Sleep Patterns and Sleep-Related Factors Between Caregiving and Non-Caregiving Women

Cynthia M. Castro  
Stanford Prevention Research Center  
Stanford University School of Medicine

Kathryn A. Lee  
Department of Family Health Care Nursing  
University of California, San Francisco

Donald L. Bliwise  
Department of Neurology  
Emory University School of Medicine

Guido G. Urizar  
Department of Psychology  
California State University at Long Beach

Steven H. Woodward  
National Center for PTSD, Dissemination and Training Division  
VA Palo Alto Health Care System, CA

Abby C. King  
Departments of Health Research and Policy & Medicine  
Stanford University School of Medicine

This exploratory study compared objective sleep patterns and sleep-related factors between caregiving and non-caregiving women with sleep impairments, and compared the sleep patterns of the
Caregivers with their care recipients. Nine women caring for adults with dementia and a comparison sample of 34 non-caregiving women provided three nights of in-home polysomnography (PSG) and self-report questionnaires of sleep quality and physical and emotional well-being. Care recipients’ sleep was monitored with actigraphy on the same nights of the caregivers’ PSG. Caregivers and non-caregivers’ sleep patterns were similar across most PSG-measured parameters. Caregivers perceived more sleep disturbances, but PSG showed minimal differences compared to non-caregivers. Caregivers reported more depressive symptoms, and depression was strongly correlated with longer sleep latency. Caregiver’s sleep quantity was highly correlated with the sleep quantity of their care recipient. The results suggest that, in this sample, caregivers’ sleep was not significantly different from the non-caregiving women, despite differences in perceptions. Although the sample is small, this exploratory study supports the use of multiple nights of in-home PSG to assess caregiver sleep and provides more data on sleep patterns of female dementia caregivers and their relatives.

Caregiving for an impaired family member is increasingly common for many Americans. Among the estimated 35 million adults currently assuming caregiving responsibility for an older relative, approximately 25% care for someone with some form of dementia (National Alliance for Caregiving [NAC], 2004; National Sleep Foundation, 2007; Salganicoff, Ranji, & Wyn, 2005). Family caregivers are vital assets to their family and the health care system; however, the burden often associated with caregiving has a negative impact on the physical and emotional well-being of the caregiver. Among the detrimental health effects associated with dementia caregiving are impaired immune functioning (Kiecolt-Glaser et al., 2003), increased depression and anxiety (Mahoney, Regan, Katona, & Livingston, 2005; Schulz & Martire, 2004), increased risk for cardiovascular disease (Lee, Colditz, Berkman, & Kawachi, 2003), and increased mortality for caregivers with elevated role strain (Schulz & Beach, 1999). These effects appear to be more pronounced in women caregivers than in men (Atienza, Henderson, Wilcox, & King, 2001; Yee & Schulz, 2000).

Sleep complaints are quite common among dementia caregivers, and in many ways may influence or compound caregiving burden. Some research has found dementia caregivers to report more sleep problems than age-matched non-caregivers, and caregivers’ sleep patterns appear similar to individuals with insomnia or depression (Wilcox & King, 1999). Sleep impairment is often a reason for institutionalization of the care recipient (Chenier, 1997). Recent evidence suggests that sleep disturbances in caregivers are associated with elevations in inflammation and procoagulation markers linked to cardiovascular risk (Mausbach et al., 2006; von Känel et al., 2006). Sleep problems are also more frequent for caregivers with greater psychological distress, suggesting that the psychological impact of caregiving may create intrusions or ruminations among caregivers at night (McCurry, Logsdon, Teri, & Vitiello, 2007). Given the impact of poor sleep on the well-being of both the caregiver and care recipient, efforts are needed to understand the factors related to poor sleep in order to intervene to preserve the functioning of the caregiver–care receiver dyad.

The study of caregivers’ sleep has improved in recent years with the use of objective measurement, specifically ambulatory polysomnography (PSG) and actigraphy (McCurry, Pike, Vitiello, Logsdon, & Teri, 2008; Pollak & Stokes, 1997; Pollak, Stokes, & Wagner, 1997). Both actigraphy and PSG are more advantageous than sleep self-reports, which can be subject to bias and misperception about the severity of sleep impairments, particularly among caregivers.
Whereas actigraphy is noninvasive and is reliable for capturing sleep–wake patterns and total sleep time (TST), PSG is able to differentiate time spent in various sleep stages and is more reliable for detecting sleep disorders (Ancoli-Israel et al., 2003). Although PSG data are more detailed, the method is more cumbersome and expensive than actigraphy. Few researchers have attempted to conduct PSG on caregivers. Currently, one American study and two Japanese studies have measured caregiver sleep using in-home ambulatory PSG (Kanda, Sato, & Nagata, 1997; McKibbin et al., 2005; Sato, Kanda, Anan, & Watanuki, 2002). The methodology was limited to one or two nights of PSG. Some studies have suggested that more nights may enhance the representativeness of characterizing an individual’s sleep, although the number of nights required may differ depending upon the variable of interest (Wohlgemuth, Edinger, Fins, & Sullivan, 1999). In addition, the aforementioned PSG studies of caregivers did not have indicators of the care recipients’ sleep patterns in relation to the caregivers. The current study attempted to improve upon previous research by increasing the number of nights of PSG and by simultaneously collecting sleep–wake data on the care recipients.

This current investigation was an exploratory, cross-sectional study to describe subjective and objective sleep characteristics in women who are dementia family caregivers compared to women who are non-caregivers. It was hypothesized that caregivers would experience worse sleep than non-caregivers on all dimensions when their sleep was measured in the home with ambulatory PSG. A secondary aim was to examine actigraphy data on the care recipients to explore the correspondence of the care recipients’ sleep–wake patterns in relation to the caregivers.

METHOD

Participants

The institutional review board of the Stanford University School of Medicine approved the study protocol and all procedures conducted with study participants. Women family caregivers for a spouse or parent with dementia were recruited for a small companion-comparison project to a larger study of sleep in midlife and older adults (King et al., 2008). Caregivers were contacted through personal mail to Alzheimer’s Association distribution lists and advertisements in local caregiving-related newsletters. Male caregivers were not recruited due to the predominance of women caregivers in the population, potential gender differences in caregiving roles, and recent evidence of the disproportionate impact of caregiving on health outcomes in women (Atienza et al., 2001; Yee & Schulz, 2000). An initial sample included 34 caregiving women screened for the following eligibility criteria: (a) age 55 years and older; (b) reporting moderate sleep complaints not due to physical illness, major depression, or diagnosed sleep disorders; (c) not currently taking sleep medications and stable on other medications for 8 weeks; (d) postmenopausal or stable on hormone replacement therapy for 6 months; (e) nonsmoker for past 6 months; (f) providing at least 10 hr per week of care in the home for a spouse or parent with dementia; (g) body mass index (BMI) less than 35; (h) average alcohol intake less than or equal to three drinks per day; and (i) scores of three or higher (on a scale of 1–5) on at least two of the following three items from the Sleep Questionnaire and Assessment of
Wakefulness (Miles, 1982): “Based on the last 6 months, (a) how much of a problem do you have getting to sleep at night? (b) waking up during the night? and (c) waking up and getting up in the morning?”

Twenty-five women were excluded based on initial screening criteria. Eight were excluded because they did not share residence with the care recipient, two did not meet the age criteria, four lived beyond the geographic boundaries to conduct the nightly assessments, five had sleep impairments secondary to a medical condition, one person was a regular smoker, two were unable to be contacted for screening, and 1 withdrew during the screening process due to too many time commitments. Two initially eligible women were subsequently excluded due to possible sleep apnea as indicated by overnight pulse oximetry (described below). The final 9 participants gave written, informed consent to participate and were enrolled. Of these caregivers, 6 were caring for a husband with dementia, and 3 were adult daughters caring for a parent.

Concurrent with the caregiver recruitment, non-caregiving women were recruited for a randomized clinical trial of exercise for the treatment of mild to moderate sleep complaints that are commonly reported among mid-life and older adults (King et al., 2008). In addition to the same selection criteria mentioned above (with the exception of the caregiving items), women for this comparison sample met the following criteria: (a) not engaged in more than 60 min per week of moderate-intensity or more vigorous physical activity over the previous 6 months, (b) free of any medical condition that would limit participation in moderate-intensity exercise, and (c) stable on all medications for at least 3 months. Of the 43 women recruited for that study, 34 were comparable to the caregiver sample in age, ethnicity, and marital status and were selected as the comparison group.

Procedures

**Oximetry.** Prior to PSG, all participants underwent one night of pulse oximetry using the Nellcor NPB-290 device (Nellcor, Pleasanton, CA). To maximize the likelihood that participants were free of sleep apnea or other clinically diagnosed sleep disorder, participants had to meet the criteria of a multivariate apnea prediction score of ≤ .8 (Maislin, Dinges, Pack, & Pack, 1996), pulse oximetry readings of less than 10% cumulative time of oxygen saturation (SaO$_2$) below 90%, and a desaturation index (> 3% falls in SaO$_2$ per sleep hour) below 10 per hour (George, Millar, & Kryger, 1988; Series, Marc, Cormier, & LaForge, 1993). As mentioned, two potential participants from the caregiving sample were excluded after oximetry screening as a result of excessive pulse oximetry desaturations.

**PSG.** PSG was collected using the Oxford MR95 Medilog digital recording system (Oxford Instruments, Oxford, England) with silver chloride electrodes and electrode gel. Channels collected EEG readings (C4–A1, C3–A2, Pz–A1), bipolar electrooculography, and surface mentalis electromyography. In addition, we recorded a modified lead II electrocardiogram (ECG) and four channels (2 left, 2 right) of surface anterior tibialis EMG for the measurement of periodic leg movements in sleep (PLMS). Snap electrodes were used for ECG and leg EMG signals. A final MR95 channel recorded ambient light, which was used primarily to aid in the determination of the beginning of the sleep period.
PSG was collected on three consecutive nights in the participant’s home under normal sleeping conditions. Each evening, two technicians arrived at the participant’s home at approximately 8 p.m. to apply the PSG montage. Participants were instructed to complete a self-report sleep log at bed and wake times, to press the event marker on the MR95 at the time they intended to go to sleep at night, and to remove the electrodes upon awakening the next morning. Each morning, the research assistant returned to the home to pick up the equipment and sleep log. Sleep data were downloaded at the Stanford research offices where PSG data were de-identified, assigned a study code, and then transferred via file transfer protocol (FTP) to the sleep lab secured server at the Palo Alto Veterans Administration Hospital Medical Center for artifact identification, removal, and data compression. Only one caregiver night and three comparison participant nights were eliminated from analysis because of technical problems (e.g., > 25% of recordings were unscored because of artifact, weak battery, etc.), resulting in a technical failure rate of 3.1%. Cleaned data were then placed on a separate secured server for transfer via FTP to the Laboratory for Sleep, Aging, and Chronobiology at Emory University Medical School for stage scoring, which followed conventional scoring rules (Rechtschaffen & Kales, 1968). All PSG recordings were scored in 30-sec epochs by one of two trained and blinded polysomnographic technologists whose median interrater reliability (intraclass correlation coefficient) for sleep stages was .90. Approximately 0.4% of the data were defined as sleep, but could not be definitively scored into specific stages. All scored data from the Emory site were transferred electronically via FTP back to the study site at Stanford for statistical analyses.

**Care recipient sleep–wake actigraphy.** Although caregivers’ sleep was the primary focus of this study, measurement of care recipient sleep was also conducted in order to explore the synchronicity of sleep and wake patterns between caregivers and care recipients (e.g., Were care recipients asleep before or after their caregivers went to bed, and were care recipients awake or asleep when the caregivers awoke?). Actigraphy for care recipients was chosen as it is a minimally invasive, reliable method often used to measure total sleep quantity and timing of sleep onset and awakening in dementia patients (Ancoli-Israel, Clopton, Klauber, Fell, & Mason, 1997). When able to provide verbal or written assent, the care recipient was asked to wear a wrist-worn actigraph overnight (LUX model actigraph, Actigraph LLC, Fort Walton Beach, FL). The actigraph was put on the care recipient at the same time the PSG equipment was applied to the caregiver. Three households did not provide actigraphy data because the care recipient could not provide verbal or written assent, and the caregiver could not guarantee the actigraph could be tolerated by the care recipient throughout the night. Out of the 18 nights (6 Care Recipients × 3 Nights) when actigraphy data were collected, 4 nights of data were lost due to actigraph malfunctioning or human error (i.e., the care recipient removed it before going to bed).

The actigraph collects continuous motion data via a battery-operated microprocessor that senses motion with a piezoelectric linear accelerometer. The data were analyzed with an empirically validated sleep scoring modification of the actigraph software provided by the manufacturer (Jean-Louis, Kripke, Cole, Assmus, & Langer, 2001). The refined scoring program has been shown to have good stability and high agreement rates compared to simultaneous PSG measurement (Jean-Louis et al., 2001).
Measurements

**Objective PSG variables.** The following variables were derived from each night of recording: TST minutes; sleep efficiency (SE) percentage (defined as the proportion of time in bed spent asleep); sleep latency (minutes) defined as the time from start of intended bedtime to the first epoch of Stage 2 sleep; wake (time) after sleep onset (WASO) defined as percentage of sleep period spent awake after first epoch of sleep; and the proportion of TST spent in Stage 1, Stage 2, slow wave sleep (SWS; Stages 3 and 4 combined for scoring), and REM sleep. SWS was defined using a conventional 75 uV amplitude criterion. In addition, we analyzed the number of brief awakenings, defined with standard criteria (American Sleep Disorders Association Atlas Task Force, 1992) and PLMS also defined with previously published criteria (American Sleep Disorders Association Atlas Task Force, 1993).

Intraclass correlations for SE and TST were calculated for caregivers and non-caregivers, and all values were between .45 and .47. In addition, repeated measures analyses of variance were run separately for caregivers and non-caregivers to detect any differences in TST and SE across the three nights, and there were no significant night-by-night differences. Given this relative consistency of night-to-night patterns within groups, sleep variables were averaged across the available nights. One caregiver and 3 non-caregivers were missing data for one of the three nights due to technical considerations (explained earlier). Thirty-nine participants had all three nights of usable data, and all participants had at least two usable nights of complete data.

**Sleep diaries.** Caregivers completed a daily sleep diary for each night of PSG recording, and were asked to self-report their bedtime and wake time. They were instructed to complete the diary at bedtime and immediately upon awakening the next morning, and diaries were collected in the morning along with the PSG equipment. Sleep diaries were used to provide estimated caregivers’ bedtimes and wake times to assist with PSG scoring and to identify the relevant actigraph recording period that coincided with the caregivers’ sleep period (to examine the care recipient’s sleep–wake status during the caregiver’s sleep period).

**Actigraphy.** Actigraph data were identified and truncated to coincide with the caregivers’ reported sleep and wake times from the sleep diaries. Specifically, the actigraphy recording period that overlapped with the caregivers’ sleep period was separated from the rest of the actigraphy recording in order to examine synchronicity in sleep–wake states between care recipients and their caregivers. The total time the care recipient was asleep during the caregiver’s sleep period served as the primary care recipient sleep variable.

**Self-reported sleep and psychological variables.** On the first day of PSG collection, participants were given a questionnaire packet to complete independently. The questionnaire battery contained a variety of self-report measures of perceived sleep and physical and emotional well-being.

**The Pittsburgh Sleep Quality Index (PSQI).** The PSQI was used to capture self-reported sleep quality (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). It is a widely used and well-
validated questionnaire that assesses sleep quality and disturbances over a 1-month time interval. Nineteen individual items are used to generate seven subscales (0–3 range of possible subscale scores): subjective sleep quality, sleep latency, sleep duration, habitual SE, sleep disturbances, use of medications to induce sleep, and daytime sleep-related dysfunction. The sum of these component scores yields a global score (range = 0–21). The PSQI has been found to have acceptable internal consistency, test-retest reliability, and discriminant validity in psychometric validation studies (Buysse et al., 1991). Internal consistency for this sample was .61.

The Epworth Sleepiness Scale (ESS; Johns, 1991). The ESS is an eight-item assessment of the level of daytime sleepiness. Scores range from 0 to 24, with higher scores indicating greater daytime sleepiness and, thus, inadequate nighttime sleep. Cronbach’s coefficient alpha for the scale in the study sample was .77.

The Center for Epidemiologic Studies of Depression (CES–D) Scale (Andresen, Malmgren, Carter, & Patrick, 1994). The 10-item version of the CES–D is a measure of the frequency of depressive symptoms. Possible scores range from 0 to 30, with higher scores indicating a greater degree of depressed mood. This version has been tested with generally healthy older adults, and has adequate psychometric validity and reliability. Cronbach’s coefficient alpha for this sample was .83.

The Cohen Perceived Stress Scale (PSS; S. Cohen, Kamarck, & Merelstein, 1983). This is a 14-item scale that measures the degree to which situations in one’s life are perceived as stressful. Possible scores range from 0 to 56, with higher scores indicating greater perceived stress. Internal consistency (Cronbach’s alpha coefficient) for the study sample was .85.

Caregiving survey. Caregivers completed self-report questions on their relationship to their care recipient, age and diagnosis of the care recipient, length of tenure as a caregiver, types of duties performed as a caregiver, and weekly time spent in caregiving activities.

The Screen for Caregiver Burden (SCB; Vitaliano, Russo, Young, Becker, & Maiuro, 1991). Caregivers also completed the SCB, a 25-item questionnaire that measures the occurrence of potentially negative or upsetting experiences (i.e., objective burden) and the amount of perceived distress related to those experiences (i.e., subjective burden). The objective burden score is derived by summing the number of caregiving-related situations reported by the respondent (range = 0–25). For each experience endorsed, the caregiver rates level of distress from that experience on a scale of 1 to 4, with higher scores indicating more distress. The subjective burden scores are summed from these distress ratings, with a range of 25 to 100. In the current sample, the Kuder–Richardson coefficient of internal consistency for the objective scale was 0.50, and Cronbach’s alpha for the subjective scale was .81.

Revised Memory and Behavior Problem Checklist (RMBPC; Teri et al., 1992). This is a 24-item caregiver-reported measure of observable behavior problems among persons with
dementia. Scores relating to patient problems and caregiver reactions to the problems are averaged for the total scale and three subscales (i.e., memory-related problems, depression, and disruptive behaviors). Scores range from 0 to 4. Cronbach’s alpha coefficients were .91 for the total Frequency scale, .69 for the total Reaction scale, and from .76 to .96 for the three subscales.

Analysis Plan

T test and chi-square analyses were first performed to detect any demographic variables (e.g., age, socioeconomic indicators, ethnicity, and marital status) that could potentially confound differences between caregivers and non-caregivers. One-way, between-subject analyses of covariance using the SAS software General Linear Model (Proc GLM) for unbalanced groups were used to detect differences between caregiving and non-caregiving groups on the PSG and self-perceived sleep variables. Due to the known impact of age on sleep quality and quantity (Bliwise, 1993), an Age × Group interaction term was examined first. If no significant interactions emerged, age was subsequently entered alone as a continuous, independent covariate for analyses of group effects. To explore potential associations between caregivers’ sleep and various psychosocial factors, Pearson correlations were conducted between these variables within the caregiving sample. To examine association between caregivers’ sleep and care recipient’s sleep, caregiver sleep time and care recipient sleep time during the caregiver sleep period were correlated. In consideration of the exploratory nature of this study, the alpha level for tests was set at .05 for statistical significance, and Cohen’s $D$ was calculated to determine the effect sizes for group differences in continuous variables (J. Cohen, 1992).

RESULT

See Table 1 for descriptive statistics of the sample. On average, study participants were in their early 60s, primarily Caucasian, married, and retired or not employed outside the home.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Caregivers$^a$</th>
<th>Non-Caregivers$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age in years ($SD$)</td>
<td>62.6 (9.7)</td>
<td>61.6 (7.0)</td>
</tr>
<tr>
<td>Mean years of education ($SD$)</td>
<td>15.5 (2.5)</td>
<td>16.2 (1.6)</td>
</tr>
<tr>
<td>White</td>
<td>67%</td>
<td>91%</td>
</tr>
<tr>
<td>Black</td>
<td>11%</td>
<td>—</td>
</tr>
<tr>
<td>Asian</td>
<td>22%</td>
<td>9%</td>
</tr>
<tr>
<td>Married or living with partner</td>
<td>67%</td>
<td>62%</td>
</tr>
<tr>
<td>Divorced or widowed</td>
<td>33%</td>
<td>38%</td>
</tr>
<tr>
<td>Employed (full or part time)</td>
<td>22%</td>
<td>51%</td>
</tr>
<tr>
<td>Homemaker or retired</td>
<td>78%</td>
<td>49%</td>
</tr>
<tr>
<td>Mean body mass index ($SD$)</td>
<td>27.0 (5.3)</td>
<td>26.2 (3.8)</td>
</tr>
</tbody>
</table>

$^a_n = 9$, $^b_n = 34$. 
TABLE 2
Caregiving Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of time as a caregiver in years</td>
<td>3.6</td>
<td>3.0</td>
<td>0.5–5.0</td>
</tr>
<tr>
<td>Hours per week spent in caregiving duties</td>
<td>33.0</td>
<td>25.9</td>
<td>10–84</td>
</tr>
<tr>
<td>Relationship to care recipient:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spouse</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of care recipient</td>
<td>79.2</td>
<td>11.4</td>
<td>59–96</td>
</tr>
<tr>
<td>Number of ADLs or IADLs needing assistance</td>
<td>7.2</td>
<td>1.2</td>
<td>5–9</td>
</tr>
<tr>
<td>Screen for Caregiver Burden:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective score</td>
<td>12.7</td>
<td>3.0</td>
<td>9.0–16.0</td>
</tr>
<tr>
<td>Subjective score</td>
<td>30.0</td>
<td>13.4</td>
<td>11.0–52.0</td>
</tr>
</tbody>
</table>

Revised Memory and Behavior Problem Checklist

<table>
<thead>
<tr>
<th></th>
<th>Frequency Rating</th>
<th>Reaction Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Depression scale</td>
<td>5.2</td>
<td>5.0</td>
</tr>
<tr>
<td>Disruptive Behavior scale</td>
<td>6.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Memory Problems</td>
<td>13.3</td>
<td>7.8</td>
</tr>
<tr>
<td>Total scale</td>
<td>25</td>
<td>12.5</td>
</tr>
</tbody>
</table>

* n = 9. ADLs = activities of daily living (e.g., dressing, feeding, bathing). IADLs = instrumental activities of daily living (e.g., paying bills, grocery shopping, managing medications).

Caregivers and non-caregivers did not differ by age \((t = -0.35, p = .7)\); years of education \((t = 0.96, p = .3)\); BMI \((t = -0.5, p = .6)\); White versus non-White race, \(\chi^2(1, N = 43) = 3.5, p = .1\); married versus divorced or widowed status, \(\chi^2(1, N = 43) = 0.07, p = .8\); or employed versus homemaker or retired status, \(\chi^2(1, N = 43) = 2.2, p = .1\). See Table 2 for a more detailed description of the caregivers and their care recipients. Overall, this sample of caregivers is similar to samples found in population-based caregiver surveys (Castro et al., 2007; NAC, 2004; Wisniewski et al., 2003).

PSG Comparisons Between Caregivers and Non-Caregivers

See Table 3 for PSG values for each group. Both groups averaged approximately 6 hr of sleep per night. The majority of sleep time was spent in Stage 2 sleep, with almost no SWS in either group (both groups averaging less than 2% of TST).

Age, but not caregiving status, was negatively associated with SE, \(F(2, 41) = 4.49, p = .02\); percentage of sleep time in Stage 2, \(F(2, 41) = 3.65, p = .04\); percentage of WASO, \(F(2, 41) = 4.45, p = .02\); and total brief awakenings, \(F(2, 41) = 3.48, p = .04\). After adjusting for age, caregivers and non-caregivers did not differ significantly in PSG-measured TST, \(F(2, 41) = 0.76, p = .5\); sleep latency, \(F(2, 41) = 0.47, p = .6\); percentage of sleep time in Stage 1, \(F(2, 41) = 0.13, p = .9\); percentage of sleep time in SWS, \(F(2, 41) = 0.89, p = .4\); percentage of sleep time in REM sleep, \(F(2, 41) = 1.04, p = .4\); or PLMS per hour, \(F(2, 41) = 1.8, p = .2\).
TABLE 3
Group Values and Between-Group Effect Sizes for PSG and Self-Report Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Caregivers</th>
<th>Non-Caregivers</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PSG measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TST (minutes)</td>
<td>341.9</td>
<td>359.1</td>
<td>-.26</td>
</tr>
<tr>
<td>SE (TST/time in bed)</td>
<td>79.3%</td>
<td>82.5%</td>
<td>-.38</td>
</tr>
<tr>
<td>Sleep Latency (minutes to Stage 2)</td>
<td>19.8</td>
<td>16.5</td>
<td>.27</td>
</tr>
<tr>
<td>WASO</td>
<td>19.7%</td>
<td>17.3%</td>
<td>.30</td>
</tr>
<tr>
<td>Time in Stage 1</td>
<td>8.3%</td>
<td>8.0%</td>
<td>.09</td>
</tr>
<tr>
<td>Time in Stage 2</td>
<td>53.0%</td>
<td>53.8%</td>
<td>-.10</td>
</tr>
<tr>
<td>Time in SWS</td>
<td>0.8%</td>
<td>1.3%</td>
<td>-.34</td>
</tr>
<tr>
<td>Time in REM</td>
<td>17.2%</td>
<td>19.4%</td>
<td>-.42</td>
</tr>
<tr>
<td>Awakenings per night</td>
<td>4.1</td>
<td>4.0</td>
<td>.09</td>
</tr>
<tr>
<td>PLMS per hour</td>
<td>7.5</td>
<td>6.12</td>
<td>.14</td>
</tr>
<tr>
<td><strong>Self-report questionnaires</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSQI Global Score (0–21)</td>
<td>10.4</td>
<td>8.9</td>
<td>.45</td>
</tr>
<tr>
<td>PSQI perceived hours sleep</td>
<td>6.2</td>
<td>6.3</td>
<td>-.07</td>
</tr>
<tr>
<td>PSQI Sleep Latency (minutes)*</td>
<td>49.7</td>
<td>23.8</td>
<td>1.05</td>
</tr>
<tr>
<td>PSQI Sleep Disturbances*</td>
<td>1.9</td>
<td>1.5</td>
<td>.72</td>
</tr>
<tr>
<td>PSQI Sleep Efficiency</td>
<td>1.3</td>
<td>1.2</td>
<td>.08</td>
</tr>
<tr>
<td>PSQI Daytime Dysfunction</td>
<td>1.3</td>
<td>1.1</td>
<td>.33</td>
</tr>
<tr>
<td>PSQI Sleep Latency</td>
<td>1.9</td>
<td>1.4</td>
<td>.55</td>
</tr>
<tr>
<td>PSQI Sleep Duration</td>
<td>1.2</td>
<td>1.0</td>
<td>.21</td>
</tr>
<tr>
<td>PSQI Subjective Sleep Quality</td>
<td>2.0</td>
<td>1.9</td>
<td>.18</td>
</tr>
<tr>
<td>PSQI Sleep Medications</td>
<td>0.8</td>
<td>0.94</td>
<td>-.13</td>
</tr>
<tr>
<td>Epworth Sleepiness Scale</td>
<td>8.3</td>
<td>6.8</td>
<td>.33</td>
</tr>
<tr>
<td>CES–D scale (10 items)*</td>
<td>12.2</td>
<td>8.2</td>
<td>.73</td>
</tr>
<tr>
<td>Perceived Stress Scale (14 items)</td>
<td>25.3</td>
<td>22.7</td>
<td>.33</td>
</tr>
</tbody>
</table>

**Note.** PSG = polysomnography; TST = total sleep time; SE = sleep efficiency; WASO = wake after sleep onset; SWS = slow wave sleep; PLMS = periodic leg movements in sleep; PSQI = Pittsburgh Sleep Quality Index; CES–D = Center for Epidemiologic Studies of Depression scale.

*aCohen’s D effect sizes: 0.2 = small effect, 0.5 = medium effect, and 0.8 = large effect. Percentages of sleep times do not equal 100% due to epochs that could be scored as sleep but could not be scored into specific stages.

*p < .05: significant between-group difference adjusted for age.

Subjective Sleep Reports

There was a significant Age × Caregiving Group interaction for the PSQI sleep disturbance scale, $F(3,40) = 4.22, p = .01$; and PSQI perceived sleep latency, $F(3,40) = 6.56, p = .001$. In post hoc analyses, the sample was divided in age by a median split (age 59 or younger vs. age 60 and older), and $t$ tests were performed to examine differences between caregivers and non-caregivers within these two age groups. Given the smaller subgroups in these post hoc analyses, these results are exploratory and should be interpreted cautiously. There were no differences in PSQI sleep disturbance or perceived sleep latency between caregivers and non-caregivers in the younger age group (ages 59 and younger). In the older age group (ages 60+ years), caregivers reported more sleep disturbance (older caregiver: $M = 2.3, SD = 0.5$;
older non-caregiver: $M = 1.4, SD = 0.5; t = -3.13, p = .03$) and longer sleep latency (older caregiver: $M = 64.5\text{ min}, SD = 29.3\text{ min}$; older non-caregiver: $M = 24.2\text{ min}, SD = 16.4\text{ min}; t = -3.70, p = .002$).

Age, but not caregiving status, was associated with greater daytime sleepiness on the ESS, $F(2, 41) = 5.05, p = .03$; poorer global sleep quality on the total PSQI scale, $F(2, 41) = 3.84, p = .03$; shorter sleep duration on the PSQI subscale, $F(2, 41) = 8.71, p = .005$; and less SE on the PSQI subscale, $F(2, 41) = 9.11, p = .0005$. There were no group or age effects on the following PSQI subscales: use of medications, perceived TST, sleep quality, and daytime dysfunction. Caregivers reported significantly higher scores on the CES–D measure, $F(2, 41) = 4.43, p = .04$. There were no differences between groups on the PSS, $F(2, 41) = 0.41, p = .7$. In post hoc analyses of depressive symptoms and sleep variables among the caregivers, depressive symptoms were positively correlated with PSG-measured sleep latency ($r = .67, p = .05$). PSG sleep variables were not associated with caregiver burden or perceived stress self-report.

Caregiver and Care Recipient Sleep

In the six caregiver–care recipient dyads that provided actigraphy data, four dyads shared a bedroom, and two caregivers–care recipients slept in different bedrooms. There was a high correlation between caregiver (polysomnographically measured) and care recipient (actigraphically measured) sleep time during the period between the caregiver’s estimated bedtime and wake time ($r = .92, p < .009$). For the dyads that provided actigraphy data, caregivers averaged $332 \pm 87\text{ min}$ sleep per night between their estimated bedtime and wake time, and their care recipients averaged $368 \pm 105\text{ min}$ during this same timeframe. Upon visual inspection of actigraphy data, care recipients were asleep before their caregiver went to bed (based on caregivers’ self-reported bedtime) on 86% of the nights. Care recipients were asleep for an average of $35 \pm 37.5\text{ min}$ before their caregiver went to sleep. On only two mornings (one morning each for two different families) were care recipients awake before their caregiver, with the caregiver arising approximately 16 min after her care recipient. In one of these families, the caregiver and care recipient shared a bedroom, but in the other family the caregiver and care recipient slept in separate rooms. For all other assessment mornings, actigraphy data showed care recipients still sleeping when their caregivers awoke, with a range of 6 min to 6.5 hr of sleep beyond their caregiver’s wake-up time. One half of the caregiver–care recipient dyads maintained a consistent sequence of bedtimes and wake times (i.e., the care recipient was always asleep before the caregiver, and the caregiver always awoke before the care recipient). In the other half of the dyads, the pattern was inconsistent from night to night. In the dyads with consistent patterns, two dyads slept in different bedrooms and one co-slept. In the dyads with inconsistent patterns, the caregiver and care recipient slept in the same bedrooms.

CONCLUSION

To date, this is the first study to collect multiple consecutive days of in-home PSG data on family caregivers. In addition, actigraphy was used to measure sleep–wake patterns in the care
recipients on the same nights as the caregivers’ PSG recordings. This unique study of PSG in the home provides useful information about sleep and psychological factors associated with sleep in family caregivers of dementia patients. As with most other sleep research on caregivers, the sample of caregivers is relatively small, and the information is limited to cross-sectional data; therefore, caution is necessary when interpreting these results. With this caveat in mind, overall, there were more similarities than differences between the caregiver and non-caregiver sleep patterns in this study. The caregivers and non-caregivers did not have significantly different sleep quantity and quality results on any PSG measures, even though there were differences in subjective sleep quality measures for perception of sleep latency and perception of sleep disturbance. However, the comparison group did consist of women with documented levels of mild to moderate sleep impairment; therefore, the caregiver’s sleep in this study was compared to women with impaired sleep, not necessarily women with good or salutary sleep quantity and quality. However, some level of sleep impairment is prevalent in normal aging (Bliwise, 1993). “Normal” sleep in middle-aged and older women is frequently characterized by some level of diminished sleep quantity or sleep quality, and sleep problems become more frequent with increasing age (National Sleep Foundation, 2007). Thus, although the comparison group did not consist of “good sleepers,” their sleep patterns are not unlike the sleep patterns of women in these later stages of life relative to younger women.

In addition to the similarities in sleep quantity, it is interesting to note the similarities in the distribution of sleep across the sleep stages and the comparable number of awakenings during the night experienced by the two groups. The very low levels of SWS and the predominance of Stage 2 sleep across both samples add further evidence that the sample of caregivers in this study were sleep impaired, but were not uniquely or disproportionately impaired relative to the comparison group. The lack of differences in nightly awakenings suggests that cohabitation with a relative with dementia does not necessarily result in increased interruptions to the sleep cycle during the night.

The significant differences in depression levels between the caregivers and comparison group may offer some evidence of qualitative differences in the barriers to sleep initiation among women. Although overall sleep latency was not significantly different between the caregivers and comparison group, the caregivers, on average, had more severe depressive symptoms, and the caregivers with more severe depressive symptoms took more time to fall asleep. These results suggest that non-depressed caregivers may not have trouble falling asleep, but caregivers who are more depressed may have greater difficulty with initiation insomnia. This could be due either to depression-related physiological processes that make sleep initiation more difficult, or due to rumination or worry at bedtime (after her care recipient has fallen asleep) that could prevent a more depressed caregiver from being able to readily fall asleep.

As expected, we found a significant relationship between duration of caregiver sleep and her care recipient’s sleep duration. In this sample, some caregivers got very few hours of sleep (< 5) and others got more than 7 hr. In each case, a care recipient had similar sleep quantity as the respective caregiver. This finding highlights the value of conducting concurrent, objective sleep assessments on both the caregiver and the care recipient. Although these data are cross-sectional and cannot prove causal mechanisms, the high correlation of caregiver–care recipient sleep time suggests that a caregiver’s ability to sleep longer is a function of her care recipient’s sleep time. It should be noted, however, that data were missing for one-third of care recipients, as participation in actigraphy was not required for the study, and it was at the caregiver’s
discretion to decide whether or not the care recipient could tolerate it. In addition, several nights of actigraphy were unusable due to technical and human errors. Given these omissions, it is likely that care recipients with more disruptive nocturnal patterns were not represented in the data; thus, our findings may not accurately capture the impact of care recipient sleep patterns on the caregiver’s sleep period. Further study with more thorough simultaneous measurements on caregivers and care recipients are needed to confirm our preliminary findings. It would also be valuable to repeat sleep assessments over time as the care recipient’s sleep becomes shorter or more disrupted in order to fully assess the impact of the care recipient’s sleep on the caregiver’s sleep patterns.

As with other sleep research on caregivers, there are some methodological limitations that should be considered when interpreting these results. The sample was quite small and was limited to caregivers and non-caregiving women who self-reported moderate sleep complaints. Comparing sleep-impaired women to each other likely contributed to the lack of differences between study groups and limits the generalizability of these findings to other caregiving women. A broader sampling of caregiving and non-caregiving women is needed to more precisely determine the influence of caregiving status on sleep patterns. Another influential factor may have been the fact that the caregivers did not appear to be highly strained. According to scores on the SCB, the caregivers’ perceived burden was relatively mild, and they reported relatively mild care recipient problems on the RMBPC. It could be that a more severely burdened caregiver sample would have exhibited more dramatic sleep impairments than the sample in this study. Although care recipients all had a diagnosis of dementia, we did not classify the level of severity. However, the mild RMBPC scores are consistent with more mild levels of impairment. If we assume the care recipients in this sample were relatively mildly impaired versus more moderately to severely impaired, this could have easily influenced the caregivers’ sleep. This is also consistent with previous research (McKibbin et al., 2005) that found caregivers of mildly impaired dementia patients did not have significant differences in sleep patterns relative to non-caregiving controls.

One benefit of this study is that it established the feasibility of conducting multiple nights of in-home PSG with a hard-to-reach population of dementia family caregivers. This is a useful contribution to caregiver sleep research, and will hopefully encourage more objective data collection and more elaborate studies of the complex nocturnal environment shared by caregivers and their care recipients. Caregiver sleep research is ripe with opportunities to develop a richer and more scientifically rigorous evidence base by using PSG more frequently with this important segment of the population.

Given that multiple nights of measurement are feasible, future studies should consider replicating this study and improving it by comparing caregivers with similarly aged women who do not have symptoms of impaired sleep and controlling for co-sleeping arrangements. It is important to continue to build the literature base on PSG-assessed sleep quantity and quality in caregivers versus non-caregivers in order to fully understand the discrepancies in sleep that may result by assuming a caregiving role. It is also important to improve caregiver sleep research methodology by incorporating more simultaneous assessments of the caregivers and care recipients. Concurrent data collection will help to establish the chronological influences that the care recipient’s nighttime patterns have on the caregiver’s sleep quantity and quality. Finally, although objectively assessed sleep data are sorely needed, it is still important to examine caregivers’ personal attributions for poor sleep. These perceptions can help to better
differentiate the potential causes of poor sleep as specifically caregiving-related versus age-related physiological changes.

In summary, results of this study indicate few significant differences in objective or subjective indicators of sleep quantity and quality between caregivers and non-caregivers. For several of the sleep parameters, age was a stronger indicator of poor sleep than caregiving status. However, results indicate that both a caregiver’s state of depressive symptoms and her care recipient’s sleep patterns influence caregiver sleep quantity and quality. This study demonstrated the viability of longer home-based PSG data collection on caregivers. The feasibility of this measurement strategy should encourage more thorough assessment of the caregiver’s sleep patterns in future research. More comprehensive assessment will advance our understanding of sleep and quality of life in caregivers, and offer valuable insight for areas to intervene and improve on the sleep for these valued family members.

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REFERENCES


