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Sleep quality and medication management in family caregivers of community-dwelling persons with memory loss

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1. Introduction

In the United States, approximately 34 million family caregivers are providing care to someone aged 50 years or older, and 29% of these caregivers report that their family member has a memory problem (Hunt & Reinhard, 2015). Caregivers of persons with memory impairment often report sleep problems. A review study found that 50%–74% of caregivers for people with dementia experience sleep disturbance with reported sleep durations ranging from 5.4 to 7.3 h during a 24-hour period, which is less than recommended for adults (Peng & Chang, 2013). Also, caregivers of older adults with dementia commonly report poor sleep quality, greater daytime sleepiness, and greater fatigue than their non-caregiving peers (Rowe, McCrae, Campbell, Benito, & Cheng, 2008). For many caregivers, a poor night's sleep occurs as a result of the care recipient's disturbed sleep, vigilance about that person's needs or activities, and worries about caregiving tasks and the future (McCurry, Logsdon, Teri, & Vitiello, 2007; Simpson & Carter, 2013). Additionally, sleep in caregivers who are themselves older adults may be affected by their own health issues such as pain and sleep-disordered breathings (Crowley, 2011; Dikeos & Georgantopoulos, 2011).

The poor sleep of caregivers may negatively impact their ability to effectively perform complex daily tasks. Riegel and Weaver (2009) proposed a model illustrating how poor sleep may link to poor self-care behaviors and outcomes in adults with heart failure. The model posits that poor sleep is associated with daytime sleepiness, deficits in attention, and impairments in working memory and higher-order cognitive functions which may compromise self-care management. Similarly, Chasens, Korytkowski, Sereika, and Burke (2013) found that in their sample of 107 patients with type 2 diabetes, poor sleep and daytime sleepiness were associated with decreased compliance with self-care behaviors (e.g., medication) needed for diabetes management.

Quite often family caregivers have considerable responsibility for managing medications for older adults, especially for those who have declining cognitive function (Reinhard, Levine, & Samis, 2012). Managing medication regimens for this population of older adults is complicated and requires physical and cognitive efforts to comprehend information, organize and track medications, assist with administering medications, obtain timely prescription refills, and ensure the safety of the medication regimen (Look & Stone, 2017). This intricate medication management process and the cognitive effort required for care may be negatively impacted by poor sleep quality of caregivers.

To date, little is known about how sleep quality affects caregiving tasks, particularly medication management for persons with memory loss. Therefore, the purpose of this secondary analysis was to examine the association between caregivers' sleep quality and medication management. We hypothesized that good sleep quality of caregivers will be associated with better medication management by these individuals for persons with memory loss who reside in the community.

2. Method

This secondary analysis used baseline data from a 6-month randomized controlled trial (RCT) to examine the association between caregiver sleep quality and medication management. The purpose of the parent RCT was to test the efficacy of a problem-solving intervention to improve medication management provided by caregivers of community-dwelling persons with memory loss. Data from the 91 dyads was collected at four time points at 8-week intervals; only data at baseline from the caregivers and care recipients were used for the current study. Baseline data of caregivers was collected through interviews by research staff at the care recipient's home. Also, caregivers were asked to complete an additional set of questionnaires during the following week and to return the questionnaire packet by postal mail to the research office. Details of the parent RCT protocol have been described previously (Erlen et al., 2013; Lingler et al., 2016). The parent study was approved by the Institutional Review Board of [name deleted to maintain the integrity of the review process]. Prior to the start of the study, informed consent was provided by all caregivers; care recipients provided either informed consent or assent.

2.1. Sample

Persons with memory loss and their informal caregiver were recruited as a dyad from the community and a National Institute on

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Aging-funded Alzheimer Disease Research Center in the greater Pittsburgh area and through the use of flyers and purchased caregiver mailing lists. Eligible caregivers were family members or kin-like friends, aged 18 years and older, who managed medications for their care recipient. Care recipients were included if they had memory loss as self-reported by themselves or their caregivers.

2.2. Measure

The measures used in this secondary analysis included the University of Pittsburgh Center for Research in Chronic Disorders (CRCD) socio-demographic questionnaire (Sereika & Engberg, 2006) and a study-specific health information form assessing years of caregiving and number of medications managed for care recipients. The caregiver's number and type of comorbidities were assessed using the (CRCD) Comorbidity Questionnaire. The Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) was used to assess the care recipient's level of cognitive function at the time of entry into the study.

The Pittsburgh Sleep Quality Index (PSQI) was used to assess the caregiver's self-reported sleep quality. The PSQI refers to the previous 1-month interval and consists of seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, sleep medication use, and daytime dysfunction. Each component is scored on a 0–3 scale with higher scores indicating greater difficulty or a more negative response. The sum of the component scores yields a global sleep quality score ranging from 0 to 21. A score of 5 or greater indicates poor sleep quality. The PSQI has demonstrated good internal consistency (Cronbach's alpha = 0.83) and adequate validity to accurately distinguish individuals with or without depression (97%) and sleep disorders (84%–88%) in a community sample of 148 older adults (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). For the current study, the internal consistency based on Cronbach's alpha was 0.72. Additionally, the PSQI yields the number of hours slept, a ratio level self-report.

Medication management was assessed using three self-report instruments. The Medication Management Instrument for Deficiencies in the Elderly (MedMaIDE) assesses three important areas: knowledge of medications, how to take medications, and medication procurement (Orwig, Brandt, & Gruber-Baldini, 2006). Total deficiency scores range from 0 to 13 with higher scores suggesting more deficiencies across medications. Internal consistency of the MedMaIDE based on Cronbach's alpha is reported as 0.71 in a community sample of 50 older adults with good test-retest reliability (intra-class correlation coefficient [ICC] = 0.93). Validity was evidenced by a 75% agreement of the MedMaIDE deficiency scores with the 30-day pill count compliance.

The MedMaIDE was supplemented by the investigator-developed Medication Deficiency Checklist (MDC) to assess specific self-reported deficiencies in medication administration (e.g., forgetting to administer, repeating doses). The MDC has 15 items with response options of Yes (1) or No (0) with higher sum scores indicating more deficiencies. Internal consistency based on Cronbach's alpha was 0.40 for the current study.

The 4-item Morisky, Green, and Levine medication adherence scale (MGL) was adapted for our caregiver population to assess their behaviors associated with their adherence for the care recipient's medication (e.g., stop taking medication when feeling better, ever forget to take medication, etc.). Using a Yes (0)-No (1) response format, the total score on the MGL can range from 0 to 4, with 4 indicating high adherence. The internal consistency based on Cronbach's alpha has been reported as 0.61 for this measure (Morisky, Green, & Levine, 1986), while for the current study, the internal consistency was 0.51.

2.3. Statistical analysis

Analyses were conducted using SPSS for Windows (version 24, IBM Corp., Armonk, NY). The significance level of 0.05 was set a priori for two-sided hypothesis testing. Data were screened for the amount and pattern of missing data, univariate and bivariate distributions (i.e., normality), and the presence of outliers. The assessment of missing data revealed that eight caregivers did not return the baseline questionnaire packet, and one additional caregiver completed only half of the questionnaire packet, resulting in missing data for the PSQI global sleep quality and component scores (n = 9) and the MGL (n = 8). A comparison of baseline characteristics was performed between caregivers with (n = 9) and without missing data (n = 82) and no significant differences were evident, suggesting that our 82 caregivers with complete data were representative of the full sample. Various approaches were considered to handle the missing data in the analyses, including more ad hoc (listwise deletion, pairwise deletion) and model-based approaches for single imputation (stochastic regression, EM algorithm) and multiple imputations. Multiple imputation was implemented with 20 imputations, with the results of the analyses conducted for each 20 completed datasets aggregated to yield pooled statistics. Additionally, the preliminary investigation of the data revealed a negatively skewed distribution for the MGL and a positively skewed distribution for the seven PSQI components.

Descriptive statistics were reported as the mean and standard deviation for continuous variables, the median and inter-quartile range for ordinal variables and non-normally distributed continuous variables, and frequencies and percentages for nominal variables. To examine the association between sleep quality and medication management, either Pearson product-moment or Spearman rank-order correlations was used. As the results were similar regardless of the strategy used to handle missing data, only the pooled descriptive statistics and correlations from the 91 caregivers where missing data were imputed via multiple imputations are reported for analyses involving the primary study variables of sleep quality and medication management.

3. Results

3.1. Sample characteristics

Descriptive statistics of the characteristics of the caregivers and care recipients are presented in Table 1. The sample of 91 caregivers was primarily white (84.6%) and female (70.3%) and were on average 67.0 (SD 12.2) years of age. Most caregivers (87%) resided in the same household as the care recipient (Tang, Jang, Lingler, Tamres, & Erlen, 2015), and over half of the caregivers (57.1%) were caring for their spouse. Care recipients were on average 80.1 (SD 8.5) years old with an MMSE score of 17.6 (SD 7.6) as indicated in our previous paper (Erlen et al., 2013). Caregivers had a mean 5.5 (SD 9.2, range 1–60) years of experience with medication management; two caregivers reported managing their husband's medications for 60 years as they assumed this responsibility following their marriage. The average number of medications managed by caregivers was 10.5 (SD 5.3, range 1–30).

A previously published abstract has reported on selected sleep components (Erlen, Houze, Lingler, & Walker, 2016). Table 2 presents the descriptive statistics characterizing the sleep quality and medication management of the caregivers. The average PSQI global score was 7.69 (SD 4.08); 62 (68.1%) caregivers had a score of 5 or higher, indicating poor sleep quality among these caregivers. Caregivers reported sleeping for 6.7 (SD 1.6) hours per night. No differences in any of the sleep components were observed between female and male caregivers. Responses to symptom items on the (CRCD) comorbidity questionnaire indicated that 47 caregivers (51.6%) had frequent sleep problems; approximately half of these caregivers (n = 24, 51.1%) noted that sleep problems had negatively impacted them in the past six months. Additionally, many caregivers reported that they were diagnosed by a healthcare provider as having high blood pressure (n = 52, 57.1%), arthritis or rheumatic disease (n = 43, 47.3%), lung or breathing

Table 1
Descriptive statistics for the characteristics of the caregivers and care recipients.

Characteristic	Caregivers (n = 91)	Care recipients (n = 91)
	n (%)	n (%)
Race		
White	77 (84.6%)	80 (87.0%)
Black	9 (9.9%)	9 (9.8%)
Other	5 (5.5%)	2 (2.2%)
Gender		
Female	64 (70.3%)	54 (58.7%)
Male	27 (29.7%)	37 (40.2%)
Relationship to patient		
Spouse	52 (57.1%)	N/A
Child	35 (28.5%)	N/A
Other	4 (4.4%)	N/A

Characteristic	Caregivers (n = 91)	Care recipients (n = 91)
	Mean (SD)	Mean (SD)
Age, years	67.0 (12.2)	80.1 (8.5)
Education, years	14.9 (3.3)	13.1 (3.0)
Patient medications managed, number	10.5 (5.3)	N/A
Duration of managing medications, years	5.5 (8.9)	N/A

Note. N/A = Not assessed.

Table 2
Descriptive statistics for self-reported caregiver sleep quality (PSQI) and medication management.

Study variable	Mean ± SD Median (IQR)	Observed range
Global PSQI score	7.69 ± 4.08	1–17
Sleep duration	1.00 (2.00)	0–3
Perceived sleep quality	1.00 (1.00)	0–3
Sleep latency	1.00 (1.15)	0–3
Sleep efficiency	0.14 (1.14)	0–3
Sleep disturbance	1.95 (1.14)	1–3
Daytime dysfunction	1.00 (0.05)	0–3
Sleep medication use	0.00 (1.00)	0–3
Sleep duration, hours	6.74 ± 1.60	1–10
Medication management		
MedMaIDE	0.98 ± 0.76	0–3
MGL	4.00 (0.76)	1–4
MDC	2.91 ± 1.84	0–8

Note. PSQI = Pittsburgh Sleep Quality Index; MedMaIDE = Medication Management Instrument for Deficiencies in the Elderly; MDC = Medication Deficiency Checklist; MGL = 4-item Morisky, Gteen, Levine Adherence Measure.

disorder (n = 31, 34.1%), and diabetes (n = 21, 23.1%).

Caregivers in our study made few medication errors. As previously reported by Author and colleagues (Year), the average scores for the MedMaIDE and MDC were 0.98 (SD 0.76) and 2.91 (SD 1.84), respectively. Median medication adherence as measured by the MGL was 4.00 (IQR 0.76), with the majority of caregivers (84.6%) scoring either 3 or 4, suggesting overall good medication adherence among caregivers.

3.2. Association between sleep quality and medication management

We observed that as sleep duration decreased, medication adherence as assessed by the MGL also decreased. Also, we observed that decreased caregiver sleep duration demonstrated a trend with greater medication deficiency (MedMaIDE) ($r = -0.181$, $p = 0.098$). We did not find statistically significant associations between the other sleep components (i.e., sleep quality, sleep latency, sleep efficiency, sleep disturbance, daytime dysfunction, and sleep medication use) and caregivers' medication management (Table 3).

Table 3
Association between sleep quality and medication management[a].

Factor	MedMaIDE (*p* value)	MGL(*p* value)	MDC (*p* value)
Global sleep quality	−0.049 (0.667)[b]	0.162 (0.152)	0.147 (0.171)[b]
Sleep duration	−0.181 (0.098)	0.265[*] (0.017)	−0.007 (0.947)
Sleep quality	−0.059 (0.596)	0.083 (0.479)	0.147 (0.177)
Sleep latency	−0.069 (0.541)	−0.009 (0.934)	0.123 (0.254)
Sleep efficiency	−0.053 (0.635)	0.090 (0.436)	0.092 (0.393)
Sleep disturbance	−0.004 (0.970)	0.098 (0.399)	0.130 (0.236)
Daytime dysfunction	−0.122 (0.273)	−0.011 (0.921)	0.051 (0.637)
Sleep medication use	0.091 (0.409)	0.024 (0.835)	−0.022 (0.839)
PSQI hours slept	0.159 (0.158)[b]	−0.254[*] (0.024)	−0.058 (0.592)[b]

Note. PSQI = Pittsburgh Sleep Quality Index; MedMaIDE = Medication Management Instrument for Deficiencies in the Elderly; MDC = Medication Deficiency Checklist; MGL = 4-item Morisky, Green, Levine Adherence Measure.

[a] Correlations were calculated using the Spearman's rank-order correlation unless otherwise indicated.

[b] Values were calculated based on the Pearson product-moment correlation.

[*] $p < 0.05$.

4. Discussion

This study examined the association between caregivers' sleep quality and medication management for older adults with memory loss. Overall, caregivers received an average of 6.7 h of sleep per night, which is similar to a previously reported 6.3 h of objectively measured sleep using actigraphs in family caregivers of older adults with memory impairment (Spira et al., 2010). Although caregivers reported sleeping nearly 7 h per night, the overall sleep quality was poor as evidenced by the average global PSQI score of 7. Poor sleep quality among caregivers was also shown by responses on the (CRCD) comorbid questionnaire. A large proportion of our sample reported having frequent sleep problems that negatively impacted them during the previous six months.

Overall, caregivers in our study performed well in managing care recipients' medications. This finding of few medication management errors or problems was consistent regardless of the medication management measure we used. The findings from the associations suggested that shorter sleep duration was associated with poorer medication adherence as measured by the MGL. Researchers examining the effects of sleep quality on factors associated with medication adherence have reported that in older adults, poor sleep quality contributes to increased daytime fatigue (McCurry et al., 2007) and deficits in attention (Martin, Sforza, Barthélémy, Thomas-Anterion, & Roche, 2012; Maurice & Vecchierini, 2002); these factors are predictors for medication nonadherence (Riegel et al., 2011; Stilley, Bender, Dunbar-Jacob, Sereika, & Ryan, 2010). Thus, it is conceivable that poor sleep quality as reported by caregivers in our study may have compromised their ability to manage medications for the care recipient.

Even though we found significant associations supporting our hypothesis, other factors affecting sleep may need to be addressed such as health problems of caregivers and behavioral problems of the care recipient. Responses to items on the (CRCD) comorbidity questionnaire indicated that half of the caregivers (n = 49, 53.8%) had frequently experienced joint pain over the previous six months, of which 31 (63.3%) caregivers indicated that they were negatively impacted by the pain. However, it remains unknown whether this pain affected their sleep quality. Furthermore, care recipients' behavioral and emotional problems, such as wandering at night, may also affect caregivers' sleep quality; but, these related issues were not assessed in this study.

5. Limitations

There were several limitations in this secondary analysis. First, given that cross-sectional data were used, these results do not allow us to make a causal inference regarding the association between sleep quality and medication management. Second, problems exist with the measures used in the study. We relied on self-reported measures of sleep quality and medication management by caregivers, which may have influenced our findings due to the possibility of recall bias. Moreover, two of the three self-reported medication management measures, the MGL and the MDC, may be unreliable for assessing adherence and deficiencies in medication management as they have only moderate internal consistency based on Cronbach's alpha. Third, we were unable to examine additional variables that may have been related to sleep quality and/or medication management because they were not included in the parent study. Also, the parent study only assessed nighttime sleep and did not assess daytime sleep. Lastly, we had a relatively small, homogeneous sample of caregivers (i.e., female and Caucasian) who reported an average of three medication management errors, which limits the generalizability of our findings.

6. Implications for research and practice

The findings of the study suggest important implications for research and clinical practice. To our knowledge, this is the first study that provides evidence for the association between sleep quality and medication management in informal caregivers of community-dwelling persons with memory loss. Among all components that comprised sleep quality in the PSQI questionnaire, we observed that only sleep duration was correlated with one of the medication management measures. However, we observed associations between poorer sleep and poorer medication management. In the future researchers need to examine the association longitudinally in larger and more diverse samples using objective sleep and medication management measures. There is also a need to investigate other factors that may influence caregivers' sleep, such as the sleeping environment and sleep-related health conditions. Studies in the future should also examine the impact of sleep on other caregiving tasks such as assistance with the care recipient's basic needs.

The associations we observed between sleep duration and medication management variables can be applied in multiple clinical contexts given the growing population of caregivers of older adults with memory related issues living in the community. Specifically, health care providers treating patients who were prescribed medications need to assess the caregiver's ability to manage the patient's medications and identify factors that may affect the caregiver's performance in managing the medications. Sleep quality needs to be more frequently assessed in clinical practice and factors contributing to poor sleep need to be evaluated such as the caregivers' physical health conditions and the care recipients' sleep habits. Likewise, the sleep habits of caregivers need to be addressed including naps and whether sleep occurs mainly at night or during the day.

Conflict of interest

Declarations of interest: none.

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