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SCIENTIFIC INVESTIGATIONS

Prevalence of insomnia disorder and sleep apnea in a sample of veterans at risk for cardiovascular disease

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Study Objectives: The objectives of this study were to examine the proportion of study participants screening positive for insomnia disorder and/or sleep apnea in veterans engaged in routine health care and known to be at risk for cardiovascular disease and to compare these proportions with those previously documented in medical records.

Methods: This was a cross-sectional analysis of baseline data from a randomized clinical intervention trial for patients at risk of cardiovascular disease and a review of study participants' medical records. Participants were veterans ≥ 40 years of age, enrolled in Veterans Affairs primary care, and diagnosed with hypertension and/or hypercholesterolemia. Self-report outcomes were the proportion of patients screening positive for an insomnia disorder and sleep apnea, self-reporting a sleep apnea diagnosis, and endorsing undertreated sleep apnea. Medical record outcomes were the proportion of patients diagnosed with insomnia and sleep apnea.

Results: Participants (n = 420) were veterans (84.8% male) with a mean age of 61.1 years. More than half of the sample (52.1%) screened positive for sleep apnea without prior self-reported diagnosis. More than one-third of the sample (39%) screened positive for an insomnia disorder. Medical records revealed considerably lower rates, with 3.8% diagnosed with insomnia, 20.5% diagnosed with sleep apnea, and about 1% diagnosed with both conditions.

Conclusions: Undiagnosed and undertreated sleep disorders are common among veterans at risk for cardiovascular disease. Most of the sample (82%) screened positive for, or met, study criteria for sleep apnea or an insomnia disorder. Limitations include the use of self-reported sleep apnea treatment adherence, an insomnia disorder diagnosis based on questionnaire score, and a sample comprised primarily of male veterans. Routine sleep disorders screening in veterans at risk for cardiovascular disease could help to identify those at even greater risk because of the adverse effects of undiagnosed or undertreated sleep disorders.

Clinical Trial Registration: Registry; ClinicalTrials.gov; Name: Cardiovascular Intervention Improvement Telemedicine Study; URL: https://clinicaltrials.gov/ct2/show/NCT01142908; Identifier: NCT01142908.

Keywords: insomnia, sleep apnea, veterans, cardiovascular disease

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BRIEF SUMMARY

Current Knowledge/Study Rationale: The 2 most common sleep disorders, insomnia and sleep apnea, confer increased risk of cardiovascular disease (CVD), and veterans are at greater risk than the general public for both CVD and sleep disorders. Yet, sleep disorders screening is not part of routine health care, even among those known to be at risk for CVD.

Study Impact: Undiagnosed and undertreated sleep disorders are common among veterans at risk for CVD; screening for insomnia and sleep apnea revealed considerably more veterans with possible sleep disorders than documented in medical records. Routine sleep disorders screening is needed in patients at risk of CVD to identify those at even greater risk because of the adverse effects of undiagnosed or undertreated sleep disorders.

INTRODUCTION

Sleep disorders are associated with increased risk of cardiovascular disease (CVD), the leading cause of death among US adults. In a meta-analysis of prospective cohort studies, individuals with untreated severe obstructive sleep apnea (OSA) were at a 79% greater risk of CVD than the general population, and a dose-response analysis showed a 17% increase in CVD for each 10-unit increase in the apnea-hypopnea index.[1] In prospective research, adults with an insomnia complaint followed for up to 20 years were found to have a 45% increased risk of incident CVD.[2] Veterans are at greater risk of CVD than the general public. In a representative sample of Americans over the age of 50, the risk of new onset of heart disease was 48% higher in veterans than non-veterans.[3] In a nationally representative health survey of independent living US adults (n = 153,556), veteran status was associated with a 42% higher odds of reporting more cardiovascular conditions than non-veterans.[4]

Sleep apnea and insomnia disorder are the 2 most common sleep disorders,[5,6] and, like CVD, sleep disturbances are also more prevalent in veterans than non-veterans. Compared with the general US population, veterans reported significantly more sleep disturbance[7] on the Patient-Reported Outcomes Measurement Information System (PROMIS) sleep disturbance

measure, and veterans endorsed higher rates of insufficient rest/sleep and short sleep duration on the Behavioral Risk Factor Surveillance Survey.[8] Sleep disorders are not only more prevalent among veterans and military personnel, but some evidence suggests increasing prevalence of sleep disorders in these populations. The National Veteran Sleep Disorder study found a 6-fold increase in sleep disorder prevalence from 2000 to 2010,[9] and insomnia diagnoses increased 19-fold from 2000 to 2009 among military service members.[10]

Despite the greater prevalence of sleep disorders and CVD among veterans, and the established association between sleep disorders and CVD, the existing clinical practice guidelines for sleep disorders do not promote routine screening of veterans known to be at risk for CVD, and screening for sleep apnea and an insomnia disorder are not routinely integrated into current clinical practice. In their review of screening and assessment for OSA in primary care, Miller and Berger[11] stressed the importance of diagnosing and treating OSA and CVD as comorbid conditions for stabilizing and improving cardiovascular outcomes. In their review of sleep disorders and cardiometabolic disease risk factors, Grandner et al[12] found that, although prior research has consistently shown a high prevalence of sleep apnea among patients treated in obesity, cardiology, and diabetes clinics, "few are diagnosed and even fewer are successfully treated." They concluded that clinics treating patients with cardiovascular disease and related conditions should routinely screen for sleep apnea and refer for treatment as appropriate. Similar assertions have been made for the importance of assessing and treating an insomnia disorder in primary care clinics. In their commentary[13] on the findings of a survey of primary care providers[14] entitled "Insomnia in Primary Care: Misreported, Mishandled, and Just Plain Missed," Grandner and Chakravorty state that "although insomnia is considered an important concern in primary care, its prevalence may be underestimated, its documentation unreliable, and its treatment suboptimal, despite access to standard treatment interventions." The recommendation that patients with cardiometabolic disorders should be screened for sleep disorders, as noted above, is well reasoned and supported by research showing associations between sleep disorders and these conditions. However, this literature is largely comprised of patients recruited for sleep disorders research without consideration for level of engagement in routine health care. Few studies have attempted to quantify the potential impact of sleep disorders screening on patients at risk for cardiovascular disease among patients known to be engaged in routine clinical care.

In the current study, we sought to assess the potential impact of routine sleep disorders screening in veterans at risk for CVD. We leveraged data from a prior study (the Telemedicine Cardiovascular Risk Reduction in Veterans: The CITIES trial) wherein recruited patients were required to be routinely followed in primary care and to also have established CVD risk factors. In addition, participants in the parent study were screened for insomnia disorder and sleep apnea at baseline and assessed for sleep apnea treatment adherence when applicable. Using data from the the Telemedicine Cardiovascular Risk Reduction in Veterans trial, we examined the following research questions. (1) What proportion of patients either self-report a previous diagnosis of OSA or screen positive for OSA? (2) What proportion of patients screen positive for insomnia disorder? (3) How do these proportions compare with diagnoses for these conditions as recorded in the medical record? (4) What proportion of patients self-reporting a sleep apnea diagnosis report using positive pressure airway (PAP) for at least 4 hours per night? Based on the small existing literature summarized above, we hypothesized that sleep apnea and an insomnia disorder would be highly prevalent conditions; sleep apnea and an insomnia disorder would be frequently undiagnosed (ie, not documented in the medical record); and many patients with sleep apnea would self-report low rates of PAP use.

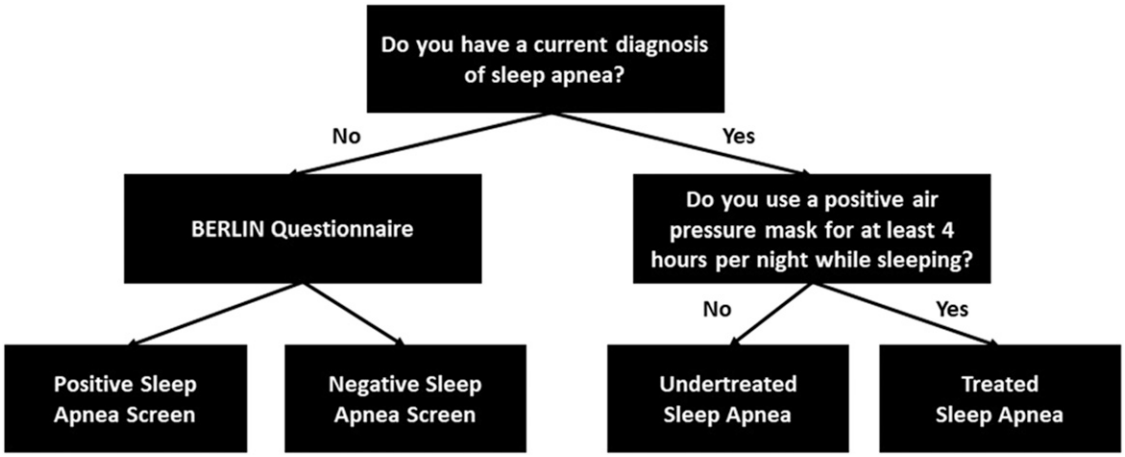
METHODS

Data were obtained from a completed randomized clinical trial designed to evaluate the utility of a phone-based clinical pharmacist specialist-delivered intervention for veterans with hypertension and/or hypercholesterolemia.[15] Patients in the parent study were identified from electronic medical records. Those meeting initial screening criteria received an introductory letter with an option to opt out of future contacts. Patients not opting out were contacted for additional screening and an in-person meeting where they completed baseline measures. Eligible patients were ≥40 years of age at baseline; enrolled in a primary care clinic affiliated with the Durham Veterans Affairs Medical Center (VAMC) (at least 1 visit with assigned primary care provider in the past year); had a diagnosis of hypertension or hypercholesterolemia; and had poorly controlled hypertension defined by averaging all clinic obtained blood pressure values recorded in the electronic medical record in the previous year of >150/100 mm Hg and/or hypercholesterolemia defined as low-density lipoprotein value of >130 mg/dL. Low-density lipoprotein was also obtained by electronic medical record review for the same time period. In the parent study, participants were randomized to either a clinical pharmacist specialist–delivered, telehealth intervention, or education control, and the primary outcome was the Framingham CVD risk score at 6 and 12 months. Data for these secondary analyses, however, were conducted using baseline data collected before randomization.

Sleep outcomes

Self-reported sleep outcomes were obtained from: a baseline assessment interview and from a review of the electronic medical record conducted after the study had concluded. During the baseline assessment interview, all patients were asked, "Do you have any sleep problems or concerns about your sleep?" Those endorsing this item completed the Insomnia Severity Index (ISI). The ISI was chosen as an insomnia screener for a number of reasons. First, the ISI has excellent psychometric properties and has been validated against diary and polysomnographic measures of sleep.[16] Second, although other insomnia screeners have been developed since the parent study began, the ISI is still recommended as the standard for self-reported insomnia symptoms.[17] The ISI is a 7-item questionnaire providing a global measure of perceived insomnia severity over the last 2 weeks. Each item is rated on a 5-point Likert

Figure 1—Sleep apnea assessment approach (self-report).



scale, and the total score ranges from 0 to 28. The following guidelines are recommended for interpreting the total score: 0–7 (no clinical insomnia), 8–14 (subthreshold insomnia), 15–21 (insomnia of moderate severity), and 22–28 (severe insomnia). In prior research, a cutoff of 11 on the ISI was found to have a sensitivity of 97% and specificity of 100% for identifying cases of an insomnia disorder in clinical samples.[18] Accordingly, patients met study criteria for an insomnia disorder if they scored ≥11 on the ISI.

Sleep apnea diagnosis, positive screens, and PAP adherence were obtained via patient self-report. As shown in **Figure 1**, all participants were asked if they had been diagnosed with sleep apnea. Because the typical procedure at this facility is to offer PAP treatment to all patients diagnosed with sleep apnea, we asked all study participants endorsing a current diagnosis of sleep apnea, "Do you use a positive air pressure mask for at least 4 hours per night while sleeping?" Undertreatment was defined as self-reported PAP use of less than 4 hours per night, including those stating they did not currently use PAP treatment. Patients denying a prior diagnosis of sleep apnea were screened with the Berlin Questionnaire. The Berlin Questionnaire is an 11-item measure assessing sleep apnea risk.[19] Responses are grouped across 3 categories based on frequency and intensity of snoring, frequency of daytime sleepiness or fatigue, and presence of obesity or hypertension. Those deemed high risk for OSA endorse both persistent snoring and daytime fatigue in combination with a diagnosis of hypertension or elevated body mass index (≥30 kg/m^2).[20] The Berlin Questionnaire score of ≥2 has a sensitivity of 95% for predicting OSA.[21] We selected the Berlin Sleep Apnea Questionnaire because it is recommended for sleep disorders screening because of its good sensitivity (76.9%) and high negative predictive value (96.3%) for predicting severe sleep apnea.[22]

Following the conclusion of the study, each participants' electronic medical record was reviewed for insomnia and/or sleep apnea diagnosis/es documented in their problem list before the baseline interview. Progress notes were also reviewed to determine whether participants diagnosed with sleep apnea had been offered PAP treatment. Frequencies were calculated for all variables to compare findings across self-report, positive screens, and medical record diagnoses. Statistical analyses were performed using SAS for Windows (version 9.4; SAS Institute, Cary, NC).

RESULTS

Of 428 participants in this trial, 420 had complete case data on self-report sleep measures and were included in these analyses. Demographic and clinical characteristics of study participants are summarized in **Table 1**. Participants were veterans (84.8% male), with a mean age 61.1 years (standard deviation = 8.6), and the sample was comprised of roughly equivalent proportions of African Americans (50.0%) and Caucasians (46.7%). Most participants (64.3%) were diagnosed with both hypercholesterolemia and hypertension, whereas 25.7% had a hypertension diagnosis without hypercholesterolemia and 10.0% had a diagnosis of hypercholesterolemia without hypertension.

Self-report assessment of sleep apnea and insomnia disorder

As summarized in **Figure 2**, more than 80% of the sample met study criteria for a sleep disorder during baseline assessment. Thirty-nine percent of the sample screened positive for insomnia disorder. Seventy-eight percent met study criteria for sleep apnea, with 26% of the sample self-reporting a prior diagnosis, and 52% of the sample not self-reporting a prior diagnosis who screened positive for sleep apnea using the Berlin Questionnaire. Thirty-five percent met study criteria for both insomnia disorder and sleep apnea through self-report diagnosis or screening. Of the 165 participants screening positive for insomnia disorder, 88.5% also met study criteria for sleep apnea, including 28.5% self-reporting a prior diagnosis of sleep apnea and 60.0% screening positive for sleep apnea without prior diagnosis.

Medical record review of sleep apnea and insomnia diagnosis

The review of participants' medical records revealed considerably lower rates, with 3.8% diagnosed with insomnia, 20%

Table 1—Demographic and clinical characteristics of sample.

	Sample (n = 420)
Age (y), mean (SD)	61.1 (8.6)
Male, n (%)	356 (84.8)
Race, n (%)*	
White	195 (46.7)
Black	209 (50.0)
Other	14 (3.3)
Medical record diagnoses	
Hypertension without hyperlipidemia, n (%)	108 (25.7)
Hyperlipidemia without hypertension, n (%)	42 (10.0)
Both hypertension and hyperlipidemia, n (%)	270 (64.3)
Sleep apnea without insomnia, n (%)	82 (19.5)
Insomnia without sleep apnea, n (%)	12 (2.9)
Both sleep apnea and insomnia, n (%)	4 (1.0)
Self-reported sleep characteristics	
Any problems or concerns about sleep, n (%)	208 (49.5)
Insomnia Severity Index score, mean (SD) among n = 208 endorsing problems or concerns about sleep, n (%)	15.5 (5.8)
Prior diagnosis of sleep apnea, n (%)	107 (25.5)
Berlin Sleep Questionnaire categories among n = 313 denying prior diagnosis of sleep apnea, n (%)	
Low risk	94 (30.0)
High risk	219 (70.0)
PAP device usage among n = 107 reporting sleep apnea, n (%)	
<4 h/night	43 (40.2)
≥4 h/night	64 (59.8)

*Missing data: race (2). PAP = positive airway pressure, SD = standard deviation.

diagnosed with sleep apnea, and 1% diagnosed with both conditions. Eighty-two participants (19.5% of the sample) self-reported a sleep apnea diagnosis and had a sleep apnea diagnosis in the medical record, whereas 309 participants (73.6%) neither reported a sleep apnea diagnosis nor had a diagnosis in the medical record (simple agreement = 93.1%). Of those self-reporting a prior diagnosis of sleep apnea (n = 107), only 76.6% were found to have a diagnosis of sleep apnea in their medical record.

Nine participants (2.1% of the sample) screened positive for insomnia disorder and had an insomnia diagnosis in the medical record; conversely, 248 participants (59.0% of the sample) neither screened positive for insomnia disorder nor had an insomnia diagnosis in the medical record (simple agreement = 61.2%). Of the 165 participants screening positive for insomnia disorder, only 5.5% had a diagnosis of insomnia in their medical record.

PAP treatment

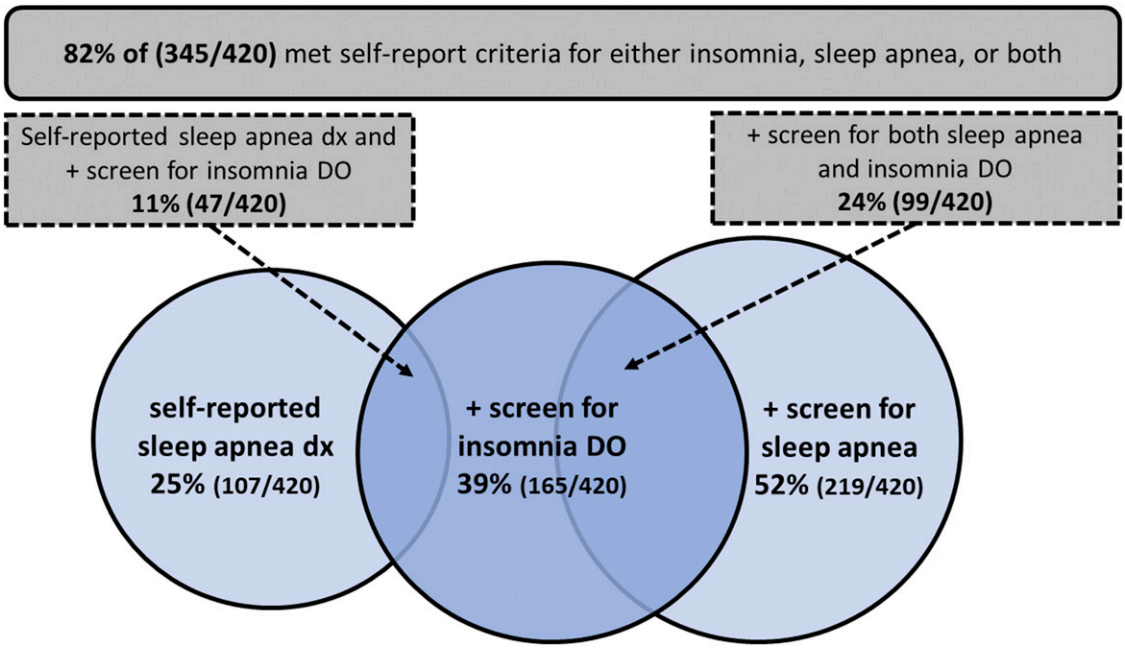
Of those self-reporting a prior diagnosis of sleep apnea (25.5% of the sample), 59.8% endorsed using their PAP device for 4 or more hours per night. Of the 86 veterans with a sleep apnea diagnosis in the medical record, 4.7% did not self-report a sleep apnea diagnosis, 64.0% self-reported a diagnosis and reported using PAP for at least 4 hours per night, and 31.4% reported a sleep apnea diagnosis but responded negatively to using PAP for at least 4 hours per night.

DISCUSSION

The trial from which these data were obtained was specifically designed to identify and recruit veterans at risk for CVD. Because the relationship between OSA and hypertension is a bidirectional and causal one,[23] it is not surprising that we found high rates of sleep apnea in a sample of individuals wherein most were diagnosed with hypertension. What is surprising and arguably alarming is that, despite being engaged in routine clinical care (a study requirement) and diagnosed with conditions placing them at increased risk of CVD, undertreated sleep disorders were commonplace among veterans in this study. More than half of the sample screened positive for sleep apnea without prior diagnosis, more than 40% of those with sleep apnea reported undertreatment, and almost 40% endorsed current insomnia symptoms at levels consistent with an insomnia disorder diagnosis. Moreover, a notable discrepancy was found when comparing the prevalence of these sleep disorders in our sample identified through screening (82%) vs the medical record (23.3%). Of course, not all participants screening positive for sleep apnea would ultimately be diagnosed with the condition after diagnostic testing. However, the positive predictive value of 50% for the Berlin Questionaire[22] suggests that an additional 109 participants (26% of the sample) screening positive for sleep apnea would likely meet criteria for sleep apnea based on a diagnostic sleep study, for a total of 46% of the sample ultimately diagnosed with sleep apnea. This value is more than double what was found by medical record review.

Our findings underscore a missed opportunity for disease prevention and suggest that 2 modifiable risk factors are highly prevalent and overlooked among those at risk for CVD. Insomnia disorder and sleep apnea are conditions amenable to brief screening approaches and subsequent behavioral intervention. In the reviews discussed above, Miller and Berger[11] conclude that "PCPs [primary care providers] need to be educated on how to detect OSA and its long term effects on cardiovascular morbidity and mortality," and Grandner and Chakravorty assert that "Health services research in the context of insomnia care is critically needed to better understand how to overcome these obstacles and deliver optimal care to patients." In alignment with these recommendations, the recently published Veterans Affairs/Department of Defense Clinical Practice Guidelines[17,24] recommend that all patients presenting to a primary care provider with a sleep complaint be screened for insomnia and sleep apnea, and additional assessment is recommended for those screening positive. The high prevalence of sleep disorders in our sample suggests that all patients at risk for cardiovascular disease should be routinely screened

Figure 2—Visual representation of frequencies of study participants with insomnia disorder, sleep apnea, or both by screening and self-report.



DO = disorder, dx = diagnosis.

for insomnia and sleep apnea. When identified, these sleep conditions can be successfully treated. Cognitive Behavioral Therapy for Insomnia is recognized as the standard of care for insomnia disorder by a number of organizations,[25] including the American College of Physicians.[26] Cognitive Behavioral Therapy for Insomnia is highly effective at reducing insomnia severity[27] and is associated with reduced CVD risk.[28] Similarly, all-cause and cardiovascular mortality among those with *treated* obstructive sleep apnea is no different than individuals without the condition.[29] Thus, established treatments are effective and available for the 2 most common sleep disorders.

Limitations of our study include the use of self-reported PAP adherence and the use of a self-report measure to infer that diagnostic criteria for insomnia disorder are met. In addition, the generalizability of our findings could differ from other populations because our sample was predominantly male and comprised entirely of veterans enrolled in a randomized clinical trial. However, high rates of sleep disorders found in this veteran population point to the likelihood of widespread sleep disorders that are frequently undiagnosed or undertreated.

Veterans are at greater risk than the general public for both sleep disorders and CVD,[1,4] and the most common sleep disorders confer increased risk of CVD. Our findings suggest that sleep apnea and insomnia disorder are highly prevalent but underrecognized conditions among veterans at risk for CVD. Identification and treatment of occult sleep disorders may be an underused strategy for reducing incident CVD among patients in general. Because veterans are at increased risk of both CVD and sleep disorders,[1,4] routine screening and clinical assessment for sleep disorders in this population should be considered.

ABBREVIATIONS

CVD, cardiovascular disease
ISI, Insomnia Severity Index
OSA, obstructive sleep apnea
PAP, positive airway pressure

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