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Sleep Disruption and Quality of Life in Persons with Dementia: A State-of-the-art Review

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Abstract

Sleep disruption in persons with dementia is pervasive and contributes to negative health outcomes and decreased quality of life. Using Lawton's framework for quality of life in persons with dementia, the aim of this state-of-the-art review was to synthesize current knowledge on the association between sleep disruption and quality of life in persons with dementia in four domains: physical, social/behavioral, emotional well-being, and cognitive. Based on the final sample of six studies, sleep disruption was negatively associated with all four quality of life domains in persons with dementia. Given the variations in research design, measurement and sample size, conclusions could not be generated on the magnitude of the effects by domain. We do, however, provide recommendations for future research and clinical practice.

Keywords

sleep disruption; Alzheimer's disease; dementia; cognitive impairment; quality of life

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Introduction

Over 6 million people are estimated to be living with dementia in the US, a number expected to reach close to 15 million by 2060.[1,2] At present, approximately 15 million family caregivers provide unpaid care to persons with dementia.[2] Sleep disruption affects approximately 60–70% of older adults with dementia [3] and varies by dementia subtype. [4] For example, people with Lewy body dementia and Parkinson's disease dementia have the highest prevalence (90%) of sleep disruption and 25–60% older adults with Alzheimer's Disease (AD) have sleep disruptions or abnormal circadian rhythms. [5] The shifting population demographics coupled with the high prevalence of sleep disruption in dementia may precipitate significant burden for families, caregivers, and the healthcare system.

Sleep disruption includes poor sleep efficiency and increased night awakenings. Sleep efficiency (defined as the percentage of time in bed actually asleep) in persons with dementia is severely impaired, [6] driven primarily by frequent night awakenings and complicated by nocturnal restlessness. [7] Multiple factors contribute to sleep disruption in dementia, including degeneration of neural pathways responsible for sleep-wake function and presence of psychiatric and medical co-morbidities. [8] Additionally, physiological changes associated with aging, pathophysiological changes that accompany dementia, and subsequent environmental changes may also contribute to sleep disruption. [9] For example, decreased exposure to daytime light [10] and increased exposure to nighttime noise and light [11] can contribute to disrupted sleep. Furthermore, persons with dementia experience increased daytime sleepiness and tend to nap or doze during the day which may contribute to night awakenings.[12] In persons with dementia, lack of sleep at night is often associated with daytime behavioral symptoms, which may in turn affect their quality of life (QOL).[13] Current accelerometer-based sleep measures (e.g actigraphy) in older adults tend to assess sleep using the mean of sleep variables from 7 to 14 consecutive nights. However, night to night sleep variability and how variability affects older adults with dementia's daytime function has been often overlooked in the previous literature.[14]

Previous evidence suggests a link between sleep disruption and health outcomes in persons with dementia. For example, untreated sleep disruption is associated with increased rates of neuropsychiatric symptoms, daytime napping, 'sundowning' behaviors, functional decline, morbidity, and mortality. [12,15] Older adults with sleep disruption are more likely to experience greater cognitive decline compared to adults without sleep disruption, although the direction of the relationship is still unclear. [16] Furthermore, sleep disruption is a major predictor for institutionalization [17] and caregiver burden. [18] Additionally, sleep disruption as a result of sleep disorders contributes to increased healthcare utilization,[19] is associated with multiple chronic conditions (such as depression and heart disease),[20] increased caregiver distress[21] and dementia-related costs.[22] While common and distressing, there is no existing review paper that summarizes how sleep disruption influences qualify of life (QOL) for persons with dementia.

M. Powell Lawton's QOL framework provides a useful way to examine quality of life domains most pertinent in older adults with dementia. Lawton [23] defined quality of life as "the multidimensional evaluation, by both intrapersonal and social-normative criteria, of the

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person–environment system of the individual" (p. 6). Inherent in most conceptualizations of quality of life in dementia is agreement that QOL is a multidimensional construct representing four domains: (1) Physical functioning: defined as the ability to perform basic physical activities of daily life (ADLS) and instrumental activities of daily living (IADLs), discretionary activities and symptoms of physical discomfort; (2) Social/behavioral functioning: defined as the ability to participate in social relationships, and the manifestations of behavioral symptoms influencing social relationships (e.g. neuropsychiatric symptoms); (3) Emotional well-being: defined as the positive and negative emotional/affective states and (4) Cognitive function encompass reasoning, memory, attention, that leads to the attainment of information. [23] Lawton advanced the notion that QOL has both an objective component (what the person experiences and does) and a subjective one (how the person feels about it). In his model, Lawton emphasized the positive qualities of life that constitute QOL and the lack of theory and empirical research in this area. He concluded that QOL would best be assessed from multiple perspective, consistent with the 1948 World Health Organization QOL definition. Behavioral symptoms and associated disability in persons with dementia may partially contribute to decreased QOL, but do not represent the complete multidimensional view of QOL according to M. Powell Lawton. These symptoms are often described as a manifestation of the disease, rather than aspects directly related to QOL. As such, this review fills the gap between the growing recognition of sleep disruption and its relationship with four QOL domains in persons with dementia.

The purpose of this review was to provide an overview of the association between sleep disruption and QOL in older adults with dementia using Lawton's guiding framework. A secondary aim was to identify future directions for research and clinical practice. [24]

Material and Methods

We conducted a state-of-the-art review on research published on sleep disruption and QOL for persons with dementia since January 2004 through June 2017.[24] A search for evidence-based studies was completed in several electronic databases: PubMed, CINAHL, PsycINFO, EMBASE, ProQuest, and Google Scholar. Search terms included common terms for sleep disruption and dementia – ("dyssomnias" or "sleep disruption" or "sleep disorder") and ("Lewy Body disease" or "dementia" OR "amnestic, cognitive disorders" or "frontotemporal dementia" or "Alzheimer's disease" or "cognitive impairment") and ("quality of life" OR "daily life"). We included both descriptive and experimental design studies that: 1) reported on the relationship between sleep and QOL, and 2) included people with dementia living in the community. The exclusion criteria were as follows: 1) studies that focused on sleep disruption as a risk factor for dementia, and 2) studies that did not report QOL domains as outcomes for persons with dementia. Of the 533 papers reviewed in the first round by two researchers independently (LC, AB), 512 were excluded for the following reasons: studies of sleep disruption as a risk factor for dementia (n=313), did not report QOL domains as outcomes for persons with dementia (n=199). A third researcher settled all disagreements between the two researchers in the first round of review (NH). The remaining twenty-one papers were retained for full review. All members of the research team agreed on the final

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study selection. After applying our inclusion and exclusion criteria, the final analysis includes six original studies (Table 1).

Results

Based on the final sample of six studies, sleep disruption was negatively associated with all four QOL domains in persons with dementia: physical function, social/behavioral function, emotional well-being, and cognitive function. We organize, present and synthesize our findings following M. Lawton's QOL framework.

Physical Functioning

The studies included in our review suggest that sleep disruption is associated with various aspects of physical functioning. In one study, Ownby and colleagues applied latent class analysis to determine three distinct subtypes of sleep disruption (normal, moderate and severe) in 344 older adults with AD based off caregiver reported sleep problems on a standard clinic questionnaire. [25] Those with moderate and severe sleep disruptions had significantly lower scores on the Blessed Dementia Rating Scale than those with no sleep disruptions (mean scores normal 4.3, moderate 6.9, severe 8.1 [$p<0.001$]). [25] These results suggest those with sleep disruptions were less able to perform key self-care skills independently. [25] In McCurry's study of 46 persons with AD, participants with higher objective sleep efficiency derived from one week of wrist actigraphy monitoring had less physical impairments based off the SF-36 physical functioning subscale ($F[1,40]= 6.11$, $p= 0.018$) and better IADL functioning on the Physical Self Maintenance and Instrumental Activities of Daily Living Scales ($F[1,40] = 6.26$, $p=0.017$). [26] In addition to nocturnal sleep disruption, the timing of sleep was shown to impact QOL. Gehrman and colleagues reported that acrophase deviation (χ^2 (1) = 9.01, $p=0.003$) and beta parameter (χ^2 (1) = 4.88, $p =0.027$), based off 72 hours of continuous actigraphy monitoring, were associated with shorter survival time. [27] Therefore, participants with a sleep timing closer to that of patients without dementia had longer survival times (smallest [10^{th} percentile] deviation from normal had survival mean of 2.7 ± 2.7 years; largest deviation [10^{th} percentile] deviation from normal had survival mean of 2.2 ± 1.7 years). Thus, sleep disruption and disrupted circadian rhythms affect day-to-day physical functioning and even survival rates in persons with dementia.

Social/Behavioral Functioning

Disruptive sleep poses a threat to sustaining social relationships in persons with dementia. A study published by Moran and colleagues [28] suggested that daytime behavioral disturbances, assessed using the BEHAVE-AD, were associated with poor sleep among a sample of 215 older adults attending a memory clinic. [28] In addition, insomnia was found to perpetuate aggressiveness and effectively managing insomnia was shown to postpone institutionalization, [29] which is often desirable for families. Aggression was associated with increased rates of institutionalization due to caregiver burden. [30] Suitable management of daytime behavioral disturbances and/or sleep disruption may prove highly beneficial in persons with dementia and their relationships with their caregivers.

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Emotional Well-being

Previous research explored the link between sleep disruption and the emotional well-being in persons with dementia and their caregivers. Several studies focused on the relationship between sleep disruption and depression. For example, higher depression levels in older adults with dementia (β=0.08, p=0.01) and their caregivers (β=0.06, p=0.007) were associated with moderate sleep problems in older adults with dementia in a study by Ownby and colleagues. [25] Furthermore, higher caregiver depression was associated with severe sleep problems in older adults with dementia (β=0.09, p<0.001). [25] In McCurry's study in a sample of 46 older adults with AD and their caregivers, participants with better sleep efficiency had lower levels of depression (F [1,21] = 4.60, p= 0.044) and greater QOL (F [1,24] = 7.18, p= 0.013). [26] In a separate study, having any sleep disorder was associated with depression (p=0.003) and anxiety (p=0.02) in 151 community-dwelling older adults with dementia. [31] In addition, sleep disruption was associated with apathy/indifference in a sample of 63 older adults with AD (r=0.382, p<0.01). [32] In a multiple regression analysis controlling for age and education, sleep disruption predicted apathy/indifference (β=0.218, p=0.002). [32] Taken together, sleep disruption is associated with depression, anxiety and apathy symptomatology in older adults with dementia and their caregivers.

Cognitive Functioning

Evidence suggests that disturbed sleep, such as longer sleep duration and excessive daytime sleepiness, could be an early sign or independent risk factor of dementia, especially for people at risk for developing dementia. [33,34] Disturbed sleep may be associated with overall cognitive function as measured by Mini-Mental Status Examination (MMSE). For example, in a study of 46 older adults with AD, McCurry et al. reported better actigraphically derived sleep efficiency was associated with a better MMSE score (F [1,39] = 5.26, p=0.027). [26] Significant negative associations between sleep and MMSE score were found in the bivariate analysis of a sample of 334 older adults with AD. However, the associations were no longer significant after adjusting for participants' mood and functional status. [25] Only one study examined the associations between sleep and subdomains of cognitive function in a sample of 63 AD patients from South Korea. [32] The researchers reported that, independent of age and education, self-reported shorter sleep latency (β=−0.008, p=0.041), longer sleep duration (β=0.003, p=0.034) and higher sleep efficiency (β=0.026, p=0.026) were related to better praxis; and sleep latency was also negatively associated immediate recall (β= −0.029, p=0.041) and recognition (β= −0.025, p=0.008). [32] Overall, sleep disruption is associated with various aspects of poor cognition, but the evidence is limited in persons with dementia.

We observed several limitations in the selected studies, which makes it difficult to compare across samples and have confidence regarding the validity of the results. For example, included studies used small, convenience samples recruited from the community, which encompassed nursing homes, memory clinics and individuals living at home (N ranged from 46–571). Additionally, selected studies used various tools to collect information on sleep disruption, included individuals of variable age, and did not control for many confounding variables (such as comorbidity, current medications and pain).

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Discussion

In this state-of-the-art review, six studies met our inclusion criteria to examine the relationship between sleep disruption and QOL in persons with dementia. Sleep disruption was associated with negative effects in all four domains of quality of life: physical, social/behavioral, emotional well-being, and cognitive function. Sleep disruption was associated with poor physical function and shorter survival; increased behavioral symptoms; increased depression, anxiety, apathy, agitation and aggressiveness; and worse cognitive function including executive function and verbal memory.

This current review presents findings that are aligned with previous reviews, such that disturbed sleep is associated with negative health outcomes in persons with dementia. [33] The unique contribution of our work is that we provide the first overview of how sleep disruptions affect QOL domains in people with dementia by synthesizing current evidence based on Lawton's QOL framework. We examined the associations between sleep disruption and four essential dimensions of health that are particularly relevant to the QOL in people with dementia.

Sleep disruption had a negative impact on physical functioning in persons with dementia in the domains of key self-care skills and instrumental activities of daily living. Furthermore, higher sleep disruption was associated with shorter survival rates in this population. Similarly, sleep disruption was negatively correlated with social/behavioral functioning particularly in the increased risk for behavioral symptoms of dementia (i.e. aggression). In addition, sleep disruption was associated with increased levels of depression, anxiety, and apathy/indifference in older adults with dementia, thus having a negative impact on their emotional well-being. For the cognitive QOL domain, sleep disruption was inversely correlated with cognition in older adults with dementia. According to M. Powell Lawton, QOL encompasses a multidimensional view and includes both positive and negative aspects of life. As evidenced by this review, most of the emphasis in the literature has been on the negative aspects of life (such as depression, anxiety, aggression) often ignoring the positive aspects of life (such as positive affect, resilience, adversity). Future inquiries need to include qualitative and mixed-methods approaches to understanding the relationship between sleep disruption and positive and negative aspects of QOL in persons with dementia and their caregivers. Furthermore, using M. Powell Lawton's QOL framework will not only contribute to our understanding of QOL issues related to sleep disruption, but also help focus future studies on the areas of life that matter most to persons with dementia and their caregivers.

There are a few plausible explanations for the findings related to the complex relationship among sleep disruption and physical function presented in this review. First, the accuracy of caregiver reported sleep disruption in persons with dementia may be affected by caregiver characteristics such as physical and mental health, caregiver burden, and caregiver sleep problems. [25,26] It is possible that the caregivers who reported poor sleep in persons with dementia were the same caregivers who reported poorer functional status, thus biasing their responses. In other words, the caregivers who themselves were the most stressed or had the most health problems, may have rated the care receiver's sleep and physical function the worst. Furthermore, poor sleep in caregivers may have substantial impact on the person with

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dementia. [35] Another explanation could be the lack of inclusion of unexplored confounding variables that also affect sleep such as medications and issues related to sleep hygiene (e.g., caffeine). We must also consider the reciprocal nature of our findings. For instance, persons with disrupted sleep and circadian rhythms may have additional physical ailments which could impact both sleep and survival. [27] It is also plausible that functional status represents progression of AD, which is known to be associated with increased prevalence of sleep problems. [25]

The underlying mechanisms between sleep disruption and the negative consequences of sleep disruption on emotional and social domains of QOL remain poorly understood. Kales, Gitlin, Lyketsos [36] proposed that a combination of patient, caregiver and environmental factors in addition to the neurodegeneration associated with dementia contribute to increased vulnerability to stress resulting in behavioral and psychological symptoms of dementia. The disruption of brain neurocircuitry [36] may result in sleep disruption, thus increasing the risk for diminished QOL in emotional and social domains. Furthermore, the use of commonly prescribed medications in AD is associated with sleep disruption and behavioral disturbances. For example, previous research linked the use of acetylcholinesterase inhibitors (i.e. donepezil) with nighttime stimulation and dream disturbances. [37] Atypical antipsychotic medications (i.e. olanzapine and risperidone) have been associated with daytime fatigue and drowsiness. [37]

Many possible mechanisms underlying the association between poor sleep and cognitive decline have been proposed. First, recent studies suggest a bidirectional association between poor sleep and β-amyloid accumulation, which is widely viewed as a causal factor in the development of Alzheimer's disease. [38] Sleep disruption may increase β-amyloid burden in older adults, which in turn can contribute to increased wakefulness and disturbed sleep patterns. [39] Second, sleep disruption has been associated with increased neuroinflammation and disrupted neurogenesis, which could result in neurodegeneration. [38] In addition, the hypoxia and sleep fragmentation may contribute to impaired cognition in older adults with sleep-disordered breathing. [40] Sleep disruptions such as sleep-disordered breathing and insomnia, which are frequent in persons with dementia, may adversely affect cognitive function and daytime performance [29] and may accelerate cognitive decline in persons with dementia. [30] Furthermore, studies suggest that circadian rhythm disruptions and dysregulation may affect hippocampal function and impair learning and memory. [38,41]

Limitations

The studies reviewed have several limitations. Given the variations in research design, measurement and sample size, conclusions could not be generated on the magnitude of the effects by domain, as multiple measures were utilized between studies - many of which had a small sample size. Small, convenience samples drawn from the memory clinic, nursing homes and homes in the community are often heterogeneous in terms of age, education, socioeconomic status and sleep patterns. For example, sleep patterns of residents in a nursing home are often driven by the set schedule, whereas sleep patterns of older adults with dementia living at home may be driven by their daily routines and their caregivers. The heterogeneity of the samples may lead to invalid conclusions and low statistical power. The

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interpretation of these findings is limited by the cross-sectional design, using self or caregiver reported sleep measures and the lack of inclusion of possible confounding variables. Lack of consensus on the participant inclusion/exclusion criteria among the studies also made comparison difficult. Additional limitations include lack of the relationship between sleep disruption and caregiver's QOL as well as lack of consensus of the mechanism underlying the link between sleep disruption and QOL in persons with dementia.

Future Directions for Research

Our review suggests the need for future research in this area. Most importantly, given the influence of sleep disruption on QOL domains, we need more accurate and valid ways to assess sleep and sleep quality in persons with dementia. Objective sleep measures need to be unobtrusive for people with dementia to decrease the risk of removal while accurately reflecting daytime changes in sleep and wake activity. Limitations in the most widely used longitudinal objective sleep measure, actigraphy, include the inability to differentiate sleep versus rest and the reliance on often incomplete sleep diaries for hand scoring. One potential suggestion to improve objective monitoring is to have people concurrently complete a tablet-based sleep diary that generates real-time data. This offers the opportunity for researchers to contact people the next day if they have not filled in diary information (memory impairment often precludes diary completion) and therefore gain more accurate estimates of prospective sleep measures. Second, we can consider using light weighted devices that have sensors (such as heart rate, body temperature) in addition to accelerometer and light sensors, which could potentially add more accuracy to sleep analysis than accelerometer only. Another option is to develop and validate a sleep algorithm for wearing the actigraph on patient's ankle, which could be more invisible and less irritating for patients with dementia. It is critical that future investigators examine the effects of poor sleep on global QOL, in addition to each specific domain. Lastly, given that sleep is modifiable, we need more interventional studies with non-pharmacological approaches to improve sleep and QOL in persons with dementia.

Future Considerations for Clinical Practice

Given the strong associations between sleep disruption and QOL, clinicians should include sleep assessment as part of their physical and psychological evaluation. Doing so may provide a more comprehensive picture of the patient's environment and the potential factors related to poor QOL. In addition, nurses should be aware of how disruption affects caregivers. Lastly, clinicians should be aware of the current non-pharmacological approaches shown to be effective in improving sleep disruption, while noting the limitations of the current knowledge in the use of these approaches in this population.

Conclusion

Sleep disruption is pervasive and disturbing in persons with dementia. Sleep disruption has negative consequences on health and QOL in this population. It is critical for nurses to understand sleep disruption in persons with dementia and the ultimate negative impact it has

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on quality of life. Nurses are ideally positioned to assess and intervene on disrupted sleep given that they monitor health and wellbeing of older adults with dementia at various points of care. Nurses understand the biopsychosocial influences on sleep; therefore, they are optimally positioned to help improve sleep in older adults with dementia.

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Table 1

Summary of studies examining the association between sleep disruption and quality of life in persons with dementia

First author(s), year, country	Sample	Sleep assessment	Quality of life measure(s)	Quality of life domain(s)	Results
Shin, H-Y, 2014, South Korea [32]	N=117 63 AD patients & 54 age- and sex-matched cognitively normal elderly from a memory clinic	PSQI-K	**1** Cognitive function (K-BNT; ideomotor praxis; RCFT; SVLT; COWAT; Stroop test, MMSE **2** Depression (GDS) **3** Behavioral symptoms **4** Activities of daily living (B-ADL; SI-ADL	Physical Social Physiological/Emotional Cognitive	Sleep efficiency was positively associated with cognition (K- BNT, praxis and RCFT). Sleep latency was associated with praxis, immediate recall and recognition of the RCFT.
Ownby, R.L., 2014, United States [25]	N=344 344 older adults with dementia from a memory clinic	Investigator created sleep questionnaire	**1** Cognition (MMSE) **2** Functional status (BDS) **3** Depression (CSDD) **4** Caregiver mood (CES-D) **5** Behavioral disturbances	Cognitive Social Physiological/Emotional	Sleep disruption is associated with cognition, functional status, and depression (both in person with dementia and his/her caregiver)
McCurry, S.M., 2006, United States [26]	N=46 Older adults with probable or possible Alzheimer's disease from the community	NPI-NBS 1 week of actigraphy (percent nighttime sleep and nocturnal sleep) ESS PSQI	**1** Depression (GDS, CSDD) **2** Quality of life (QOL-AD) **3** Behavioral disturbances (RMBPC) **4** Physical function (PSM, IADL) **5** Health Status (SF-36) **6** 6. Cognition (MMSE)	Physical Social Physiological/Emotional Cognition	Higher percent sleep was associated with better patient scores on the SF-36 physical functioning subscale, higher cognition, better IADL functioning, and less daytime sleepiness reported by caregivers on the ESS. Higher percent sleep was also associated with lower depression.
Moran, M. (2005), Ireland [28]	N=224 55 persons diagnosed with probable Alzheimer's disease at a memory clinic reported sleep disturbance, 169 – did not.	BEHAVE-AD	**1** Daytime behavioral disturbances (BEHAVE-AD, global rating) **2** Cognition (MMSE; CAMCOG) **3** Function (BDS; IADL)	Social Physiological/Emotional Cognitive Physical	Sleep disruptions were strongly associated with aggressiveness (including symptoms such as verbal outbursts, physical threats, and agitation) and global rating.
Gehrman, P., 2004, United States [27]	N=149 Older adults with dementia living in nursing homes	Actigraphy (acrophase deviation and beta parameter)	**1** Survival (public death records)	Physical	Lower acrophase deviation and higher beta parameter were associated with longer survival times.
Rongve, A., 2010, Norway and United States [31]	N=571 151 community- dwelling western Norway residents with dementia and 420	NPI; ESS; MSQ	**1** Behavioral disturbances (NPI) **2** Depression (MADRS)	Social Physiological/Emotional	Sleep disruption was associated with greater depression, anxiety and higher total NPI score.

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First author(s), year, country	Sample	Sleep assessment	Quality of life measure(s)	Quality of life domain(s)	Results
	participants without dementia from the Mayo Clinic Study of Aging		**3** Apathy (Starkstein apathy scale) **4** Parkinsonism (UPDRS) **5** Cognition (CACF or MFS)		

Abbreviations: B-ADL - Barthel Activities of Daily Living; BDS - Blessed Dementia Scale; CACF – Clinician Assessment of Cognitive Fluctuations; CAMCOG - Cambridge Examination for Mental Disorders of the Elderly; CES-D - Center for Epidemiological Studies Depression Scale; COWAT - Controlled Oral Word Association test; CSDD - Cornell Scale for Depression in Dementia; DBRS - Disruptive Behavior Rating Scale; ESS - Epworth Sleepiness Scale; GDS - Geriatric Depression Scale; IADL – Instrumental Activities of Daily Living; K-BNT - Boston Naming Test in Korean; MADRS – Montgomery-Asberg Depression Rating Scale; MFS – Mayo Fluctuation Scale; MMSE - Mini Mental Status Exam; MSQ - The Mayo Sleep Questionnaire; NPI - Neuropsychiatric Inventory; NPI-K- Neuropsychiatric Inventory in Korean; NPI-NBS - Neuropsychiatric Inventory Nighttime Behavior Scale; PSQI - Pittsburgh Sleep Quality Index; PSQI-K - Korean version of the Pittsburgh Sleep Quality Index; PSM – Physical Self-Maintenance; RAGE - Rating Scale for Aggressive Behavior in the Elderly; RCFT - Rey-Osterrieth Complex Figure Test; RMBPC - Revised Memory and Behavior Problems Checklist; SI-ADL - Seoul-Instrumental Activities of Daily Living Scale; SF-36 Health Status Survey; SVLT - Seoul Verbal Learning Test; UPDRS - Unified Parkinson's Disease Rating Scale.

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