighting system
n = 5
1. Agitation
2. Sleep
1. Agitation
2. Sleep
1. CRIS index score
2. Activity and
measured by activity
4. Positive behavior
1. Agitation
2. Sleep
1. CRIS index score
2. Activity
4. Positive behavior
1. MOD calculated: 0.5
2. Significant
3. Sleep-Activity: not significant
### Table 8. Results Summary

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**Agitation**

1. CMAI (9)
2. ABRS (2)
3. CRBRS (1)
4. NPI-NH (1)
5. BEHAVE-AD (1)
6. CADS (1)
7. CRS (1)
8. BARS (1)
9. PAS (1)
10. Observation (1)

1. S. (6)
2. N.S (3)
3. S. (2)
4. N.S (1)
5. S. (1)
6. N.S.(1)
7. Not Provided
8. S. (1)
9. S. (1)
10. Not Provided

1. S. (3)
2. N.S (2)
3. N.S. (1)
4. N.S.(1)
5. N.S. (1)
6. Not Calculable
7. N.S (1)
8. N.S. (1)
9. N.S. (1)
10. Not Calculable

1. NPI-NH (1)
2. GIP (1)
3. SDAS-9 (1)
4. BEHAVE-AD (1)
5. EBIC (1)
6. Observation (1)

1. S. (1)
2. S. (1)
3. N.S. (1)
4. S. (1)
5. S. (1)
6. Not Provided
7. Not Calculable
8. S. (1)
9. N.S. (1)
6. Not Calculable

1. GIP (1)
2. S-MMSE (1)
3. NPI-Q (1)
4. CRS (1)
5. MOUSEPAD (1)

1.S(1)
2. N.S. (1)
3. N.S. (1)
4. Not Provided
5. N.S. (1)
1.N.S.(1)
2. N.S. (1)
3. Not Calculable
4. S. (1)
5. N.S. (1)
6. Not Calculable

### KEY:

S = SIGNIFICANT  
N.S = NOT SIGNIFICANT

**OUTCOME MEASURES:**

- ABRS: Agitated Behavior Rating Scale
- BARS: Brief Agitation Rating Scale
- Behave-AD: Behavioral Pathology in Alzheimer Disease scale
- CADS: Change in Advanced Dementia Score
- CMAI: Cohen-Mansfield Agitation Inventory
- CRBRS: Crichton Royal Behavior Rating Scale
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<td>GIP</td>
<td>Gedragsobservatieschaal voor Intramurale Psychogeriatrie (Dutch version of the geriatric behavioural observation scale)</td>
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<td>SDAS-9</td>
<td>Social Dysfunction and Aggression Scale</td>
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<tr>
<td>S-MMSE</td>
<td>Severe Mini Mental Status Evaluation</td>
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Figure 1. Flowchart

Number of studies identified through database search = 701

PsychINFO: 108
OT Search: 4
OT Seeker: 7
CINAHL: 102
Health & Medical Complete: 302
Cochrane: 4
Pubmed: 174

Number of studies excluded after screening “Title and Abstract”= 662

Causes of Exclusion:
- Not peer reviewed: 24
- Not published in English: 2
- Not Quantitative Study: 133
- Systematic Review: 21
- Population not individuals with dementia: 69
- Intervention is not “light therapy” (as defined by reviewers): 203
- Outcome does not include decreasing “sundowning” behavior (as defined by reviewers): 211

Total Number of Remaining Articles: 39

Duplicates Removed: 22

Number of articles included in Systematic Review: 17

1 article unable to be retrieved

Number of articles included in Systematic Review: 16