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Sleep and Physical Functioning in Family Caregivers of Older Adults with Memory Impairment

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Abstract

Background—Sleep disturbance is common in caregivers of older adults with memory disorders. Little is known, however, about the implications of caregivers' poor sleep with regard to their physical functioning.

Methods—In this cross-sectional study, we investigated the association between objectively measured sleep and self-reported physical functioning in 45 caregivers (mean age = 68.6 years) who completed the Beck Depression Inventory-II, the Medical Outcomes Study SF-36, and the Mini-Mental State Exam and wore an actigraph for at least three days. Our primary predictors were actigraphic sleep parameters, and our outcome was the SF-36 Physical Functioning subscale.

Results—In multivariate-adjusted linear regression analyses, each 30-min increase in caregivers' total sleep time was associated with a 2.2-point improvement in their Physical Functioning subscale scores (unstandardized regression coefficient (*B*) = 2.2, 95% confidence interval (CI) 1.0, 3.4, p = 0.001). In addition, each 10-min increase in time awake after initial sleep onset was associated with

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Conflict of interest declaration:

Adam Spira, Ph.D. is a member of the scientific advisory board of MDCI Automation. He received honoraria while serving as a clinical editor for the *International Journal of Sleep and Wakefulness—Primary Care*, which provides continuing medical education materials through pharmaceutical industry support.

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Description of authors' roles:

Adam P. Spira, Ph.D. developed the research question, and was involved in study design, data collection and analysis, and manuscript preparation.

Leah Friedman, Ph.D. was involved in formulating the research question, designing the study, carrying it out, and in manuscript preparation.

Sherry A. Beaudreau, Ph.D. assisted with manuscript preparation.

Sonia Ancoli-Israel, Ph.D. was involved in study design, data analysis, and manuscript preparation.

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Javaid Sheikh, MD helped design and carry out the parent study that yielded these data, and assisted with manuscript preparation.

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a 0.5-point decrease on the Physical Functioning subscale, although this was not statistically significant (B = -0.5, 95% CI -1.1, 0.1, p = 0.09).

Conclusions—Our findings suggest that shorter sleep duration is associated with worse self-reported physical functioning in caregivers. Longitudinal studies are needed to determine whether poor sleep predicts functional decline in caregivers.

Keywords

dementia; burden; insomnia

Introduction

Disturbed sleep is common among family caregivers of older adults with a memory disorder. Findings indicate that family caregivers of individuals with dementia report worse overall sleep quality than non-caregivers of a similar age (Wilcox and King, 1999), as well as shorter, less efficient, and more fragmented sleep than their non-caregiving peers (Rowe *et al.*, 2008). In addition, studies that have measured sleep by polysomnography have found that older caregivers of individuals with moderate or severe dementia sleep for a shorter duration than older non-caregivers (McKibbin *et al.*, 2005), and that the sleep of dementia family caregivers is comparable to that of non-caregivers of the same age reporting mild or moderate sleep disturbance (Castro *et al.*, 2009).

The caregiving role is often physically demanding, and to maintain caregivers' ability to provide care, it is important to identify modifiable risk factors for decline in their physical functioning. Preliminary findings indicate that poor sleep might be one of these risk factors. Self-reported poor sleep in older adults has been linked to impairment in physical functioning, as measured by the Medical Outcomes Study Short Form 36 (SF-36), and impairment in activities of daily living (ADLs), instrumental ADLs (IADLs) and ambulation (Byles *et al.*, 2003; Foley *et al.*, 1995; Motivala *et al.*, 2006; Newman *et al.*, 1997; Ware and Sherbourne, 1992). In addition, recent studies using *actigraphy*—an objective method of estimating sleep by recording movement (Ancoli-Israel *et al.*, 2003)—have found that poor sleep is associated with impaired IADLs and worse objectively measured neuromuscular performance (e.g., gait speed) in the general population of community-dwelling older adults (Dam *et al.*, 2008; Goldman *et al.*, 2007).

Given that many caregivers are older, and that sleep disturbance is common among caregivers, these links between poor sleep and poorer functioning in older adults could have important implications for the growing population of caregivers. Nonetheless, little is known about the association between sleep disturbance and physical function in family caregivers of older individuals with cognitive impairment. A recent study by Creese *et al.* (2008) found a modest, non-significant association between worse self-reported sleep quality and the Physical Health component of the SF-12 in this population (Ware *et al.*, 1996). Although studies of caregivers of older adults with memory problems have been published that included both actigraphic measurement of sleep and a measure of physical functioning (McCurry *et al.*, 2006; McCurry *et al.*, 2008), we are not aware of studies that have explicitly examined the association between these measures in caregivers.

In the present cross-sectional study, we investigated the association between sleep parameters, measured objectively by wrist actigraphy, and self-reported physical functioning on the SF-36 in family caregivers of older individuals with memory problems. We predicted that worse actigraphic sleep in caregivers would be associated with greater impairment of their self-reported physical functioning, and that this association would remain after adjustment for age, depressive symptoms, and self-rated health.

Methods

Participants

Participants were 45 caregivers enrolled in a randomized controlled trial of bright-light treatment for sleep/wake disturbances in patients with memory disturbances. Caregivers were included if they were living in the home of the memory-impaired individual and were willing to participate in the protocol. Exclusion criteria for caregivers were a history of mania or an eye condition that precluded bright light exposure. The data reported here were collected at the baseline phase of the randomized trial.

Predictors

Caregivers wore actigraphs on their non-dominant wrists (Octagonal Basic actigraph with light sensor, Ambulatory Monitoring, Inc., Ardsley, NY) for at least three consecutive 24-hr periods. We derived sleep parameters using Action 4 software (Ambulatory Monitoring, Inc.) and we selected two key nocturnal sleep parameters as predictors for this study: total sleep time (TST; total time asleep from time into bed until time out of bed) and wake after sleep onset (WASO; mean time awake after initial sleep onset). During the period they collected actigraphic data, caregivers recorded their times into- and out-of-bed, nap times, and intervals during which actigraphs were removed in a brief sleep log.

Outcome

We measured physical functioning with the Physical Functioning subscale of the Medical Outcomes Study Short Form 36 (SF-36), a self-report measure of emotional and physical health-related quality of life (Ware and Sherbourne, 1992). The Physical Functioning subscale contains ten items that measure the difficulty respondents have with moderate and vigorous activities, lifting/carrying groceries, climbing stairs, bending/stooping/kneeling, walking various distances, and bathing/dressing, on a 3-point Likert-type scale (1 = yes, a lot; 2 = yes, a little; 3 = no, not at all). Based on instructions, responses were summed and recoded; higher scores indicate better functioning (possible range = 0 - 100) (Saris-Baglama *et al.*, 2004).

Other Measures

Caregivers provided demographic information, and completed the Beck Depression Inventory-II (BDI-II), a 21-item questionnaire measuring depressive symptoms (Beck *et al.*, 1996). Self-rated health was measured by item 1 of the SF-36 on a 5-point scale (excellent = 1, poor = 5). Caregivers and patients also completed the Mini-Mental State Exam (MMSE), a 30-item screen for cognitive impairment (Folstein *et al.*, 1975).

Analyses

To determine the association between actigraphic sleep parameters and physical functioning, we conducted two unadjusted linear regression analyses, each with actigraphic TST or WASO as the predictor, and the SF-36 Physical Functioning subscale as the outcome. To prevent confounding by age, self-rated health, and depression, we repeated analyses, adjusting for these variables. We added a quadratic term age^2 (i.e., age squared) to multivariate models to transform the association between caregiver age and the Physical Functioning subscale from non-linear to linear.

Results

Participant Characteristics

Of the 45 caregivers, 30 (67%) were women (see Table 1). A total of 38 (84%) were Caucasian, 4 (9%) were Hispanic or Latino, 2 (4%) were Asian, and 1 (2%) reported mixed race. The

caregivers had a mean age ± standard deviation (SD) of 68.6 ± 13.2 years, and 15.8 ± 2.3 years of education. Of the 45 patients, 25 (56%) were men; 89% were Caucasian, 2 (4%) were Asian and 3 (7%) were Hispanic or Latino. They had a mean age of 78.4 ± 8.5 years, 15.2 ± 2.3 years of education, and a mean MMSE score of 21.7 ± 4.9 (range = 10 to 28).

Caregivers had a mean MMSE score of 29.2 ±1.1. Their mean SF-36 Physical Functioning score was 74.6 ± 22.5; scores ranged from 20 to 100. Their mean BDI-II score was 7.2 ± 5.6, indicating a low mean level of depression in this sample. Caregivers completed a mean of 6.5 ± 0.8 (range = 4 to 7) days of actigraphy, and completed a mean of 6.5 ± 0.8 sleep logs (out of 7; range = 4 to 7). Caregivers' mean TST was 378.5 ± 87.2 min, and their mean WASO was 87.5 ± 72.6 min.

Total Sleep Time and Physical Function

In unadjusted regression analyses, each 30-min increase in caregivers' TST was associated with a 2.5-point increase in their Physical Functioning scores (unstandardized beta coefficient (*B*) = 2.5, 95% confidence interval (CI) 0.2, 4.7, adjusted R^2 = 0.08) (Table 2). After adjustment for caregiver age, age^2, self-rated health, and BDI-II score, each 30-min increase in TST was still associated with a statistically significant 2.2-point increase on the Physical Functioning subscale (*B* = 2.2, 95% CI 1.0, 3.4, adjusted R^2 = 0.75).

Wake Time and Physical Function

In unadjusted analyses, each 10-minute increase in WASO was associated with a 1.2-point decrease on the Physical Function subscale (*B* = -1.2, 95% CI -2.1, -0.4, adjusted R^2 = 0.14). After adjustment, this association decreased such that every 10-minute increase in WASO was accompanied by a 0.5-point decrease on the Physical Function subscale; this association was no longer statistically significant (*B* = -0.5, 95% CI -1.1, 0.1, adjusted R^2 = 0.69).

Discussion

In the present study, we found that shorter total sleep time was associated with poorer self-reported physical function in family caregivers of individuals with memory impairment, and that this association was independent of caregiver age, self-rated health, and depressive symptoms. We also observed an association between greater wake after sleep onset and physical function, but this decreased in magnitude and was no longer significant after adjustment for the same potential confounders. The general pattern of our findings is consistent with those from other studies of older adults that used self-report sleep measures and various measures of functioning (Byles *et al.*, 2003; Foley *et al.*, 1995; Motivala *et al.*, 2006; Newman *et al.*, 1997). Our results also are similar to those of Creese *et al.* (2008), who found a trend-level association between caregivers' self-reported sleep and a more general measure of physical health, the Physical Component Summary of the SF-12. The present study extends prior research on the association between sleep and function in caregivers by using an objective measure (i.e., actigraphy) to estimate caregivers' sleep.

Various mechanisms could underlie the association between poor sleep and poor physical functioning in caregivers. Short sleep duration has been linked to hypertension and diabetes in community-dwelling older adults (Gottlieb *et al.*, 2005; Gottlieb *et al.*, 2006), and sleep fragmentation is associated with increased markers of inflammation and coagulation in dementia family caregivers (von Kanel *et al.*, 2006). Because hypertension, diabetes, and elevated coagulatory and inflammatory responses have themselves been linked to disability (Bourdel-Marchasson *et al.*, 2007; Cohen *et al.*, 2003; Newman *et al.*, 2009), these variables might mediate the association between disturbed sleep and functional impairment. In addition, caregivers who are more stressed and often sleep-deprived are less likely to engage in basic

health behaviors (e.g., healthful diet, exercise) (Schulz *et al.*, 1997; Son *et al.*, 2007), which may contribute to the worsening of their health and level of physical function.

Limitations of this study include its cross-sectional design, which prevents us from drawing conclusions about the direction of a potential causal link between sleep and functional impairment. In addition, to reduce caregiver burden, we used a brief sleep log, rather than a full sleep diary. Although this resulted in a high rate of adherence to our protocol, as indicated by an average of 6.5 completed sleep logs per caregiver, the brief log did not require participants to report the amount of time spent awake after sleep onset or their total sleep time. This precluded us from identifying discrepancies between self-reported sleep and sleep parameters from actigraphy. Further, the small sample size may have limited statistical power to detect smaller effects in one of our multivariate models. Finally, although multiple subscales can be derived from the SF-36, the present study focused specifically on the SF-36 Physical Functioning subscale as an outcome. Further hypothesis-driven research is needed to determine the extent to which poor sleep is linked to other domains of functioning and health-related quality of life in family caregivers.

Despite these limitations, the present investigation is, to our knowledge, the first to provide evidence for an association between objectively measured sleep and self-reported physical functioning in family caregivers of patients with memory disorders. Additional studies of sleep and function in caregivers are needed that use a broader range of outcome measures, including performance-based functional measures (e.g., grip strength, gait speed). Further, prospective studies are needed to investigate the extent to which both subjectively and actigraphically measured caregiver and patient sleep predict nursing home placement. Evidence of a longitudinal association between nocturnal sleep and physical functioning in family caregivers would raise the possibility that interventions to improve caregivers' sleep might have a positive impact on their functional status. Improved functioning might support caregivers' ability to provide ongoing care, and perhaps delay institutionalization of older adults with memory problems.

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This study was conducted using data from a clinical trial registered in the ClinicalTrials.gov Registry (ClinicalTrials.gov Identifier: NCT00946530).

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Table 1

Participant characteristics (N = 45)

Characteristic	Mean (± *SD*) or *N* (%)
Caregivers	
Age	68.6 ± 13.2
Women	30 (67)
Race	
Caucasian	38 (84)
Hispanic/Latino	4 (9)
Asian	2 (4)
Mixed	1 (2)
Education (years)	15.8 ± 2.3
Mini-Mental State Exam score	29.2 ±1.1
Beck Depression Inventory-II	7.2 ± 5.6
Patients	
Age	78.4 ± 8.5
Women	20 (44)
Race	
Caucasian	40 (89)
Hispanic/Latino	3 (7)
Asian	2 (4)
Education (years)	15.2 ± 2.3
Mini-Mental State Exam score	21.7 ± 4.9

Table 2

Associations between sleep parameters and Physical Functioning subscale.

Predictors	Units	Unadjusted			MV-Adjusted*		
		B (95% CI)	*p*-value	Adjusted R^2	*B* (95% CI)	*p*-value	Adjusted R^2
Total sleep time	30 min	2.5 (0.2, 4.7)	0.03	0.08	2.2 (1.0, 3.4)	0.001	0.75
Wake after sleep onset	10 min	-1.2 (-2.1, -0.4)	0.006	0.14	-0.5 (-1.1, 0.1)	0.09	0.69

Note: $N = 45$.

*Adjusted for age, age^2, self-rated health, and Beck Depression Inventory-II score. *B* = unstandardized regression coefficient. CI = confidence interval.