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Authors

Fung, Constance
Martin, Jennifer
Dzierzewski, Joseph
et al.

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Prevalence and Symptoms of Occult Sleep Disordered Breathing among Older Veterans with Insomnia

Constance H. Fung, M.D., M.S.H.S.[1,2]; Jennifer L. Martin, Ph.D.[1,2]; Joseph M. Dzierzewski, Ph.D.[1,2]; Stella Jouldjian, M.S.W., M.P.H.[1]; Karen Josephson, M.P.H.[1]; Michelle Park[3]; Cathy Alessi, M.D.[1,2]

[1]Geriatric Research, Education and Clinical Center (GRECC): Veterans Administration Greater Los Angeles Healthcare System, Los Angeles, CA; [2]David Geffen School of Medicine at the University of California, Los Angeles, Los Angeles, CA; [3]Western University of Health Sciences

SCIENTIFIC INVESTIGATIONS

Study Objectives: To determine the prevalence of occult sleep disordered breathing (SDB) and describe the relationship between classic SDB symptoms (e.g., loud snoring) and occult SDB in older veterans with insomnia.

Methods: We analyzed baseline survey and in-home sleep study data for 435 veterans (mean age = 72.0 years [SD 8.0]) who had no known history of SDB, met International Classification of Sleep Disorders 2nd Edition criteria for insomnia, and were enrolled in a behavioral intervention trial for insomnia. Variables of interest included apnea-hypopnea index (AHI) ≥ 15, age, race/ethnicity, marital status, body mass index (BMI), insomnia subtype (i.e., onset, maintenance, or terminal), self-reported excessive daytime sleepiness, snoring, and witnessed breathing pause items from the Berlin Questionnaire. We computed the frequency of AHI ≥ 15 and assessed whether each classic SDB symptom was associated with an AHI ≥ 15 in 4 separate multivariate logistic regression models.

Results: Prevalence of AHI ≥ 15 was 46.7%. Excessive daytime sleepiness (adjusted odds ratio 1.63, 95% CI 1.02, 2.60, p = 0.04), but not snoring loudness, snoring frequency, or witnessed breathing pauses was associated with occult SDB (AHI ≥ 15). Insomnia subtypes were not significantly associated with occult SDB (p > 0.38).

Conclusions: In our sample of older veterans with insomnia, nearly half had occult SDB, which was characterized by reported excessive daytime sleepiness, but not loud or frequent snoring or witnessed breathing pauses. Insomnia subtype was unrelated to the presence of occult SDB.

Keywords: Sleep disordered breathing, prevalence, risk factors, older adults, comorbid insomnia

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Sleep complaints are common among veterans.[1,2] One study of veterans in a primary care setting found that 41% of patients had symptoms of insomnia and 47% met high risk criteria for sleep disordered breathing (SDB) based upon Berlin Questionnaire (BQ) results.[1] One explanation for these high rates of sleep complaints is that veterans have a high prevalence of risk factors such as chronic alcohol consumption[3] and obesity[4] that make them vulnerable to insomnia and SDB.[1] A review of all Veterans Health Administration (VHA) outpatient clinic files found that as many as 16% of veterans have sleep apnea (including 2.9% with an actual formal clinical diagnosis).[5]

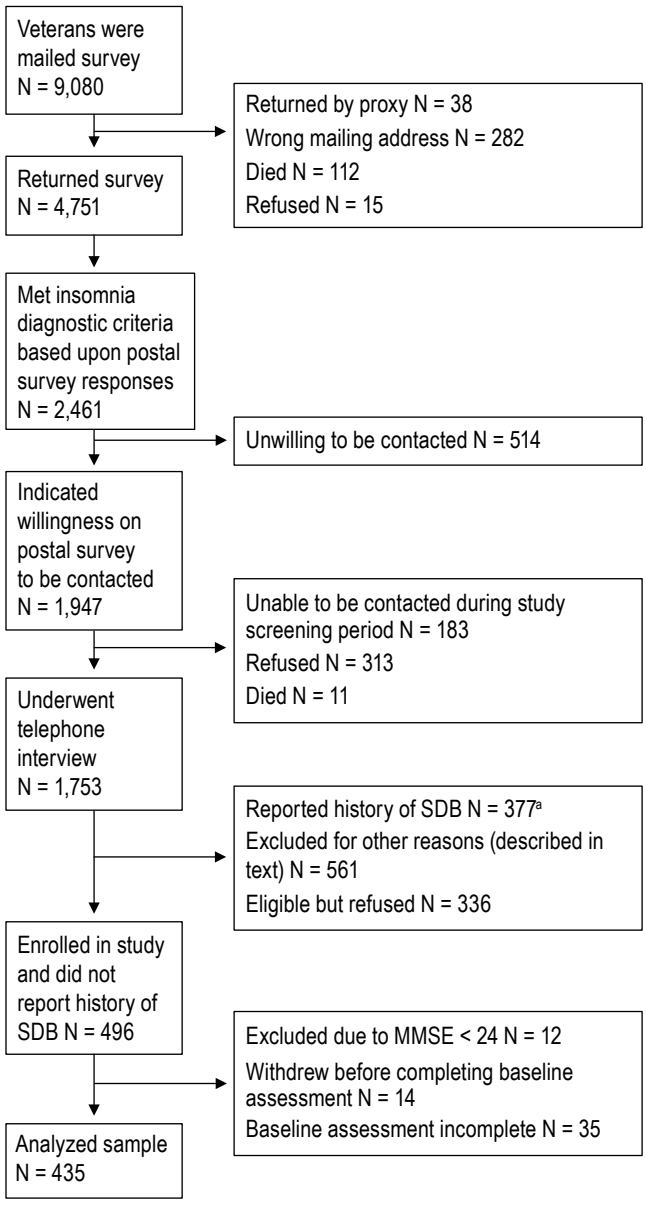
An increasing number of studies conducted in a variety of populations are finding that SDB and insomnia frequently co-occur.[6-11] A 2002 study, for instance, reported the prevalence of SDB (apnea-hypopnea index [AHI] ≥ 5) to be 60.4% among women with insomnia.[12] Several studies have focused on older adults with insomnia,[11-13] such as a 2006 study that found a SDB (AHI ≥ 15) prevalence of 30% among older adults with insomnia.[14] The co-occurrence of occult SDB (i.e., SDB that is present but has not been diagnosed with a sleep study) in the context of insomnia was examined in a study of patients initiating insomnia therapy.[15] This study found that 27% of patients had occult SDB and that patients with SDB were older and had a higher body mass index (BMI) than insomnia patients without SDB.[15] Another study found that 29% of older individuals recruited for an insomnia study had occult SDB.[11] Although older veterans are at high risk for both occult SDB and insomnia, the prevalence of occult SDB among older veterans with insomnia has not been reported, to our knowledge. Yet this information is relevant given the number of older veterans who will be treated for insomnia as a result of the VHA's cognitive behavioral therapy for insomnia (CBT-I) roll-out program, which will provide increased access to CBT-I for veterans.[16]

BRIEF SUMMARY

Current Knowledge/Study Rationale: Although older veterans are at high risk for both occult sleep disordered breathing (SDB) and insomnia, the prevalence of occult SDB among older veterans with insomnia has not been reported. Furthermore, the strength of association between classic SDB symptoms and occult SDB has not been examined in older veterans with insomnia.

Study Impact: We found that nearly half of participants had occult SDB, and although the presence of excessive daytime sleepiness was associated with occult SDB, snoring frequency, snoring loudness, and witnessed breathing pauses were not associated with occult SDB. Researchers and clinicians should account for the high prevalence of occult SDB among older veterans when planning research studies and initiating therapies for insomnia.

Figure 1—Study flow chart



[a]Includes participants who answered "yes" to a question asking whether a doctor had told him or her that she or he has sleep apnea (includes participants who reported that they no longer have sleep apnea due to surgery, weight loss, or other interventions).

Recognizing that sleep disturbance is due to both SDB and insomnia may affect treatment, because interactions between these conditions are a concern. For example, patients with untreated SDB resulting in excessive daytime sleepiness could have difficulty adhering to sleep restriction.

Symptoms of SDB in the general population have been examined in numerous studies,[17-20] but fewer studies have focused on symptoms of SDB among patients with insomnia. In one study of older adults, classic SDB symptoms such as loud snoring were associated with increased odds of SDB among older adults with insomnia, whereas excessive daytime sleepiness was not significantly associated with SDB (AHI ≥ 15).[14] In contrast, a study of older adults with insomnia and occult SDB found that self-reported snoring did not differ between participants with and without occult SDB.[11] In theory, the symptom pattern of occult SDB in the context of insomnia could differ from formally diagnosed SDB because symptoms that are bothersome to bed partners such as frequent snoring[21] might prompt patients to seek medical attention for possible SDB. Interestingly, however, a study that examined this question among non-veterans found the same pattern of symptoms exhibited by clinic patients formally diagnosed with SDB as community-dwelling individuals identified with occult SDB.[20] To our knowledge, the strength of association between classic SDB symptoms (loud snoring, frequent snoring, witnessed breathing pauses, and excessive daytime sleepiness)[11,13] and occult SDB has not been examined in older veterans with insomnia.

We sought to compute the prevalence of occult SDB among older veterans meeting International Classification of Sleep Disorders 2nd Edition (ICSD-2) diagnostic criteria for insomnia and to describe the relationship between each classic SDB symptom (i.e., snoring loudness, snoring frequency, witnessed breathing pauses, and excessive daytime sleepiness) and occult SDB in older veterans with insomnia. We tested whether SDB symptoms that are bothersome to bed partners (e.g., frequent snoring, loud snoring) are less likely to be associated with occult SDB in models adjusting for demographic data (age, race/ethnicity, marital status), BMI, and insomnia subtype (i.e., onset, maintenance, or terminal), and whether other classic SDB symptoms (e.g., witnessed breathing pauses and excessive daytime sleepiness) are more likely to be associated with occult SDB among older veterans with insomnia in adjusted models.

METHODS

Study Design, Sample, and Data Collection

We analyzed baseline screening data for individuals who were considered for a randomized controlled trial testing a behavioral treatment for insomnia targeting older veterans (see study flow diagram in **Figure 1**). Between May 2010 and December 2011, we sent a postal questionnaire to all veterans in the Los Angeles area aged ≥ 60 years who had at least one healthcare provider visit within the past 24 months at a Veterans Administration (VA) outpatient clinic, had a valid Los Angeles or Ventura County address, and lived within 25 miles of our study site, as determined by a review of VA administrative data. The postal questionnaire collected information needed to determine if the respondent met basic diagnostic criteria for an insomnia disorder using the ICSD-2.[22] Older veterans with sleep disturbance accompanied by daytime consequences (i.e., met ICSD-2 criteria for insomnia) lasting ≥ 3 months based upon their postal questionnaire responses and who agreed to be contacted (i.e., did not check an "opt out" box) underwent a telephone interview with research staff to further determine eligibility for the controlled trial. Individuals were excluded if they were a nursing home resident, participated in our local VA Adult Day Health Care program (which had another ongoing insomnia treatment trial), were homeless or had an atypical sleeping arrangement (e.g., homeless, slept on a floor), were

unavailable to travel to 5 weekly sessions, or reported self-assessed "significant health or emotional problems" that would preclude participation in the study.

Individuals were considered eligible for face-to-face baseline assessment if they met the eligibility criteria above and denied a history of sleep apnea or a prior prescription for positive airway pressure (PAP) therapy. All individuals meeting these criteria were invited to complete a face-to-face interview with our research staff, where baseline health data were collected, and a single-night unattended in-home sleep study was conducted (described below).

The full study methods were approved by the institutional review board of the VA Greater Los Angeles Healthcare System.

Measures

We collected information on patients' race/ethnicity and marital status in the postal questionnaire. Age was calculated based upon date of birth obtained from an administrative database from the VA's Austin Automation Center, which also provided the patients' gender. We abstracted each patient's most recent height and weight from the patient's electronic health record and calculated their BMI.

Sleep Measures

Presence of Occult SDB

We performed a single-night, unattended in-home sleep study (WatchPAT, WP100, Itamar Medical) that includes an actigraphy channel for differentiating between periods of sleep and wake. After visual inspection of the recording, AHI was calculated using the manufacturer's automated, validated scoring algorithms.[23] We employed ICSD-2 obstructive sleep apnea (OSA) (adult) criteria, selecting AHI ≥ 15 as the threshold for categorizing a participant with occult SDB. The WatchPAT device has high sensitivity (93.3%) and specificity (73.3%) for diagnosis of OSA at an AHI ≥ 15 threshold.[24]

Snoring Frequency, Snoring Loudness, and Witnessed Breathing Pauses

During the face-to-face interview, participants completed an adapted version of the Berlin questionnaire,[25] which included items that assessed snoring loudness, snoring frequency, and presence/absence of witnessed breathing pauses. We defined "habitual snoring" to be ≥ 3 times per week and "moderately frequent snoring" to be ≥ 1 time per week but ≤ 2 times per month. We defined "extremely loud snoring" to be "very loud—can hear in the next room" and "moderately loud snoring to be "as loud as talking or louder than talking."[25]

Excessive Daytime Sleepiness

During a face-to-face interview, participants indicated whether or not they "take a nap or doze off during the daytime" (yes/no) because they "did not sleep well at night."

Insomnia Subtypes

During the face-to-face interview, participants indicated whether they have "trouble falling asleep" (yes/no), "trouble staying asleep all night" (yes/no), and "wake up earlier than you wanted" (yes/no).

Data Analysis

Participants with insomnia who denied a history of SDB and who completed both the face-to-face interview and the in-home sleep study formed the sample for these analyses. Descriptive statistics were calculated for each participant characteristic. The prevalence of SDB was defined as AHI ≥ 15. Finally, 4 multivariate logistic regression models were constructed using the presence or absence of SDB as the dependent variable, to assess the independent association of four classic SDB symptoms (loud snoring, frequent snoring, witnessed breathing pauses, and excessive daytime sleepiness) with SDB, above and beyond the influence of demographics (age, race/ethnicity, marital status, and BMI). Variables for the models were selected based upon risk factors for SDB identified in the literature.[11,14,18,25-28] Two-sided testing was performed, and α was set at 0.05. Statistical analyses were performed using Stata/SE 11.2 (StataCorp LP, College Station, Texas).

RESULTS

Descriptive Statistics

Four hundred thirty-five participants completed both a face-to-face interview and an in-home sleep study. **Table 1** summarizes participant characteristics for this sample. The prevalence of AHI ≥ 15 was 46.7%.

Table 2 summarizes the multivariate logistic regression results. The presence of self-reported excessive daytime sleepiness was associated with a 1.62 fold increased odds of AHI ≥ 15. Snoring frequency (habitual or moderately frequent snoring), snoring loudness (extremely loud or moderately loud snoring), and witnessed breathing pauses were not associated with an increased odds of AHI ≥ 15 ($p > 0.22$). In all 4 models, BMI was associated with a 1.16- to 1.17-fold increased odds of AHI ≥ 15 ($p < 0.001$), whereas insomnia subtypes were not significant predictors of AHI ≥ 15 ($p > 0.38$). Age ($p > 0.06$), ethnicity ($p > 0.15$), and marital status ($p > 0.80$) were not significant predictors of AHI ≥ 15.

DISCUSSION

In our study of older veterans with insomnia, nearly half of participants had SDB (AHI ≥ 15) that had not been previously diagnosed. This high prevalence is concerning, since all of the older adults in our study had at least one healthcare provider visit within 24 months of receiving our postal questionnaire and because our medical center is home to a comprehensive sleep disorders center. Our findings suggest that occult SDB is very common among older veterans with insomnia. When we examined which classic SDB symptoms are associated with occult SDB, only the presence of excessive daytime sleepiness was significant, whereas snoring frequency and loudness and witnessed breathing pauses were not associated with occult SDB in the context of insomnia. We also found that the insomnia type was not associated with occult SDB.

Our finding of a high prevalence of occult SDB among older adults with insomnia is similar to other studies that have measured prevalence of SDB in the context of insomnia.[11,14,29] In comparison to some studies conducted in non-veteran

Table 1—Participant characteristics (N = 435)

Continuous Variables	Mean (SD)	N
Age (years)	72.0 (8.0)	435
Body mass index (kg/m^2)	28.39 (4.7)	427
Categorical Variables	**Frequency (%)**	**N**
Gender		435
Male	425 (97.7)	
Female	10 (2.3)	
Race/Ethnicity		426
African American	29 (6.8)	
Asian	8 (1.9)	
Non-Hispanic White	345 (81.0)	
Native Hawaiian	1 (0.2)	
Hispanic	33 (7.7)	
Other	10 (2.3)	
Marital status		435
Married	243 (55.9)	
Other	192 (44.1)	
Snores		435
Don't know	5 (1.1)	
No	134 (31.1)	
Yes	296 (68.8)	
Snoring loudness (if snores)		298[a]
Slightly louder than breathing	47 (10.8)	
As loud as talking	104 (23.9)	
Louder than talking	55 (12.6)	
Very loud—can be heard in adjacent rooms	55 (12.6)	
Don't know	37 (8.5)	
Snoring frequency (if snores)		284
Nearly every day	97 (22.3)	
3-4 times/week	54 (12.4)	
1-2 times/week	52 (12.0)	
1-2 times/month	31 (7.1)	
Never or nearly never	50 (11.5)	
Witnessed breathing pauses during sleep		435
No	371 (85.3)	
Yes	60 (13.8)	
Don't know	4 (0.9)	
Excessive daytime sleepiness		435
No	114 (26.2)	
Yes	321 (73.8)	

[a]Two participants responded to item assessing snoring frequency despite a report of not snoring.

populations that employed a lower AHI threshold (AHI ≥ 5), our study's prevalence rate is slightly lower.[12,30,31] As described in our methods section, we chose a conservative AHI threshold of ≥ 15; our prevalence rate would have been much higher if we had selected an AHI ≥ 5. Compared to two other studies in non-veteran populations that employed the same AHI threshold used in our study,[11,14] we found a higher prevalence rate among older veterans. One explanation for our higher prevalence rate may be that these two studies excluded patients who used sedative-hypnotics, and these medications may worsen OSA in some situations.[32,33] Given the widespread use of sedative-hypnotics among older adults,[34] our study's findings may be more representative of the true prevalence rate of abnormal AHI among older adults with insomnia who have not previously been diagnosed with SDB. Another explanation for the high prevalence rate we observed is that the true underlying prevalence of SDB among older veterans may be much higher than it is among non-Veteran samples in which previous prevalence studies were conducted. A study by Sharafkhaneh et al., which estimated the prevalence of SDB among veterans of all ages, postulated that a higher prevalence of risk factors for SDB (e.g., obesity) among veterans compared to the population at large may be one explanation for the higher overall prevalence of SDB among veterans.[5]

Our study provides insight into the symptom pattern associated with occult SDB among older veterans with insomnia. Interestingly, although excessive daytime sleepiness was associated with occult SDB, loud and frequent snoring, witnessed breathing pauses, and insomnia subtype were not. Perhaps patients with loud or frequent snoring—symptoms that may be more bothersome to bed partners[21] than symptoms such as excessive daytime sleepiness—come to the attention of clinicians early on, thereby increasing the likelihood that they were previously diagnosed and therefore would have been excluded from our analysis. Our findings suggest that the presence or absence of loud snoring, frequent snoring or witnessed breathing pauses in patients with insomnia who have had access to routine medical care (and in theory have had the opportunity to discuss symptoms with their provider), may not necessarily be associated with occult SDB.

Our results have important research and clinical implications for assessing older veterans with insomnia. First, our findings suggest that researchers should carefully consider the high prevalence of SDB when planning insomnia studies involving older adults. The most common type of SDB, OSA, requires therapy that directly treats airway obstruction (e.g., PAP therapy), and left untreated, SDB may make adherence to sleep restriction challenging or even unsafe. Some but not all insomnia trials involving older adults have measured the AHI of participants.[35-37] Next, our findings further suggest that occult SDB may have a different pattern of symptoms, a finding that is relevant to providers who care for older veterans with insomnia, especially in the context of referring older veterans for CBT-I. Our study's findings (high prevalence and altered pattern of SDB symptoms) together with data from prior studies[27] showing the limitations of clinical examinations and interviews for excluding SDB among patients with insomnia, suggest that objective measurement with an overnight sleep study may be warranted in the evaluation of older veterans with insomnia. Current clinical guidelines[38] state that polysomnography is indicated when there is reasonable clinical suspicion of SDB—perhaps excessive daytime sleepiness in the context of insomnia constitutes sufficient reasonable suspicion to conduct an overnight sleep study.

Our study has several limitations. First, because our study population was recruited from patients with a recent VA clinical visit and most of our participants were male and Caucasian, our results may not be generalizable to non-Veteran, female, and ethnically diverse populations. Second, we were not able to perform gold-standard attended polysomnography to verify the AHI for participants, but unattended in-home sleep studies are commonly used to diagnose SDB in patients with sleep

Table 2—Multivariate logistic regression results

	Snoring Frequency (n = 413)		Snoring Loudness (n = 391)		Breathing Pauses (n = 426)		Daytime Sleepiness (n = 426)	
	aOR	95% CI	aOR	95% CI	aOR	95% CI	aOR	95% CI
Age	1.02	1.00, 1.05	1.02	0.99, 1.05	1.02	1.00, 1.05	1.02	1.00, 1.05
African American	1.85	0.80, 4.29	1.57	0.67, 3.68	1.80	0.78, 4.12	1.84	0.79, 4.25
Asian	0.71	0.13, 3.93	0.58	0.11, 3.19	0.57	0.10, 3.15	0.62	0.11, 3.47
Married	0.97	0.63,1.49	1.05	0.67, 1.62	0.95	0.63, 1.43	0.98	0.65, 1.48
Body Mass Index	1.17[a]	1.10, 1.23	1.17[a]	1.10, 1.23	1.16[a]	1.10, 1.22	1.16[a]	1.10, 1.22
Difficulty initiating sleep	0.97	0.64,1.47	0.93	0.61, 1.42	0.94	0.63, 1.41	0.98	0.65, 1.48
Difficulty maintaining sleep	1.09	0.56, 2.15	1.10	0.56, 2.16	1.07	0.55, 2.09	1.07	0.55, 2.08
Early awakening	1.17	0.72, 1.89	1.24	0.76, 2.02	1.19	0.74, 1.91	1.22	0.76, 1.95
SDB Symptom Dummy Variable A	1.34[b]	0.83, 2.17	0.89[d]	0.46, 1.74	1.16[f]	0.91, 1.47	1.63[a,g]	1.02, 2.60
SDB Symptom Dummy Variable B	0.84[c]	0.47, 1.50	0.85[e]	0.53, 1.37	–	–	–	–
	Goodness-of-Fit Model Statistics							
Pseudo R-Square	0.086		0.077		0.078		0.082	
Log Likelihood Chi-Square	49.19[a]		41.45[a]		45.79[a]		48.33[a]	

[a]p < 0.05, [b]habitual snoring, [c]moderately frequent snoring, [d]extremely loud snoring, [e]moderately loud snoring, [f]witnessed breathing pause, [g]excessive daytime sleepiness. aOR, adjusted odds ratio; SDB, sleep disordered breathing; CI, confidence interval. The relationship between each classic SDB (i.e., frequent snoring, loud snoring, excessive daytime sleepiness, and witnessed breathing pauses) and the presence of occult SDB was assessed in separate multivariate logistic regression models. Each regression model tested only one classic SDB symptom. In two of the regression models (snoring frequency and snoring loudness), 2 symptom subgroups (e.g., presence or absence of habitual snoring, presence or absence of moderately frequent snoring) were included as SDB Symptom Dummy Variable A and B, whereas in the other 2 regression models (excessive daytime sleepiness and witnessed breathing pauses) only SDB Symptom Dummy Variable A was included (e.g., presence or absence of excessive daytime sleepiness).

disturbances, particularly among individuals with a high index of suspicion. Third, we relied on participants' self-report of a prior diagnosis of SDB rather than a medical chart review to determine the presence/absence of previously diagnosed SDB. Some of our cases of "occult" SDB may have actually been recognized cases; however, because the first-line therapy for SDB for moderate to severe SDB is PAP therapy—a therapy that entails a lot of patient involvement—we believe it is unlikely that participants would have forgotten a diagnosis of SDB. Finally, our data were derived from participants who had some level of interest in participating in a clinical trial for insomnia. As a result they may differ from a cross section of clinical insomnia patients. A major strength of our study is our sampling strategy, in which all potentially appropriate individuals who had received healthcare at our facility within 24 months were included in our sampling frame. This strategy increases the generalizability of our findings within the older veteran population.

In conclusion, we found a high prevalence of occult SDB among older veterans with insomnia who were screened for eligibility for a clinical trial on behavioral treatment of insomnia. When planning insomnia trials involving older veterans, researchers should account for the high prevalence of comorbid SDB among prospective study participants and recognize that some classic SDB symptoms may not be associated with the presence of occult SDB. Clinicians caring for older veterans with insomnia should also consider the high prevalence of occult SDB when initiating therapies for insomnia, particularly if pharmacological treatments that may affect SDB severity are being considered[18] or if increased sleepiness during the early weeks of CBT-I is a concern. Additional studies are needed to understand why SDB among older veterans is so commonly underdiagnosed and how best to address this very common disorder in the context of existing healthcare systems.

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Address correspondence to: Constance H. Fung, M.D., M.S.H.S. GRECC (11E), VA Greater Los Angeles Healthcare System, 16111 Plummer Street, North Hills, CA 91343; Tel: (818) 895-9311; Fax: (818) 895-9519; Email: Connie.Fung@va.gov

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