Sleep-Wake Patterns Among Postmenopausal Women: A 24-Hour Unattended Polysomnographic Study

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Background. Circadian sleep-wake profiles in postmenopausal women were examined to explore relationships between nocturnal and out-of-bed sleep.

Methods. Twenty-one home recordings were obtained with unattended polysomnography from women ranging from 56 to 77 years of age.

Results. While maintaining their daily routines, volunteers slept an average of 439 minutes throughout the 24-hour recordings. Ten percent of the accumulated sleep time was recorded out of bed.

Conclusions. Greater age was associated with more afternoon-evening sleep. Sleep was also frequently observed shortly after volunteers arose from bed in the morning.

A WRIST actigraphic study found that as much as 45% of individuals older than 65 years of age slept outside of the major nocturnal sleep period (1). Sleep episodes often occurred while volunteers were reading or watching television before bedtime. Sleep episodes were also frequently observed soon after the arising time.

Preliminary unpublished analysis of an ongoing 7-day actigraphic study of sleep duration in postmenopausal women (participants in the Women’s Health Initiative Observational Study) has indicated an average of 32 minutes of out-of-bed sleep each 24-hour period. Although the recordings showed lengthy episodes of wrist immobility, some of these volunteers denied that they were asleep upon subsequent interviews. Sleep episodes were scored especially during the evening hours, often while volunteers were watching television. This ongoing study has suggested that elders might be napping more than they report.

The question arises whether actigraphic scoring is accurate in reporting that even healthy and active older adults sleep more out of bed than they report. Electroencephalographic (EEG) recordings obtained in a hospital unit from a pioneering study of age-matched elderly controls and patients with dementia had observed that healthy elders slept only an average of 7 minutes during the day (2). However, more recently, two small unattended EEG studies examined elders’ sleep-wake patterns in their natural settings and observed average daytime sleep of 25 minutes (3,4). These investigations likewise suggested that elders might be napping more than is often reported.

To verify our actigraphic observations and to delineate further the relationships between out-of-bed sleep and nocturnal sleep, we investigated the circadian distribution of sleep and wakefulness in a sample of postmenopausal women. We recorded sleep for 24 hours in the home-community setting both with unattended polysomnography (PSG) and with actigraphy.

Methods

Participants

Artifact-free polysomnographic recordings of 21 volunteers (mean age = 64.7, SD = 7.4, age range = 56–77) were selected from 39 recordings obtained for an actigraphic validation study. All were postmenopausal women who reported no major medical or psychiatric problems. None of the women reported significant sleep problems; yet, one woman consumed alcohol as a sleep aid, two used Tylenol and one Xanax. Volunteers (White = 20, Hispanic = 1) were actively involved in the affairs of their community, and some of them worked on a part-time basis in various work settings and others worked at home. They reported being outside of their homes for an average of 48 ± 40 minutes during the 24-hour recordings.

Procedures

Volunteers who agreed to participate received a home visit, where the instruments used in the study were described. Upon obtaining written informed consent under the supervision of the Institutional Review Board at the University of California at San Diego, the visiting psychologist set up the equipment for recording. EEG was recorded for 24 hours using the Oxford Medilog 9200. Volunteers also wore Actillume monitors (Ambulatory Monitoring, Inc., Ardsley, NY) concomitantly to assess activity and illumination exposure, allowing verification of self-reported time-in-bed intervals from the lights-off recordings. A sleep log on sleep-activity was maintained; it included
information on alertness and fatigue level rated on a 10-point scale. Recordings usually commenced between 10:00 and 11:00 am. The next day, the equipment and sleep-wake diaries were retrieved. Volunteers were encouraged to maintain their usual daily routines including work, exercise, and bedtimes; but the equipment probably restricted activities somewhat.

Instrumentation
The Oxford Medilog 9200 recorders (Oxford Medical, Inc., Clearwater, Fl) used in this study are eight-channel digital cassette recorders powered by batteries, which allowed 24-hour monitoring. The standard recording montage included two electroencephalographic channels (C3-A2, C4-A1), two electro-oculographic channels (ROC-A1, LOC-A2), and two electromyographic channels (submental and forearm). Previous research has documented that unattended PSG recordings are comparable to laboratory PSG data (5) and that good interrater reliability and intrarater reproducibility can be obtained (6,7). Cassette recordings were played back onto the Medilog scanner and display unit, where they were digitized and scored by a trained polysomnographer using standard criteria (8). Medilog recordings averaged slightly less than 24 hours because each recording had to be preceded by a 20-minute calibration signal to permit digitization of the recordings.

Results
Average times to bed were 22:55 ± 61 minutes and rising times averaged 06:48 ± 86 minutes, yielding an average in-bed interval of 458 minutes. Mean and SD values for PSG sleep parameters are shown in Table 1. Volunteers underestimated their nocturnal sleep time by about 8 minutes (subjective sleep = 388.6 ± 105.8 minutes, EEG sleep = 395.8 ± 88.6 minutes), but no significant differences were found between the means. Sleep diaries indicated that volunteers underestimated out-of-bed afternoon-evening sleep by about 9 minutes (subjective afternoon-evening sleep = 20.5 ± 32.8 minutes, EEG afternoon-evening sleep = 29.6 ± 36.8 minutes); mean differences were not significantly different.

Morning sleep had not been included in the sleep-wake diaries. Nevertheless, we found that volunteers slept an average of 16 minutes during the morning hours, as revealed by EEG recordings between the final wake-up time and end of the recordings. These morning recordings averaged 258 ± 115 minutes. As expected, the amount of time spent in slow-wave sleep was minimal (median = 11 minutes).

Overall, the women slept out-of-bed an average of 44.83 ± 46.02 minutes (median = 34 minutes) throughout the 24-hour recordings (Figure 1). Out-of-bed sleep accounted for over 10% of the total 24-hour sleep. When contrasting subjective reports of out-of-bed sleep during the afternoon-evening versus EEG out-of-bed sleep, volunteers correctly reported only 38% of the sleep episodes; the rate of false-positive episodes of self-reported daytime sleep was 19% (Figure 2).

A significant correlation was found between age and afternoon-evening out-of-bed sleep (r = .46, p = .04). Other variables including nocturnal sleep duration, sleep efficiency, total wake time, exercise, caffeine use, and sleep aids did not significantly correlate with evening out-of-bed sleep. None of these variables, including age, was associated with out-of-bed morning sleep.

After adjusting for the possible effects of caffeine, exercise, and sleep aids, we found no significant correlations between accumulated out of bed sleep and rising or retiring times, nocturnal sleep structure, duration, or efficiency. No significant association was noted between out-of-bed sleep and self-reported fatigue or alertness. Women who woke up early accumulated less nocturnal sleep (r = .60, p < .01), but did not acquire more out-of-bed sleep. Those who reported use of sleep aids (i.e., alcohol or sleep medications) slept more throughout the 24-hour recordings than those who did not (F(4,17) = 6.94, p < .05).

Discussion
Postmenopausal women in this sample slept an average of 45 minutes out of bed, based on 24-hour EEG recordings. These volunteers exhibited substantially greater sleep outside of the major sleep period than volunteers in previously reported unattended PSG studies (3,4) or in a PSG study performed in a hospital unit (2). The out-of-bed sleep observed in our study was greater than that of self-reported daytime sleep was 19% (Figure 2).

Table 1. Polysomnographic Sleep Parameters in Postmenopausal Women (n = 21)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in bed (min)</td>
<td>458.00</td>
<td>83.51</td>
</tr>
<tr>
<td>Stage 1 (min)</td>
<td>42.24</td>
<td>28.72</td>
</tr>
<tr>
<td>Stage 2 (min)</td>
<td>290.88</td>
<td>64.94</td>
</tr>
<tr>
<td>Slow wave sleep (min)</td>
<td>15.19</td>
<td>15.09</td>
</tr>
<tr>
<td>Rapid eye movement sleep (min)</td>
<td>47.50</td>
<td>31.81</td>
</tr>
<tr>
<td>Total sleep time (min)</td>
<td>395.81</td>
<td>88.63</td>
</tr>
<tr>
<td>Total wake time (min)</td>
<td>62.19</td>
<td>44.67</td>
</tr>
<tr>
<td>Sleep efficiency index (%)</td>
<td>86.22</td>
<td>9.72</td>
</tr>
<tr>
<td>Total nap time (min)</td>
<td>44.83</td>
<td>46.02</td>
</tr>
</tbody>
</table>

Figure 1. This bar graph illustrates the amount of napping time for each postmenopausal woman. The out-of-bed recording period ranged from 06:48 to 22:55 hr.
ported, but was consistent with self-reported nap length from survey and sleep log data (9). Interestingly, out-of-bed sleep was not associated with self-reported fatigue or alertness, which might have reflected residual sleepiness.

The present observations of out of bed sleep support a previous report by our group from a representative sample of individuals older than 65 years of age (1). The current observations of out-of-bed sleep may be rather representative of the San Diego population. Previous at-home studies elsewhere might have used less representative samples, or there may be cultural differences between populations.

We note, however, that the out-of-bed EEG sleep estimates for the current sample were somewhat larger than estimates derived from an ongoing actigraphic study of a larger number of postmenopausal women of similar age. It is plausible that women in the present sample may have been less active throughout the recording periods because they were wearing the recording devices; conceivably, restricted activity might have offered more of an opportunity for out-of-bed sleep. It is also possible that the somewhat different inclusionary criteria for the two studies produced some bias, although the primary recruitment methods were similar. Even if selection or the recording devices produced some bias, it is reasonable to conclude that postmenopausal women do indeed sleep substantially out of bed, although they often failed to report such sleep episodes which were recorded.

Interestingly, volunteers in the present study tended to underestimate their out-of-bed sleep and their nocturnal sleep time. Moreover, evening out-of-bed sleep episodes were correctly identified by only 38% of the women, suggesting that these sleep episodes may not have been deliberate. This suggests that elders may often be genuinely unaware of their own propensity to doze. Laboratory polysomnography showing disturbed nocturnal sleep in elderly individuals must be interpreted from the perspective that people of retirement age may have failed to report substantial daytime sleep, of which laboratory staff would have been unaware without daytime and evening recording.

Consistent with previous findings, accumulated out-of-bed sleep was not related to nocturnal sleep parameters (4,9–11). Thus, our data neither confirm the idea that napping disturbs nocturnal sleep nor suggest that disturbed nocturnal sleep causes napping. We acknowledge, however, that volunteers in our study were relatively healthy and did not report significant sleep disturbances. These data are also in accord with previous reports demonstrating that increasing age is associated with greater afternoon-evening sleep (12–14).

A substantial amount of sleep was observed in the morning after final wake-up time; morning out-of-bed sleep, however, was not associated with age. We are surprised by this morning sleep after elderly volunteers arise from bed, but have repeatedly observed it. The present results support the notion of a gradual return to polyphasic sleep among elders, for whom the masking effects of social obligations become feeble, thus permitting the expression of daytime sleep propensities (9,15,16).

Acknowledgments

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References


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