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Insomnia in Community-Living Persons with Advanced Age

Brienne Miner, MD, MHS¹, Thomas M. Gill, MD¹, H. Klar Yaggi, MD, MPH^{1,2}, Nancy S. Redeker, PhD, RN³, Peter H. Van Ness, PhD, MPH¹, Ling Han, MD, PhD^{1,3}, and Carlos A. Vaz Fragoso, MD^{1,3}

¹Yale School of Medicine, Department of Internal Medicine, New Haven, CT

²Veterans Affairs Clinical Epidemiology Research Center, West Haven, CT

³Yale School of Nursing, West Haven, CT

Abstract

OBJECTIVE—To evaluate the epidemiology of insomnia, including demographic and clinical correlates, in older persons with advanced age, averaging >80 years.

DESIGN—Cross-sectional.

SETTING—Community.

PARTICIPANTS—379 persons from the Yale Precipitating Events Project: mean age was 84.3 years; 67.8% were female; and 11.9% were African-American.

MEASUREMENTS—Insomnia Severity Index (ISI), wherein scores ≥8 established a case of insomnia, further stratified as mild, moderate, and severe by ISI scores of 8–14, 15–21, and 22–28, respectively. Baseline characteristics included age, sex, race, education, smoking, obesity, medical conditions, depressive symptoms (Center for Epidemiologic Studies Depression score ≥16), cognitive impairment (Mini Mental State Examination score <24), restless legs syndrome (RLS), self-reported sleep-disordered breathing (SDB), medications, and daytime sleepiness (Epworth Sleepiness Scale [ESS], range 0–24).

RESULTS—Insomnia was established in 163 (43.0%) participants, with their ISI score averaging 12.3 (mild range). For the entire sample (N=379), baseline characteristics were as follows: on average, 30.1% did not complete high school, 5% were current smokers, 19.2% were obese, 28.2% had cardiovascular disease, 19.3% had chronic lung disease, 27.2% had depressive symptoms, 16.1% had cognitive impairment, 36.8% had RLS, and 3.4% had self-reported SDB; mean number of medications was 9.2 and mean ESS was 6.4. In multivariable regression models, only depressive symptoms and RLS were associated with insomnia: adjusted odds ratios (95% confidence intervals) of 8.34 (4.49, 15.47) and 2.49 (1.48, 4.21), respectively.

CONCLUSION—In a sample of older persons with advanced age, high medical burden, and polypharmacy, insomnia was highly prevalent but, unexpectedly, mild in severity and associated only with depressive symptoms and RLS. The discordance of high prevalence but mild severity of insomnia in advanced age further highlights the need for diagnostic confirmation with objective

measures of sleep disturbances, while the strong associations with depressive symptoms and RLS inform priorities in the management of insomnia.

Keywords

insomnia; epidemiology; aging; restless legs syndrome; depression

INTRODUCTION

Although prior work has shown that insomnia commonly occurs in older persons,^{1–5} those with advanced age (averaging >80 years) were under-represented. There was also heterogeneity in the methods used to evaluate insomnia, with some studies including single-item sleep questions,^{3,4} which do not distinguish between insomnia symptoms and insomnia diagnosis (defined as insomnia symptoms with a negative impact on daytime functioning).^{2,6,7} In contrast, the Insomnia Severity Index (ISI) is a validated screening questionnaire that captures patient-reported insomnia symptoms and daytime impairments, and is thus useful for identifying insomnia cases and their severity in epidemiologic studies.^{6,7}

In the current study, we evaluated the epidemiology of insomnia and its severity, as measured by the ISI, in a sample of community-living persons with a mean age of 84.3 years (range 78–102). We hypothesized that insomnia would be more prevalent and severe with advancing age, and cross-sectionally associated with key demographic and clinical characteristics.

METHODS

Study Population

Participants were drawn from the Yale Precipitating Events Project (PEP), an ongoing longitudinal study of community-living persons.⁸ Collection of information on the ISI first began seven years after the study was initiated, i.e., at the 90-month interview in the years 2005–2007 (N=379 [50.3% of the initial cohort]). Supplementary Appendix S1 provides detailed information on the PEP cohort and describes differences between our analytical sample and the initial cohort. The Yale University Human Investigation Committee approved the study protocol and all participants provided written informed consent.

Demographic and Clinical Characteristics

Characteristics included age, sex, race, education, smoking status, body mass index, cardiovascular disease (self-reported, physician-diagnosed myocardial infarction, stroke or congestive heart failure), chronic lung disease (self-reported, physician-diagnosed chronic obstructive pulmonary disease, bronchitis, emphysema or asthma), depressive symptoms (Center for Epidemiologic Studies Depression [CES-D] score ≥ 16),⁹ cognitive impairment (Mini Mental State Examination [MMSE] score <24),¹⁰ and medication use (prescribed and over-the-counter).

Sleep-related conditions included primary sleep disorders (restless legs syndrome [RLS] and sleep-disordered breathing [SDB]) and daytime sleepiness. RLS and SDB were assessed by

self-report. To ascertain whether participants had RLS, the following features were evaluated sequentially:¹¹ (1) at night, while lying in bed, (2) do you feel that various parts of your body are restless, (3) in addition to an urge to move, especially in the legs or feet, (4) which may improve by moving or rubbing the legs or feet? Those who reported having these four features at least one to two times per week over the previous two weeks were considered to have RLS. SDB was defined as self-reported, physician diagnosed sleep apnea or presence of a breathing disorder that happens only during sleep. Daytime sleepiness was assessed by the Epworth Sleepiness Scale (ESS), with scores ranging from 0–24 and with a threshold 10 previously validated as establishing excessive daytime sleepiness in older populations.^{12,13}

Insomnia Severity Index (ISI)

The ISI consists of 7 questionnaire items that capture patient-reported symptoms and daytime consequences of insomnia, as per criteria from the *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition* (DSM-IV).^{6, 7} ISI scores range from 0–28; the higher the score, the more severe the insomnia.^{6, 7} ISI scores ≥ 8 establish a case of insomnia, with severity further stratified by ISI scores of 8–14 for subthreshold insomnia (heretofore termed mild), 15–21 for moderate insomnia, and 22–28 for severe insomnia.^{6, 7} Supplementary Appendix S1 summarizes prior work which has validated the ISI as a screening questionnaire for identifying insomnia cases in epidemiologic studies.^{6, 7}

Statistical Analysis

Distributions of key characteristics were summarized as means ($\pm$ standard deviations) or frequencies (%), and compared between participants with and without insomnia (ISI ≥ 8), using Student t-test or Chi square-test, as appropriate.

In unadjusted logistic regression models, we examined separately the association of each demographic and clinical characteristic with the outcome of insomnia (ISI ≥ 8). We then simultaneously included all characteristics in an adjusted logistic regression model to estimate the independent association for each characteristic with insomnia, using adjusted odds ratios (ORs) and 95% confidence intervals (CIs). In linear regression models, we examined the association of demographic and clinical characteristics with insomnia severity (ISI score) as the outcome. These linear regression models estimated unadjusted and adjusted absolute difference (AD) and their 95% CIs on predicted ISI scores associated with each characteristic.

ESS had 5.5% missing data, while RLS, self-reported SDB, and number of medications were missing for <5% of participants. Complete data were available for all other variables in the analysis. We used missing category for ESS as an alternative to complete case analyses in the logistic regression model, but this did not change our results substantially. We therefore present only the complete case analyses.

All analyses were conducted using SAS version 9.4 software (SAS Institute Inc. 2011; Cary, NC). Model fit was inspected using collinearity diagnostics and residual plots (with no problems identified). A p value <0.05 was used to indicate statistical significance.

RESULTS

Table 1 reports demographic and clinical characteristics. The mean age was 84.3 years, 67.8% were female, 11.9% were African-American, 30.1% did not complete high school, 5% were current smokers, and 19.2% were obese (BMI ≥ 30). The prevalence of other key characteristics confirmed high medical burden and polypharmacy. Relative to participants who did not have insomnia (ISI ≤ 8), those with insomnia (ISI ≥ 8) had a higher prevalence of depressive symptoms and RLS, took more medications, and had higher ISI and ESS scores. The mean ISI in those with insomnia was 12.3 versus 3.0 for those without insomnia.

Table 2 reports odds ratios (ORs) with 95% confidence intervals for having insomnia (ISI ≥ 8), according to key characteristics. In the multivariable model, only depressive symptoms and RLS were strongly associated with insomnia: adjusted ORs of 8.34 (4.49, 15.47) and 2.49 (1.48, 4.21), respectively.

Table 3 reports the associations between key characteristics and the severity of insomnia symptoms, as measured by the predicted absolute difference in ISI score (continuous variable). In the multivariable model, participants with depressive symptoms had ISI scores that were 5.14 (3.97, 6.32) points higher than those without depressive symptoms, while participants with RLS had ISI scores that were 2.20 (1.12, 3.27) points higher than those without RLS.

DISCUSSION

In the current study, we have evaluated the epidemiology of insomnia (ISI ≥ 8) and its severity (ISI range of 0–28) in a sample of 379 community-living older persons who had a mean age of 84.3 years, high medical burden, and polypharmacy. Our results show that insomnia was highly prevalent (43.0%) but, unexpectedly, mild in severity (mean ISI of 12.3) and associated only with depressive symptoms and RLS.

Older persons are at high risk of having insomnia, given that aging adversely affects sleep-wake physiology and is associated with high medical burden and polypharmacy.^{1–5} Thus, our observation that insomnia in persons with advanced age, high medical burden, and polypharmacy is highly prevalent but mild in severity is surprisingly discordant. There are several possible mechanisms for this discordance in advanced age. First, insomnia may be better tolerated in older age due to lower daily demands (sedentary, post-retirement) and greater flexibility in sleep-wake scheduling.^{14, 15} Second, the paradox of well-being, in which older persons are less likely to report dissatisfaction because their actual state of health exceeds the expected level, may lead to underreporting of insomnia severity.¹⁶ Finally, prior work has shown an association between aging and reduced sensory awareness to symptom severity: for example, older persons report milder respiratory symptoms in response to bronchoconstriction, have decreased symptoms in response to hypoglycemia, and have higher rates of silent myocardial ischemia, as compared with younger persons.^{17–19} A recent report has additionally shown milder levels of insomnia and daytime sleepiness in older as compared with middle-aged persons, despite more severe polysomnography-confirmed primary sleep disorders in older age.²⁰

Nonetheless, our results highlight two conditions, depressive symptoms and RLS, as having strong associations with insomnia. While we cannot infer causation in this cross-sectional analysis, prior work has established a strong basis for these as causal factors in insomnia.^{21, 22} Our results, therefore, confirm that RLS and depressive symptoms may be modifiable targets in persons of advanced age with insomnia. Notably, these conditions may be treated with behavioral therapies, e.g. avoidance of alcohol and caffeine in RLS,^{23–25} and cognitive behavioral therapy (CBT) for depression.²⁶ Behavioral interventions are especially meaningful in an aging population, given their increased vulnerability to adverse effects from polypharmacy.²⁷ Moreover, because depressive symptoms were prevalent in our study sample, behavioral interventions that target both depression and insomnia may be increasingly required in advanced age.

It is also important to note that RLS may occur secondarily, in response to nutritional deficiencies (iron, folate, and magnesium), uremia, and medications (antidepressants, sedating antihistamines, central dopamine receptor antagonists).²⁵ Given these secondary mechanisms, we posit that the high prevalence of RLS in our study sample (36.8%) may have been due to a high medical burden and polypharmacy.

We did not find an association between age and insomnia over our age range of 78–102 years. The association of age with insomnia symptoms has been examined in many studies with mixed results.⁵ When looking more specifically at the association of age with insomnia, both Ohayon and Dragioti suggest, as was found in our study, that insomnia does not increase in prevalence in elderly individuals.^{5, 28} A study by Roth *et al.* found lower rates of insomnia among persons aged 65 years and above.¹⁴ It is possible that older persons with insomnia symptoms are less likely to report a negative impact on daytime functioning, which is required to fulfill a diagnosis of insomnia.^{5, 14} Another explanation is that most age-related changes in sleep-wake physiology have taken place by the seventh decade of life,²⁹ suggesting that aging alone would have a minimal effect on perceived sleep quality in our sample of older persons averaging 84.3 years.

In our study, we found that cardiorespiratory conditions, cognitive impairment, self-reported SDB, and polypharmacy were not statistically associated with insomnia, despite evidence that these characteristics are risk factors for insomnia in younger age groups.^{1–5} As to mechanisms underlying this lack of association in our study sample, we again postulate that advanced age may be increasingly associated with the paradox of well-being, reduced sensory awareness to symptom severity, and/or lower daily demands that better tolerate less restorative sleep.^{14–16} In contrast, the strong associations of depressive symptoms and RLS with insomnia in our study sample may reflect shared diagnostic features across these conditions (these diagnoses are symptom-based, in contrast to criteria that establish cardiorespiratory disease [spirometry, echocardiography]).

The strengths of this study include: participants with advanced age; use of a validated screening instrument to assess insomnia; and concurrent availability of key demographic and clinical characteristics. There are also potential limitations. First, our modest sample size may have limited the statistical power of our analyses. Second, participants were drawn from a single urban area, limiting the generalizability of our results. Third, SDB was assessed by

self-report rather than polysomnography, likely underestimating the prevalence and association of this condition with insomnia.³⁰ Third, the severity of available medical conditions could not be established objectively, and other key risk factors for having insomnia were not evaluated, including anxiety, digestive disease, sleep-disruptive symptoms (e.g. nocturia, dyspnea, and pain), and psychosocial factors. Finally, the effect of medications (e.g. hypnotics) as potentially attenuating a patient's perception of insomnia severity, relative to an objectively measured sleep disturbance, was not evaluated.

To address the noted limitations, future work should evaluate larger cohorts of older persons with advanced age and include a longitudinal design having a broader array of insomnia-based risk factors. Future work should also evaluate objective measures of sleep disturbances (e.g. actigraphy) to better ascertain the potential discordance of high prevalence but mild severity of patient-reported insomnia in advanced age.

In conclusion, in our sample of community-living persons with advanced age, high medical burden, and polypharmacy, we found that insomnia was highly prevalent but, unexpectedly, mild in severity and associated only with depressive symptoms and RLS. In advanced age, the discordance of high prevalence but mild severity of insomnia further highlights the need for diagnostic confirmation with objective measures of sleep disturbances, while strong associations with depressive symptoms and RLS inform priorities in the management of insomnia.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Financial/Personal Conflicts	Miner	Redeker	Yaggi	Gill
	No	No	No	No
Employment/Affiliation	X	X	X	X
Grants/Funds	X	X	X	X
Honoraria	X	X	X	X
Speaker Forum	X	X	X	X
Consultant	X	X	X	X
Stocks	X	X	X	X
Royalties	X	X	X	X
Expert Testimony	X	X	X	X

Financial/Personal Conflicts	Miner	Redeker	Yaggi	Gill
	No	No	No	No
Board Member	X	X	X	X
Patents	X	X	X	X
Personal Relationship	X	X	X	X

Financial/Personal Conflicts	Van Ness	Han	Vaz Fragoso
	No	No	No
Employment/Affiliation	X	X	X
Grants/Funds	X	X	X
Honoraria	X	X	X
Speaker Forum	X	X	X
Consultant	X	X	X
Stocks	X	X	X
Royalties	X	X	X
Expert Testimony	X	X	X
Board Member	X	X	X
Patents	X	X	X
Personal Relationship	X	X	X

Author contributions: Dr. Brienne Miner had full access to study data and takes responsibility for data integrity and accuracy of data analysis. Author contributions included: conception and design—BM, NSR, HKY, TMG, PHVN, LH, and CAVF; analysis and interpretation— BM, NSR, HKY, TMG, PHVN, LH, and CAVF; and drafting the manuscript for intellectual content— BM, NSR, HKY, TMG, PHVN, LH, and CAVF. We report no conflicts of interest.

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Impact

We certify that this work is novel. In a sample of older persons with advanced age, high medical burden, and polypharmacy, we found that insomnia was highly prevalent but, unexpectedly, only mild in severity and associated only with depressive symptoms and RLS. These results further highlight the need for diagnostic confirmation of patient-reported insomnia with objective measures of sleep disturbances, while the strong associations with depressive symptoms and RLS inform priorities in the management of insomnia.

Table 1

Demographic and clinical characteristics for the analytical sample (“All”) and according to insomnia

Characteristic	ALL (N=379)	Insomnia		p value ^c
		No (ISI <8) N=216 ^a	Yes (ISI ≥ 8) N=163 ^b	
	Mean ± SD or n/N (%) ^d			
Age (years)	84.3±4.5	84.6±4.6	84.0±4.4	0.165
Range (years)	78–102	78–99	78–102	
Female sex	257 (67.8)	144 (37.8)	113 (29.8)	0.583
Non-Hispanic white race	334 (88.1)	186 (49.1)	148 (39.1)	0.163
Did not complete high school	114 (30.1)	66 (17.4)	48 (12.7)	0.816
Current smoker	19 (5.0)	13 (3.4)	6 (1.6)	0.302
Obese ^e	74 (19.2)	41(10.8)	33 (8.7)	0.759
Cardiovascular disease ^f	107 (28.2)	58 (15.3)	49 (12.9)	0.492
Chronic lung disease ^g	73 (19.3)	36 (9.5)	37 (9.8)	0.140
Depressive symptoms ^h	103 (27.2)	23 (6.1)	80 (21.1)	<.001
Cognitive impairment ⁱ	61 (16.1)	39 (10.3)	22 (5.8)	0.232
Restless legs syndrome ^j	138 (36.8)	53 (14.0)	85 (22.4)	<.001
Sleep disordered breathing ^k	13 (3.4)	6 (1.5)	7 (1.8)	0.427
No. of medications	9.2±3.8	8.7±3.8	9.7±3.7	0.014
Insomnia Severity Index (ISI)	7.0±5.5	3.0±2.4	12.3±3.8	<.001
Mild insomnia (ISI=8–14)	124 (32.7)	NA	124 (76.1)	NA
Moderate insomnia (ISI=15–21)	33 (8.7)		33 (20.3)	
Severe insomnia (ISI=22–28)	6 (1.6)		6 (3.7)	
Epworth Sleepiness Scale (ESS)	6.4±4.6	5.6±4.4	7.4±4.7	<.001
Daytime sleepiness (ESS ≥ 10)	82 (22.9)	37 (18.1)	45 (29.2)	0.014

ISI=Insomnia Severity Index; NA, not applicable; SD=standard deviation.

^a57.0% of total sample.^b43.0% of total sample.^cDerived from Student t-test for continuous and chi-square test (df=1) for categorical variables.^dPercent of the analytical sample (N=379)^eBMI ≥ 30^fSelf-reported, physician-diagnosed myocardial infarction, stroke or congestive heart failure.^gSelf-reported, physician-diagnosed chronic obstructive pulmonary disease or asthma.^hCenter for Epidemiologic Studies Depression scale (CES-D) score ≥ 16ⁱFolstein Mini-Mental Status Examination (MMSE) score <24

^jSelf-reported, as occurring at night, while lying in bed, feeling restless with an urge to move, especially legs or feet, which improve by moving or rubbing the legs or feet.

^kSelf-reported, physician diagnosed sleep apnea or presence of a breathing disorder which happens only during sleep.

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Table 2

Unadjusted and adjusted odds ratios (OR) with 95% confidence intervals (CI) for having insomnia, according to demographic and clinical characteristics (N = 358)

Characteristic ^a	Insomnia (ISI ⁸)	
	Unadjusted OR (95% CI) ^b	Adjusted OR (95% CI) ^c
Age, <i>per year</i>	0.97 (0.93, 1.01)	0.96 (0.91, 1.02)
Female sex	1.13 (0.73, 1.75)	1.03 (0.60, 1.77)
Non-Hispanic white race	1.59 (0.83, 3.07)	1.45 (0.64, 3.29)
Did not complete high school	0.95 (0.61, 1.48)	0.67 (0.37, 1.20)
Current smoker	0.60 (0.22, 1.61)	0.49 (0.14, 1.69)
Obese	1.08 (0.65, 1.81)	0.74 (0.41, 1.46)
Cardiovascular disease	1.17 (0.75, 1.84)	0.74 (0.41, 1.33)
Chronic lung disease	1.47 (0.88, 2.45)	1.04 (0.54, 1.99)
Depressive symptoms	8.09 (4.76, 13.75)	8.34 (4.49, 15.47)
Cognitive impairment	0.71 (0.40, 1.25)	0.79 (0.37, 1.67)
Restless legs syndrome	3.33 (2.15, 5.15)	2.49 (1.48, 4.21)
Sleep disordered breathing ^d	1.56 (0.52, 4.74)	0.66 (0.16, 2.76)
No. of medications	1.07 (1.01, 1.13)	1.05 (0.98, 1.12)
Epworth Sleepiness Scale ^e	1.09 (1.04, 1.15)	1.05 (0.98, 1.13)

ISI=Insomnia Severity Index.

^aSee footnotes to Table 1 regarding definitions and sample sizes for the clinical characteristics.

^bFrom logistic regression models that evaluated separately each characteristic.

^cFrom a multivariable logistic regression model that included all demographic and clinical characteristics.

^dSelf-reported.

^eContinuous variable, scale of 0–24.

Table 3

Unadjusted and adjusted absolute differences with 95% confidence intervals (CI) in insomnia severity, according to demographic and clinical characteristics (N = 358)

Characteristic ^a	Insomnia Severity (ISI range of 0–28)	
	Unadjusted Differences (95% CI) ^b	Adjusted Differences (95% CI) ^c
Age, <i>per year</i>	−0.04 (−0.17, 0.08)	−0.01 (−0.13, 0.11)
Female sex	0.84 (−0.36, 2.03)	0.44 (−0.64, 1.51)
Non-Hispanic white race	1.31 (−0.42, 3.03)	0.77 (−0.80, 2.33)
Did not complete high school	0.85 (−0.37, 2.07)	0.27 (−0.86, 1.40)
Current smoker	−0.19 (−2.75, 2.38)	−0.35 (−2.58, 1.89)
Obese	0.51 (−0.90, 1.93)	−0.31 (−1.61, 0.98)
Cardiovascular disease	0.43 (−0.81, 1.67)	−0.49 (−1.63, 0.65)
Chronic lung disease	1.57 (0.16, 2.98)	0.23 (−1.08, 1.54)
Depressive symptoms	5.89 (4.79, 7.00)	5.14 (3.97, 6.32)
Cognitive impairment	−1.53 (−3.04, −0.01)	−1.38 (−2.82, 0.06)
Restless legs syndrome	3.75 (2.65, 4.86)	2.20 (1.12, 3.27)
Sleep disordered breathing ^d	1.72 (−1.35, 4.80)	−0.33 (−3.09, 2.43)
No. of medications	0.19 (0.05, 0.34)	0.11 (−0.03, 0.25)
Epworth Sleepiness Scale ^e	0.25 (0.13, 0.37)	0.10 (−0.02, 0.21)

ISI=Insomnia Severity Index.

^aSee footnotes to Table 1 regarding definitions and sample sizes for the clinical characteristics.

^bFrom linear regression models that evaluated separately each characteristic.

^cFrom a multivariable linear regression model that included all demographic and clinical characteristics.

^dSelf-reported.

^eContinuous variable, scale of 0–24.