

Insomnia and Daytime Napping in Older Adults

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Abstract: Insomnia, daytime sleepiness, and napping are all highly prevalent among the elderly, reflecting changes in sleep architecture, sleep efficiency, sleep quality, and circadian sleep-wake cycles. Insomnia is sometimes associated with subjective daytime sleepiness, as well as other clinical and socioeconomic consequences. The daytime sleepiness will at times lead to napping. Although napping is viewed as a common age-related occurrence, little is known about its benefits or consequences. Factors reported to be contributors to daytime napping include sleep-maintenance difficulty and sleep fragmentation with consequent daytime sleepiness, nighttime use of long-acting sedating agents, daytime use of sedating medications, and dementia. However, a correlation between sleep disturbance and daytime napping has not been consistently observed. Whether napping is beneficial, neutral, or detrimental is an important issue, in light of conflicting findings regarding the impact of

daytime napping on nighttime sleep and recent reports of an association between napping and adverse clinical outcomes, including increased mortality risk. Further research is needed to determine whether there is a cause-and-effect relationship between napping and insomnia, and between napping and adverse clinical outcomes, and to explore the clinical implications of improving insomnia and reducing daytime napping. Clinical evaluations of hypnotic agents should assess efficacy for both improving insomnia symptoms (particularly sleep-maintenance difficulty, in the case of elderly patients) and reducing daytime sleepiness that would lead to inadvertent napping.

Keywords: Elderly, insomnia, daytime sleepiness, napping

Citation: Ancoli-Israel S; Martin JL. Insomnia and daytime napping in older adults. *J Clin Sleep Med* 2006;2(3):333-342.

As people age, changes occur in sleep architecture, sleep continuity, sleep quality, and circadian sleep-wake patterns.^{1,2} Polysomnographic findings suggest that older adults spend less time in deeper stages of sleep (slow wave sleep or SWS) compared with younger adults; however, meta-analytic data suggest that the drop in SWS begins in the second decade of life and stabilizes by 60 years of age.² Older adults also often have an advanced sleep phase, which is defined by an advance of the sleep-wake rhythm in relation to the desired clock time, resulting in early evening sleepiness and early morning awakenings.^{3,4} The advanced sleep phase is often exacerbated by inadequate exposure to bright light, a common situation not only for institutionalized or housebound persons, but also for many community-dwelling younger and older adults.⁴⁻⁶

The disruption of sleep precipitated by age-related physiologic changes is compounded, or perpetuated, by sleep disturbances associated with comorbid medical, psychiatric, and psychosocial factors.^{1,7,8} Medical and psychiatric conditions that have been associated with insomnia include pulmonary disease, heart failure, chronic arthritis, chronic pain syndromes, stroke, diabetes, Alzheimer's disease, Parkinson's disease, gastrointestinal disorders, depression, anxiety, and specific sleep disorders such as periodic limb movements in sleep and restless legs syndrome.^{1,9} The 2003 National Sleep Foundation survey of 1000 older adults found that those with cardiac disease, stroke, lung disease, or depression were more likely to report sleeping less than 6 hours a night, any insomnia, or excessive daytime sleepiness. In addition, the more medical conditions the older adult had, the more poor sleep they reported.⁸

Important psychosocial factors that can cause sleep disturbance include retirement, isolation, loneliness, and bereavement.¹ Elderly persons may also have poor sleep habits, such as frequent napping during the day, spending extended time in bed, and going to bed too early (in part because of reduced participation in social or physical activities), or at times too late (in part because of forcing themselves to stay up until a "more appropriate" time) for their sleep-wake cycle.¹⁰

The extent to which napping affects nighttime sleep, daytime functioning, or overall well-being in the elderly is unclear.^{11,12} In addition, there have been recent reports of a possible association between napping and adverse medical outcomes.¹³⁻¹⁷ This paper provides an overview of insomnia in the elderly and examines published findings on napping in this population.

Disclosure Statement

This was not an industry supported study. Dr. Ancoli-Israel is a member of the Advisory Board and/or has participated in speaking engagements supported by Sepracor, Takeda Pharmaceuticals, King, Sanofi-Aventis, Cephalon, Merck, and Neurocrine Biosciences. Dr. Martin is a consultant for Sepracor Inc.; and has participated in speaking engagements supported by Takeda Pharmaceuticals.

Submitted for publication December 21, 2005

Accepted for publication April 22, 2006

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Insomnia in the Elderly

PREVALENCE

The prevalence of chronic insomnia increases with age. The 1991 National Sleep Foundation survey of 1000 US residents aged 18 years and older found the prevalence of chronic insomnia in the elderly cohort (age ≥ 65 years) to be 20%, compared with 9% in the total survey sample.¹⁸ Although older adults were included in this survey, they made up a small proportion of respondents, and therefore these results may not be very generalizable to all older adults. However, surveys that focused on the elderly have also been conducted. Almost a decade earlier, in 1982, the National Institute of Aging conducted the 3-center Established Populations for Epidemiologic Studies of the Elderly study to determine the prevalence of sleep complaints among 9828 community-dwelling elderly persons aged 65 and older.¹⁹ Fifty-seven percent of the participants reported at least 1 chronic sleep complaint, and 29% reported having insomnia. In each age cohort, the prevalence of insomnia was significantly higher among women than among men (25% vs 20%, 31% vs 21%, and 36% vs 29%, respectively; $p < .05$ for each sex difference). Analysis of 3-year follow-up data from more than 6800 persons aged 65 years and older who were assessed during Established Populations for Epidemiologic Studies of the Elderly found the annual incidence of chronic insomnia to be approximately 5%.⁹ More recently, the 2003 National Sleep Foundation survey of 1000 older adults found that 47% reported having symptoms of insomnia (difficulty falling asleep, waking a lot during the night, waking too early and not being able to get back to sleep, and waking up feeling unrefreshed) at least a few nights a week.^{8,20} A complete review of epidemiologic studies of sleep in older adults can be found in Ohayon.²¹

IMPACT OF INSOMNIA AND DAYTIME SLEEPINESS

Although 1 study has suggested that self-reported sleepiness in people with insomnia does not correlate with sleepiness on objective measures (i.e., the Multiple Sleep Latency Test) in adults,²² reports of insomnia have at other times been associated with increased complaints of daytime sleepiness^{23,24} and resultant unintentional and intentional naps.²³ In response to questions posed to participants in the 1991 National Sleep Foundation survey regarding daytime drowsiness, those with chronic insomnia reported that they were more than twice as likely to doze off during the day and feel tired in the morning “very often or sometimes” than those with no insomnia (Figure 1).²³ Respondents with chronic insomnia also reported being more likely to take naps during the daytime and to doze off when bored. Daytime sleepiness may be related to cognitive deficits.^{13,25,26} Ohayon et al found that older adults who reported excessive daytime sleepiness were more likely to report cognitive impairment across several dimensions, even after controlling for other known risk factors for cognitive impairment.²⁵ A study by Asada et al examined reported napping and later development of Alzheimer disease and found that although napping less than 1 hour had some protective effects, napping for longer than 1 hour per day was associated with a higher risk of Alzheimer disease among individuals with the ApoE $\epsilon 4$ genotype (which is associated with elevated Alzheimer disease risk).¹³

Although findings regarding daytime napping and mood are less clear, studies suggest that, among older people, reported daytime napping is associated with more symptoms of depression.¹⁷

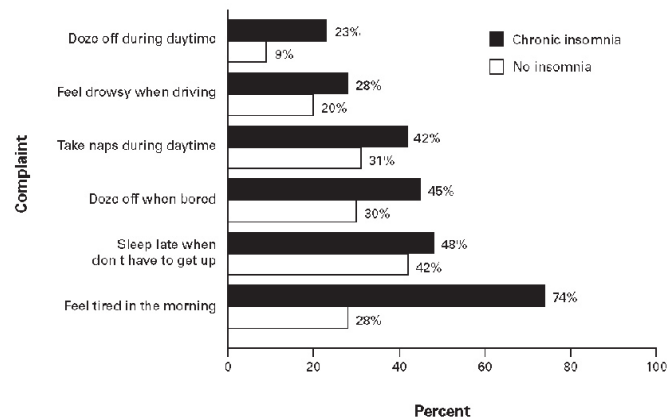


Figure 1—Percentage of respondents with chronic insomnia and no insomnia reporting different aspects of daytime drowsiness “very often or sometimes.” Adapted with permission from Roth and Ancoli-Israel. Daytime consequences and correlates of insomnia in the United States: results of the 1991 National Sleep Foundation Survey: II. Sleep 1999;22(Suppl 2):S354-8.

The study by Tamaki et al,²⁷ however, found that a short (< 30-minute) daytime nap actually had beneficial effects on mood. It is possible that nap duration may play a critical role and that older persons who are depressed are more likely to nap than their non-depressed counterparts.

Daytime sleepiness can have life-threatening consequences, as 5% of respondents in the 1991 survey reported having had an automobile accident due to sleepiness, compared with 2% of those with no insomnia.²³ An association was seen between risk of accidents and interrupted or insufficient total sleep. Of those reporting automobile accidents caused by sleepiness, 41% reported frequent midsleep awakenings, 27% reported frequent difficulty falling back to sleep, and 32% reported frequently waking up too early in the morning. Fifty percent reported frequently waking up feeling drowsy or tired.

Sleep in the older adult may be characterized by repeated nocturnal arousals and awakening, resulting in reduced total sleep time, reduced sleep efficiency, and daytime sleepiness and napping. Thus, elderly persons commonly complain of insomnia symptoms and report increased daytime fatigue, daytime sleepiness, and more frequent daytime napping.¹

Insomnia in the elderly may have serious negative medical,^{28,29} social,²³ and economic consequences³⁰ and, potentially, a negative impact on quality of life.²³ Sleep disturbance in the elderly with cognitive impairment, although not completely synonymous with chronic insomnia, has been associated with increased risk of placement in nursing homes^{1,29} and falls.^{31,32} In a prospective, 3.5-year study of 1885 men, Pollak et al determined that insomnia (defined as difficulty falling asleep or maintaining sleep or waking too early) was a stronger predictive factor for placement of elderly community-dwelling men in nursing homes than was cognitive impairment.²⁹

In an epidemiologic study involving 1526 men and women aged 64 to 99 years, multivariate analysis controlling for non-sleep-related risk factors for falls (including use of prescription medication, chronic conditions, difficulty walking or seeing, and depression) identified difficulty falling asleep at night (odds ratio [OR], 1.53; 95% confidence interval [CI], 1.04-2.24), waking up during the night (OR, 1.91; 95% CI, 1.44-2.54), difficulty

waking up in the morning (OR, 2.13; 95% CI, 1.28-3.55), and waking up too early in the morning and not being able to fall asleep again (OR, 1.64; 95% CI, 1.11-2.42) as significant correlates of falling.²⁸ Multiple regression analyses controlling for the non-sleep-related variables revealed a significant relationship ($p < .05$) between the number of falls and difficulty falling asleep at night, waking during the night, difficulty waking in the morning, daytime sleepiness, and needing to take a nap.

More recently, a study examining data from the Minimal Data Set evaluated the relationship between insomnia, hypnotic use, and falls in 34,163 nursing home patients in 437 nursing homes. Results suggested that untreated insomnia (adjusted OR, 1.52; 95% CI, 1.38, 1.66) but not hypnotic use (adjusted OR, 1.13; 95% CI, 0.98, 1.30) predicted falls.³¹ Although these data are very important, prospective studies on the relationship between insomnia, hypnotic use, and falls are needed, particularly because all data from the Minimal Data Set are based on subjective reports with no objective data validation. In addition, previous studies that have compared objective data versus subjective Minimal Data Set data on hypnotic use, falls, and insomnia resulted in low reliability and concluded that the Minimal Data Set underreports these measures.³³⁻³⁵

Results of a review of 8 studies that investigated the relationship between insomnia and coronary heart disease suggested that difficulty falling asleep and nocturnal awakenings may both be associated with future coronary events.³⁶ The authors speculated that subjective insomnia complaints might be a marker for autonomic dysfunction, which increases the risk of myocardial infarction. This association requires further investigation.

Napping in the Elderly

PREVALENCE AND PATTERNS

Reported prevalence rates for habitual daytime napping in elderly populations range from 22% to 61%.^{37,38} It is unclear if there are sex differences in napping. Icelandic ($N = 800$, aged 65-84 years)³⁹ and Swedish ($N = 876$, aged 65-79 years)³⁷ studies observed a significantly higher napping prevalence among older men than among older women; respective rates in the 2 studies were 50% versus 31% ($p < .001$) and 29% versus 15% ($p < .001$). However, several other studies observed no sex differences.^{38,40,41} Nap frequency and duration increase with age.^{20,38,40-42} In a study comparing daytime napping and 24-hour sleep-wake patterns in healthy elderly (mean age 83 years) and young adults (mean age 25 years), elderly subjects reported a significantly greater mean number of daytime naps over a 2-week period (3.4 vs 1.1 among young subjects; $p < .004$).⁴⁰ Almost two thirds of the elderly group (64%) took naps during the 2-week period, versus 45% of the younger-aged group. Results of studies examining napping patterns in “old old” and “young old” subjects (defined differently in each study) indicated that napping tendency continued to increase with age.^{20,38,42} The 2003 National Sleep Foundation survey found that 10% of respondents aged 55 to 64 years reported taking naps regularly (4 to 7 times/week), compared with 24% of respondents aged 75 to 84 years.²⁰ Similarly, Metz and Bunnell found that “older old” subjects (mean age, 80 years) took significantly more naps per week than did “younger old” subjects (mean age, 65 years; mean of 5 vs 4 naps; $p < 0.05$) and napped for a significantly longer mean duration (67.5 minutes vs 51.3 minutes for “younger old” subjects; $p < .05$).³⁸ Buysse et al found that elderly

Table 1—Potential Causes of Daytime Napping in the Elderly

Insomnia
Sleep fragmentation
Poor sleep quality
Nighttime use of long-acting hypnotics, anxiolytics, or drugs with sedative side effects
Daytime use of sedating medications
Advanced Sleep Phase Syndrome
Dementia

subjects took naps most frequently during the afternoon at around 2:30 PM, whereas young adults showed no distinct pattern.⁴⁰ Most studies have reported average nap durations in the elderly ranging from 28 to 59 minutes,³⁸⁻⁴⁰ although longer durations of up to 119 minutes have also been documented in adults aged 50 to 60 years.^{39,41}

CORRELATES OF DAYTIME NAPPING

There are several potential correlates to daytime napping in the elderly (Table 1).^{38-40,42-45} Several investigators have suggested that daytime napping is associated with symptoms of insomnia,^{39,43,46} sleep fragmentation,⁴⁷⁻⁵⁰ poor sleep quality,⁴⁴ use of long-acting hypnotics,^{38,47} circadian rhythm disturbance (e.g., advanced sleep phase),^{1,47} and dementia.⁴³

Studies in elderly populations have demonstrated significant correlations between sleep fragmentation (transient arousals) and daytime sleep tendency ($p = .02$),⁴⁶ as well as increased frequency of chronic difficulty maintaining sleep among persons reporting daytime napping (40% vs 28% among nonnappers; $p < .05$).³⁹

Consistent with these findings, Frisoni et al demonstrated a significant ($p < .05$) positive and independent association between daytime napping and not feeling rested in the morning.⁴³ Taken together, the findings from these studies support the relationship between nocturnal sleep disruption and daytime napping, with napping representing an attempt to compensate for nocturnal sleep deficit. A cause-and-effect relationship between insomnia and napping, however, has not been established because of the failure of many other studies in elderly populations to observe a statistically significant association between sleep disruption and daytime napping.^{37,38,40,41,51-54}

Effects of Napping

Whether napping is beneficial or detrimental is controversial, as both positive and negative effects have been reported.

POSITIVE EFFECTS

Most of the research on napping has been conducted in younger adults, shift workers, and long-distance drivers and has suggested beneficial effects of napping on performance and alertness.⁵⁵⁻⁵⁷ In young adults, short naps have been shown to improve subjective sleepiness, daytime alertness, neurobehavioral performance (particularly in sleep-deprived subjects),⁵⁸ and mood.⁵⁹ Napping also predicted responsiveness to hypnotics in 1 study of patients with primary circadian rhythm disorder.⁶⁰ Since some studies used small samples, results need to be replicated.

In elderly adults, napping has been shown to be associated with improvement in objective¹¹ and subjective evening sleepiness,²⁷

Table 2—Cohort Studies Assessing Mortality Risk Associated With Napping in Elderly Subjects

Reference	Study Population	Observation Period	Odds Ratio (95% Confidence Interval) for Mortality Risk vs Nonnappers*	
			Unadjusted	Adjusted
Hays et al ¹⁷	3962 community-dwelling subjects; aged 65 to 101 years	4 y	1.55 (NR)	1.30 (1.08-1.58) ^a
Burazeri et al ⁶⁵	1859 community-dwelling residents; at least 50 years of age	9-11 y (average of 10)	2.21 (1.28-3.80) (65-74 men)	1.24 (0.75-2.04) ^b
Bursztyn et al ⁶³	455 community-dwelling subjects; aged 70 years	6.5 y	2.0 (1.1-3.4)	2.1 (1.1-3.9) ^c
Bursztyn et al ¹⁴	442 community-dwelling subjects; aged 70 years	6 y	2.6 (1.14-6.23)	2.7 (1.07-6.84) ^d (men)

*Except for Hays et al, who compared mortality risk in frequent nappers (napped most of the time) vs infrequent nappers (napped sometimes, rarely, or never).

^aAdjusted for sex, age, race, residence, marital status, living arrangements, education, income, cognitive impairment, depressive symptoms, chronic illness, activities of daily living, gross mobility, physical activity, body mass index, smoking, and alcohol use.

^bAdjusted for age; smoking status; body mass index; systolic blood pressure; self-appraised health; serum levels of homocysteine, glucose, and albumin; creatinine concentration; history of coronary heart disease, congestive heart failure, diabetes, and stroke; and night sleep duration (< 6 hours, 6-8 hours, > 8 hours).

^cAdjusted for sex, blood pressure, smoking status, cholesterol level, diabetes mellitus, physical exercise level, nocturnal sleep duration, cerebrovascular disease, previous myocardial infarction, subjective financial hardship, general tiredness, and self-reported health status.

^dAdjusted for cardiovascular disease risk factors, including hypertension, diabetes mellitus, past cerebrovascular accident, past myocardial infarctions, physical activity level, cancer diagnosis, smoking status, and cholesterol and triglyceride levels.

as well as in performance.¹² Monk et al examined the effects of an afternoon nap (between 1:30 and 3:00 PM, average of 57 minutes per nap) on nocturnal sleep and evening alertness and performance in 9 healthy elderly subjects aged 74 to 87 years.¹¹ Napping was associated with a significant increase in mean sleep latency on the Multiple Sleep Latency Test (from 11.5 to 15.6 minutes; $p < .01$), indicating a significant decrease in objective evening sleepiness. However, napping had no effect on subjective evening alertness or on measures of evening performance (visual vigilance, manual dexterity, and response time), relative to no napping. In a study of 6 healthy, elderly, habitual nappers, Tamaki et al found that a short nap (30 minutes) significantly ($p < .05$) decreased subjective sleepiness.²⁷ In a polysomnographic laboratory study of naps in 32 healthy older adults, Campbell et al found that an afternoon nap (mean nap time 81 minutes) had no negative effect on subsequent nighttime sleep but did result in a significant increase in total sleep time per 24 hours and enhanced cognitive and psychomotor performance immediately after the nap and throughout the next day.¹²

Data from 2 case-control studies in Greek men of all ages suggested a protective effect of afternoon rests or naps against coronary heart disease.^{61,62} Trichopoulos et al reported a 30% (90% CI, 7%-46%) reduction in incidence of nonfatal coronary heart disease events in association with 30-minute naps,⁶¹ and Kalandidi et al reported that the duration of siesta (afternoon rest or sleep) was negatively related to risk of coronary heart disease events.⁶² However, the latter study did not establish a clear association between napping and coronary heart disease risk. The findings from these studies have not been confirmed or duplicated and contradict the recent reports of increased cardiovascular mortality associated with daytime sleepiness or napping.^{14-17,63,64}

It is important to note that none of the studies cited was able to experimentally control all confounding variables (i.e., other factors) that may contribute to the association between napping and cardiovascular risk. However, no study can ever control for every

confounding variable, and the studies cited did attempt to control for the most relevant confounders.

NEGATIVE EFFECTS (MORTALITY)

A number of studies have found a relationship between daytime napping and negative health outcomes (see Table 2). In a cohort of 5888 elderly subjects aged 65 to 100 years, Newman et al observed a significant association between daytime sleepiness complaints and mortality, with an unadjusted Cox hazard ratio of 1.71 (95% CI, 1.45-2.01).¹⁶ Women reporting both daytime sleepiness and frequent nocturnal awakening had a multivariate adjusted hazard ratio of 2.34 (95% CI, 1.66-3.29) for incident congestive heart failure, compared with women with daytime sleepiness but without frequent nocturnal awakenings. Other studies have associated napping with increased cardiovascular disease risk. A case-control study in a middle-aged Costa Rican population (mean age 57 years; 505 MI survivors; 522 age- and sex-matched controls) noted a significant trend toward taking long daily siestas (defined as afternoon nap or rest) and increased risk of MI, compared with taking a siesta less than once per week ($p = .02$), even after adjusting for cardiovascular disease risk factors (including lipids, smoking, body mass index, light physical activity, night sleep, and history of diabetes, hypertension, and angina).¹⁵ The prevalence of daily siestas among MI survivors was 44%, compared with 35% in controls ($p = .01$). This study, however, did not analyze the association between actual daytime sleep (ie, naps) and risk of MI and did not control for depression or dementia, all of which may be confounding variables.

Four prospective longitudinal studies specifically examined the risk of mortality associated with daytime napping in the elderly (Table 3).^{14,17,63,65} These studies showed a significant increase in risk of mortality in subjects who napped. Hays et al reported a 4-year mortality rate of 24% among frequent nappers versus 15% among infrequent nappers.¹⁷ The 4-year mortality risk was higher particularly in frequent nappers with moderate or severe

Table 3—Studies that Assessed Napping, Daytime Sleepiness, and Health Outcomes Among Older Adults.

Authors	Sample ^a	Design (location)	Assessment method	Main finding
Community-Dwelling Older Adults				
Hays et al ¹⁷	3962 (2581); 65-101	Prospective cohort (USA) ^b	Interview	<ul style="list-style-type: none"> • Frequent daytime nappers had higher mortality risk vs infrequent/nonnappers • 60.7% took siestas (men > women; MI survivors > no MI) • Lower 6-year survival rates for siesta takers vs for non-siesta takers; increased risk persisted in adjusted analyses • Mortality risk elevated only among those who slept vs those who “rested without sleep” and non-siesta takers
Bursztyn et al ^{63,64}	455 (249); 70	Prospective cohort (Israel)	In-person interview	
Newman et al ¹⁶	5888; mean, 73	Prospective cohort (USA) ^c	In-person interview	<ul style="list-style-type: none"> • Daytime sleeping associated with increased mortality and CVD risk among men and women, after controlling for known risk factors • Daytime sleeping associated with increased MI risk among women, after controlling for known risk factors
Campos & Siles ¹⁵	MI survivors: 505 (131); 57 ± 11 No MI controls: 522 (136); 57 ± 11	Case control (all seeking medical care at community facility in Costa Rica)	In-person interview	<ul style="list-style-type: none"> • MI survivors more likely to take regular siesta vs no-MI controls • MI survivors took longer siestas vs no-MI controls • More frequent siesta associated with MI status in adjusted analyses
Brassington et al ²⁸	1526 (971); 64-99	Descriptive (USA)	Telephone interview	<ul style="list-style-type: none"> • Daytime sleepiness and napping associated with increased fall risk • Only napping (not sleepiness) associated with increased risk in adjusted analyses
Burazeri et al ⁶⁵	1842 (1001); > 50	Prospective cohort (11 years; Israel)	In-person interview	<ul style="list-style-type: none"> • More than 8 hours of sleep in 24 hours associated with increased mortality among men only • Relationship stronger among those who reportedly took siesta
Foley et al ⁸	1506 (872); 55-84	Descriptive (random sample; USA)	Telephone interview	<ul style="list-style-type: none"> • Self-reported pain, depression, diabetes, stroke, and lung disease associated with likelihood of reporting daytime sleepiness
Nursing Home Residents				
Martin et al. 2006 ³⁴	184 (144); ≥ 65	Descriptive (USA)	Behavioral observation	<ul style="list-style-type: none"> • More daytime sleeping associated with more general impairment, medical comorbidities, time in bed during the day, time in the resident’s own room, assistance with ADLs, • More daytime sleeping associated with less participation in physical and social activities and lower cognitive functioning
Ancoli-Israel et al ⁷⁰	77 (58); 86 ± 7	Descriptive (USA)	Wrist actigraphy	<ul style="list-style-type: none"> • Residents with severe cognitive impairment slept more during daytime hours (6 AM-10 PM) than non- or mildly impaired residents
Older Adults in Other Settings				
Gooneratne et al ⁸³	114 (84); 78 ± 6	Between-groups comparison (USA)	Telephone interview and self-report questionnaire	<ul style="list-style-type: none"> • Participants with excessive daytime sleepiness (cases) had more functional impairment due to sleepiness than controls

^aData for the study sample are shown as the number of subjects (number of women); age, in years, as range, absolute age, or mean ± SD.

^bData from Established Populations for Epidemiologic Studies of the Elderly study

^cData from the Cardiovascular Health Study.

MI refers to myocardial infarction; CVD, cardiovascular disease

cognitive impairment, relative to infrequent nappers or nonnappers (OR, 1.73; 95% CI, 1.24-2.41).

Three studies using the same prospective dataset found a 2-fold increase in risk of mortality among nappers relative to nonnap-

pers, even after adjusting for traditional cardiovascular disease risk factors and after 12 years of follow-up.^{14,63,64} Thus, napping (siestas) appeared to be uniquely associated with mortality.⁶³ Further analyses of these results suggest that napping may have a stronger association with mortality in men than women.¹⁴ Although the 1999 study of Bursztyn et al observed a higher prevalence of napping among MI survivors (78% vs 58% among those without previous MIs; $p = .009$),⁶³ logistic regression analysis controlling for presence/absence of previous MIs found that napping was associated with increased mortality risk independent of prior MI history (OR, 1.78; 95% CI, 1.0-3.2). Furthermore, the association was still significant and remained double that of nonnappers in multivariate analysis (Table 2). Most of the deaths were caused by vascular diseases (cardiac, 31%; cerebrovascular, 13%); cancer and other causes accounted for 33% and 23% of deaths, respectively.

Bursztyn et al extended these findings in a subsequent study that stratified subjects according to daytime napping, daytime resting without napping, or no daytime napping or resting.¹⁴ The 6-year mortality rate for those who napped was more than double the rate for those who neither napped nor rested without sleeping (ie, ceased strenuous activity without sleeping; 19.0% vs 9.5%, respectively); the rate for those who only rested was 10.9% ($p < .02$). The mortality risk for those who napped for 1 hour or more was more than double the risk for those who only rested (OR, 2.6; 95% CI, 1.14-6.23) and almost quadruple the risk for those who neither napped nor rested (OR, 3.68; 95% CI, 1.36-9.92). The mortality rate in men was significantly higher than the rate in women (19% vs 10%, respectively; $p = 0.006$). In men, nap duration was a significant mortality variable (Figure 2). The mortality rate in men who napped for less than 1 hour was 14%, compared with 28% in men who napped for 1 hour or more ($p = .02$). In multivariate analysis incorporating conventional risk factors, duration of daytime sleep was significantly associated with mortality for men ($p = .02$). The other significant covariates were lack of exercise, cerebrovascular accident, and diabetes in men and diabetes and prior MIs in women, consistent with a previous finding of vascular disease as a major cause of mortality.⁶³ Men who napped 1 to 2 hours daily had a significantly increased mortality OR (OR, 2.61; 95% CI, 1.00-6.81) relative to those who neither napped nor rested (OR, 0.80; 95% CI, 0.34-2.38). Although duration of naps as a continuous variable was not predictive of mortality for women, women who napped for less than 1 hour and those who napped for 1 to 2 hours had over 4- and 5-fold respective increases in risk of mortality; ORs were 4.67 (95% CI, 1.22-17.80) and 5.57 (95% CI, 1.05-24.49), respectively.

Bursztyn and colleagues continued examining the relationship between naps and mortality with a 12-year follow-up of these same older adults.⁶⁴ Results showed that 74% of those not napping regularly survived, compared with only 64% who regularly took naps ($p < .01$). Hazard ratio for mortality for those who napped was 1.6 (CI 1.2-2.7). These results extended the finding of the 6-year observations. Increased mortality was independent of previous cancer, previous ischemic heart disease, hypertension, diabetes, smoking, renal dysfunction, or lipid levels, as well as activities of daily living and quality of life.

The final study examined the effects of daytime napping in relation to all-cause and cardiovascular mortality, while controlling for many recognized predictors of mortality.⁶⁵ The sample was part of the Kiryat Yovel Health Study and sampled all 1859 resi-

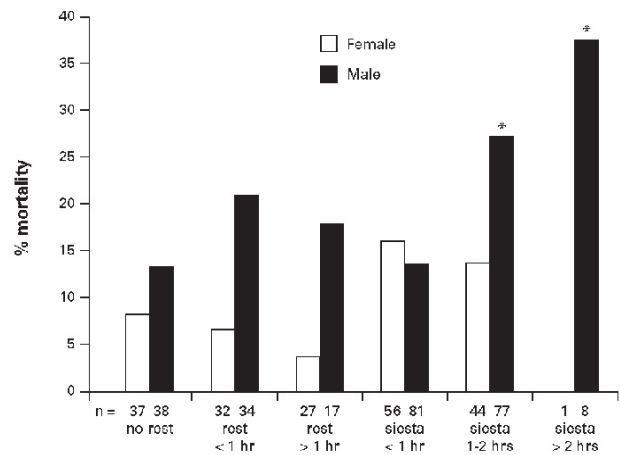


Figure 2—Six-year mortality rates in men and women according to rest or nap status. * $p = .02$ for men who napped 1 hour or more vs those who napped less than 1 hour.

Reprinted with permission from Bursztyn et al. The siesta and mortality in the elderly: effect of rest without sleep and daytime sleep duration. *Sleep* 2002;25:187-91.

dents of the community 50 years of age or older for an average of 10 years. Data were collected on the number and duration of daytime naps, in addition to a wealth of potential mortality covariates. In multivariate models among men, there was an association between mortality in men between the ages of 65 to 74 years who napped (defined as those who self-reported usually napping during the day) relative to those who did not ($p = .008$; OR, 2.21; 95% CI, 1.28-3.80).⁶⁵ Exclusion of patients with chronic conditions prior to assessment, however, reduced the magnitude of this association. Long naps (> 2 hours) were consistently associated with excess mortality risk in men regardless of age. Napping was not associated with mortality in women.

It is important to note that these studies could not control for all causes of increased mortality associated with illnesses that cause daytime sleepiness and lead to napping; therefore, cause and effect have not been established. More research is needed to more clearly elucidate whether daytime napping increases the risk of mortality.

EFFECTS ON NOCTURNAL SLEEP

The effect of napping on nocturnal sleep in the elderly is a controversial issue.⁴¹ Theoretically, napping may perpetuate a vicious cycle of sleep fragmentation, decreased sleep efficiency, fatigue, and napping.⁴⁶⁻⁴⁸ Studies examining the general population of elderly adults have reported an association between napping and nocturnal sleep difficulties, although the duration of daytime naps appears to be a key factor. Studies describing the effects of napping and daytime sleepiness on nighttime sleep are shown in Table 4. Metz and Bunnell demonstrated a potential association (not statistically significant) between increased sleep-onset latency and nap duration in an elderly population and suggested that duration of naps had more influence than frequency of napping or difficulty initiating sleep.³⁸ Longer naps have also been implicated as contributing to frequent nocturnal awakenings in the elderly.^{11,45,66} Monk et al demonstrated that a daily 1-hour afternoon “siesta” nap had negative effects on nocturnal sleep in terms of a polysomnographically recorded significant reduction

Table 4—Studies of Napping, Daytime Sleepiness, and Nighttime Sleep Disturbance Among Community-Dwelling Older Adults

Authors	Sample ^a	Design (location)	Assessment method	Main finding
<u>Community-Dwelling Older Adults</u>				
Metz & Bunnell ³⁸	132 (98); 58-95	Descriptive study	Questionnaire	• More frequent napping associated with use of medications for sleep
Hays et al ¹⁷	3962 (2581); 65-101	Prospective cohort study (USA) ^c	Interview	• Frequent daytime nappers reported more problems with nighttime sleep vs. infrequent/non-nappers
Campos & Siles ¹⁵	MI survivors: 505 (131); 57 ± 1 No-MI controls: 522 (136); 57 ± 11	Case control; seeking medical care at community facility (Costa Rica)	In-person interview	• Siesta associated with poorer nighttime sleep quality across groups
Monk et al ¹¹	9 (5); 74-87	Within-subject experiment (nap vs no-nap); (USA)	PSG	• 1.5 hour daytime nap lead to decreased nighttime sleep efficiency and earlier morning rise times
Yoon et al ⁴⁵	Older (60-75 y): 60 (38); 66 ± 5 Younger (18-32 y): 73 (47); 24 ± 4	Cross-sectional comparison (USA)	Wrist actigraphy with sleep diary	• Trend for more napping among older vs. younger group • Older group more likely to nap within 2 hrs of bedtime • Older adults who napped within 2 hrs of bedtime awoke and got out of bed earlier, spent less time in bed, and had shorter sleep periods vs. older adults who did not nap
Bonanni et al ²⁶	Mild AD: 9; 64 ± 9 Moderate AD: 11; 66 ± 7 Nondemented controls: 12; 61 ± 5	Cross-sectional comparison (Italy)	PSG, MSLT	• Patients with moderate disease had shorter sleep onset latency than patients with moderate disease or controls • Daytime sleepiness associated with more impaired cognition across several domains
<u>Nursing-Home Residents</u>				
Martin et al ³⁴	184 (144); ≥ 65	Descriptive (USA)	Wrist actigraphy	• 72% of residents who slept at least 15% of the day (9a-5p) had nighttime sleep efficiency <80%

^aData for the study sample are shown as the number of subjects (number of women); age, in years, as range, absolute age, or mean ± SD.

^bData from the 1991 National Sleep Foundation Survey

^cData from Established Populations for Epidemiologic Studies of the Elderly study

PSG refers to polysomnography; MSLT, Multiple Sleep Latency Test; AD, Alzheimer disease

in total sleep time ($p = .001$) and sleep efficiency ($p = .03$) and significantly earlier wake times ($p = .002$).¹¹ Yoon et al also demonstrated significantly earlier wake times ($p < .001$) in elderly subjects taking evening naps.⁴⁵ Although it can be argued that the napping time should be added to the overall total sleep time, these results nonetheless highlight the potential deleterious effects of daytime napping.

In contrast, other studies have found no significant effect of napping on nighttime sleep parameters in the general elderly population.^{12,37,38,54,67} Bliwise examined factors related to sleep quality in healthy elderly women (mean age, 68 years) identifying themselves as good ($n = 22$) or poor ($n = 16$) sleepers.⁵⁴ Poor sleepers were characterized by polysomnographically measured significant reductions in total sleep time and significantly more subjective nonrestorative sleep ($p < .05$ vs good sleepers). No differences were found between good and poor sleepers in the number of daily naps, suggesting the absence of an effect of napping on nocturnal sleep. Mallon and Hetta found no difference in total sleep time or sleep problems between nappers and nonnappers in a study of 876 Swedish elders (aged 65-79 years),³⁷ and Metz and Bunnell found no significant relationship between napping and number of nocturnal awakenings, sleep-onset latency, total sleep

time, or quality of sleep, although a trend was noted toward sleep-onset difficulty and duration of napping.³⁸ Hsu also found no correlation between naps and quality of sleep among 80 community-dwelling Chinese elders.⁶⁷ Campbell et al, as mentioned above, found that an afternoon nap did not have a statistically significant effect on subsequent nighttime sleep, although there was a non-significant increase in sleep-onset latency in this study.¹² This is consistent with Monk et al's finding discussed above that a siesta had some detrimental impact on subsequent nighttime sleep.¹¹

Improvement of Insomnia and Reduced Napping in Elderly Persons

There appears to be growing interest in the effect of insomnia treatment on daytime sleepiness and napping in the elderly. Circadian phase shifting with the use of timed bright-light therapy has been shown to improve nighttime sleep consolidation in community-dwelling elderly patients with sleep maintenance insomnia⁶⁸ and in institutionalized patients with dementia and sleep disturbance.^{6,68-72} Kobayashi et al reported that exposure in the morning to 1 hour of bright-light therapy at an intensity of 8000 lux for 5 consecutive days significantly improved subjective sleep maintenance and sleepiness and resulted in a nonsignificant reduction

in daytime napping in 10 healthy Japanese women aged 50 to 70 years.⁷³ Of 5 subjects who took daytime naps under controlled conditions, 3 subjects eliminated daytime naps with the use of bright-light therapy and 2 reduced their naps. In this study, morning bright-light therapy did not significantly improve the number of nocturnal awakenings, sleep latency, or sleep efficiency. In another study, 4 weeks of morning bright-light therapy for 2 hours at an intensity of 3000 to 5000 lux significantly increased nighttime sleep time and significantly decreased daytime sleep time in 14 inpatients with dementia and associated sleep and behavior disorders (average age: 75 years).⁷⁴ However, other studies have found no significant change in daytime sleepiness following improvement of insomnia with bright-light therapy in community-dwelling elderly persons.⁶⁸ Further research is needed to establish timing, intensity, and duration of bright-light therapy for optimum nighttime and daytime effect.

Most studies of hypnotic agents have not evaluated the effects of treatment on daytime napping, yet this important endpoint needs to be investigated in studies of hypnotic agents. In 1 clinical evaluation of the effect of the hypnotic agent eszopiclone in elderly patients with chronic insomnia, daytime naps were included as an efficacy endpoint.⁷⁵ In this study, sleep efficacy (improved sleep latency, sleep maintenance, and total sleep time) was coupled with significantly reduced duration and number of patient-reported daytime naps, as well as with improvements in patient reports of daytime alertness, sense of well-being, and physical functioning. Further investigations are needed to explore the clinical implications of these improvements in nocturnal sleep and daytime napping.

CONCLUSIONS

Insomnia and daytime napping are common among elderly. Although napping has traditionally been viewed as beneficial, or at a minimum harmless, this perception has been challenged by some published data. Daytime napping may perpetuate a cycle of reduced sleep quality and daytime sleepiness and has been associated with increased risk for cardiovascular morbidity or total mortality, although no causation has been established. These data suggest that napping should not be automatically dismissed as inconsequential. Further examination of this behavior may be warranted.

The mortality findings associated with daytime napping have been interpreted in several ways. First, the association between mortality and daytime napping suggests that napping may be a marker of excessive daytime somnolence, a problem associated with negative outcomes,¹⁶ rather than as a simple compensatory strategy for a restricted night sleep. Consequently, some have hypothesized that excessive daytime somnolence may result from the presence of an underlying sleep disorder.⁷⁶ The conventional wisdom suggests that a number of older individuals with excessive daytime somnolence may have undetected sleep apnea, a condition with clear age- and sex-related differential prevalence that is linked strongly to increased cardiovascular risk.⁷⁷ While this may partially explain the relationship between daytime napping and mortality, some studies have found no association between snoring (a cardinal symptom of sleep apnea) or body mass index (a risk factor for sleep apnea) and napping-related mortality.⁶⁴

One causal hypothesis suggests that the increased heart rate and blood pressure observed directly after the onset of daytime

napping is similar to the changes seen upon morning awakening.⁶³ These morning heart-related changes have been linked to an increased rate of MI and other acute cardiovascular events.^{78,79} Increased heart rate and blood pressure result in increased myocardial oxygen demand, which subsequently may act as a trigger for cardiovascular events in the morning after awakening and in the afternoon after napping cessation. Bursztyn et al^{14,63} have further hypothesized that arousal from afternoon napping may result in an abrupt surge of sympathetic nervous system activity,⁸⁰ triggering hemodynamic changes (e.g., increased myocardial oxygen demand and brain vascular shear stress precipitated by abrupt elevation of blood pressure and heart rate upon awakening), as well as thrombogenic changes that may contribute to cardiovascular events.^{80,81} Further, the rapid increase in myocardial oxygen demand immediately after a 2-hour rest (not necessarily resulting in sleep) appears similar in magnitude to the increase observed after morning awakening in healthy young adults.⁸¹ This finding suggests that arousal from afternoon napping, like morning arousal, may result in a period of increased cardiovascular risk.⁶³ There is preliminary evidence, however, that the changes in heart rate upon arousal from napping are negligible, suggesting lesser potential for ischemia, compared with the morning hours soon after arousal.⁸² It is difficult to determine, however, whether napping-related hemodynamic changes directly contribute to mortality risk or whether the overlap in risk factors for these 2 conditions accounts for the observed relationships. Daytime sleepiness and napping may be directly caused by medical illnesses (and medications used to manage cardiovascular risk factors), resulting in the observed link between napping and mortality. Further research using objective measures of both sleep apnea and daytime somnolence are needed to fully address this issue.

On the other hand, it is plausible that long daytime sleep may play a direct role in enhancing the risk of mortality. If a causal relationship between napping and mortality could be determined, then napping would feasibly represent a lifestyle factor similar to diet, exercise, and smoking status and, thus, be amenable to modification. However, possible mechanisms for this causal relationship have not yet been thoroughly elucidated.

In contrast to these negative effects, short daytime naps have demonstrated positive benefits, including increased alertness.^{12,81} It has also been argued that short afternoon naps practiced in adults may be an important stress-coping mechanism, therefore having a beneficial effect.⁸¹ Given the conflicting evidence, the clinical recommendations of these data are not clear.

More research is needed to address many issues related to insomnia and napping in the elderly, including the cause-and-effect relationship between insomnia and napping; the role, if any, of napping in cardiovascular morbidity and total mortality; the characterization of nappers at risk for cardiovascular morbidity or mortality; and the impact of improving insomnia and reducing daytime naps on clinical outcome. The effect of reduced napping on nocturnal sleep latency and continuity and on next-day cognitive and physical functioning also needs to be researched.^{80,81} Future insomnia treatment-efficacy trials, whether drug or behavioral therapies, should include evaluation of next-day benefits in terms of reduced daytime sleepiness and napping (daytime wakefulness) and improvement of cognitive and physical functioning and quality of life.

ACKNOWLEDGMENTS

Funding support was provided by NIAAG08415, NCI A85264, M01 RR00827, and NIA 5 P60 AG10415. The authors would like to acknowledge Amy Yamamoto and H. Heith Durrence of Sepracor, Inc., for their assistance in the preparation of earlier drafts of this manuscript.

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