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Original article

Frequency of insomnia report in patients with obstructive sleep apnoea hypopnea syndrome (OSAHS)

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Abstract

Background and purpose: Insomnia and Obstructive Sleep Apnoea Hypopnea Syndrome (OSAHS) are the two most common sleep disorders, and both have significant associated health costs. Despite this, relatively little is known about the prevalence or impact of insomnia in those with OSAHS, although a recent study suggested there may be substantial comorbidity between these disorders [Chest 120 (2001) 1923–9]. The primary aim of this study was to further explore the prevalence of insomnia in OSAHS. A secondary aim was to assess the effect of factors that may impact on both conditions, including mood and sleep-beliefs.

Patients and methods: Consecutive patients referred to an accredited Sleep Investigations Unit ($n = 105$) completed a brief standardized battery of validated questionnaires assessing sleep-related variables and mood.

Results: Results showed a high rate of prevalence of clinical insomnia in this OSAHS population, and a strong positive correlation between OSAHS and insomnia symptom severity. Further, OSAHS patients with comorbid insomnia had increased levels of depression, anxiety and stress compared to patients with OSAHS-only, and both patient groups reported similar and significant levels of dysfunctional beliefs about sleep. Findings in relation to habitual sleep, assessed using subjective (diary) and objective criteria (polysomnogram), were mixed but generally showed greater sleep disturbance among those with OSAHS-insomnia compared to those with OSAHS-only.

Conclusions: Overall these findings suggest that comorbidity of insomnia in OSAHS patients may lead to increased OSAHS severity and that patients with both conditions may experience more symptoms relating to depression, anxiety and stress. These findings underscore the need for insomnia assessment and management services, even in clinics that primarily service patients with OSAHS.

Keywords: Insomnia; Obstructive sleep apnea-hypopnea syndrome; Sleep disorders

1. Introduction

Obstructive sleep apnoea hypopnea syndrome (OSAHS) and insomnia are the two most common sleep disorders [2,3], yet the cooccurrence and potential for interaction between OSAHS and insomnia has rarely been examined. Findings from preliminary studies suggest there may be a comorbid relationship between these two disorders [1]. Indeed, a relationship between insomnia and OSAHS has been demonstrated previously in a range of samples including the elderly [4], patients with post-traumatic stress disorder [5], and those seeking treatment for sleep problems in primary care [6] and sleep clinic settings [1,7].

Estimates of percentage of OSAHS patients who also have insomnia range from 8% (primary care sample [6]) to between 29 and 43% (older adults [4]). Of particular relevance to this study, however, is the finding that between 25 and 50% of sleep clinic clients referred for investigation of OSAHS have been found to have comorbid insomnia [1,7]. The finding that as many as one in two OSAHS patients seen at sleep clinics may have concurrent insomnia suggests that there may be a significant relationship between OSAHS and insomnia; however, specific limitations of past research need to be addressed before the nature of this relationship can be more clearly understood.

A limitation of the two OSAHS-insomnia studies conducted previously in sleep clinic settings relates to

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the assessment and diagnosis of insomnia. For example, although Krakow et al. found that 50% of patients presenting for investigation of sleep-disordered breathing exhibited significant insomnia symptoms, a three-item scale only was used to diagnose insomnia [1]. This scale is not a well-established tool for the assessment of insomnia. In the study by Sahai, Staats and Olsen [7], 24 out of 99 patients diagnosed with OSAHS using polysomnogram (PSG) were found to have clinically significant insomnia on the basis of case note review. However, this study was retrospective and may have been limited by the quality or variability of data recorded in patient files, particularly in relation to the assessment of insomnia. In both studies, the use of unpublished or unvalidated insomnia assessment tools may have resulted in over- or under-inflation of insomnia prevalence estimates. Finally, it should be noted that although both previous studies used conventional criteria (i.e. PSG data) to assess OSAHS, the assessment could have been improved by the inclusion of other standardised measures to assess the subjective severity of the apnea complaint.

Diagnoses of insomnia and OSAHS rely to varying extents on subjective reports of sleep disturbance. However, variables that have been shown to impact on subjective sleep complaints have not typically been assessed in previous insomnia–OSAHS studies. That is, measures of depression, anxiety and dysfunctional sleep-related cognitions have been shown to be more predictive of subjective sleep complaints than are objective measures of disturbance [8]. The inclusion of measures to assess such variables may shed further light on the nature of the relationship between these two disorders, and would expand previous research in this area. In general, it would seem reasonable to expect patients with OSAHS and insomnia to report more impairment than those with OSAHS only, given that previous research has shown that insomnia and OSAHS share some characteristics such as sleep disruption and mood complaints [9–11] and that factors thought to perpetuate insomnia include poor sleep habits and dysfunctional sleep beliefs [12].

The primary aim of the current study was to investigate the prevalence of significant insomnia in a consecutive series of patients presenting to a tertiary care setting for investigation of suspected OSAHS, addressing the specific weakness identified in previous OSAHS–insomnia research (specifically, the failure to use standardized insomnia assessment tools and to include comprehensive assessment of OSAHS symptoms). Thus, the first hypothesis for this study was that a high proportion of patients with diagnosed OSAHS would report significant insomnia. Our second aim was to explore the implications of OSAHS-insomnia comorbidity on factors known to affect subjective reports of sleep quality (i.e. mood, sleep cognition) and sleep behaviour. Specifically, it was expected that more adverse health effects would result from OSAHS-insomnia than OSAHS alone.

2. Method

2.1. Participants

Participants were adult patients referred by their general practitioner for investigation of OSAHS at a sleep investigations unit. One hundred and five patients were included in the sample (73 males, mean age 53.91 ± 13.67 years; range 18–87). The mean length of sleep disturbance in this sample was 11.97 ± 10.99 years. Participants did not receive compensation for their participation.

3. Materials

Measures used in this study were primarily selected to assess signs and symptoms of insomnia and OSAHS. Participants completed a battery of four questionnaires (presented in a Latin squares design to reduce order effects) and a sleep diary (the Pittsburgh Sleep Diary (PghSD)) which was completed over 2 weeks. The questionnaires included were: the Survey Screen for the Prediction of Apnea (SSPA), the Insomnia Severity Index (ISI), Depression Anxiety and Stress Scales (DASS) and the Dysfunctional Beliefs and Attitudes Scale (DBAS-10). All participants underwent PSG diagnostic study, and data on objective sleep parameters were extracted by consent from hospital charts. Several of the measures used in this study yield total and subscale scores (e.g. SSPA, DASS, DBAS), and in most instances both score types were used in statistical analysis unless otherwise stated. A brief description of each measure including subscale scores follows.

3.1. Survey Screen for the Prediction of Apnea

SSPA [13] is a 13-item questionnaire examining the symptoms of OSAHS. Items are rated on a six-point Likert scale as frequency of occurrence ranging from never (score of zero) to 5–7 times per week (score of 4), and with a 'don't know' response option. The SSPA contains four subscales labelled *apnea symptom frequency* (three items), *difficulty sleeping* (five items), *excessive daytime sleepiness* (three items), and *narcolepsy symptoms* (two items). The reliability of the SSPA has been investigated previously [13] and found to be adequate.

3.2. Dysfunctional beliefs and attitudes about Sleep Scale-10 (DBAS-10)

The short version of Morin's Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS) [11], the DBAS-10 [14], was used in this study. It is a 10-item analog scaled questionnaire that focuses on the respondent's personal rating of statements concerning beliefs and attitudes about sleep. The DBAS-10 comprises of three factors [14]; beliefs about the immediate negative consequences of

insomnia (five items); beliefs about the long-term negative consequences of insomnia (three items) and beliefs about the need for control over insomnia (two items). Respondents place a mark along a 10 cm line to indicate the extent of agreement with given statements; response options range from 'strongly disagree' to 'strongly agree.' For the DBAS-10 total score and the three subscales, higher scores indicate increased dysfunctional beliefs and attitudes about sleep.

3.3. Insomnia Severity Index

The Insomnia Severity Index (ISI[1]; [15]) is a self-report questionnaire measuring a time interval of two weeks and consisting of seven items measuring patients' perceptions of their insomnia. Participants rate ISI items on a scale of 'not at all' (score of zero) to 'very much' (score of four). ISI items correspond generally to diagnostic criteria of significant insomnia according to the Diagnostic and Statistical Manual of mental disorders (DSM-IV) [31]. These include the severity of delayed sleep onset, severity of impaired sleep maintenance, severity of early morning awakenings, satisfaction with current sleep patterns, interference with daily functioning, how noticeable the sleep impairment is to others, and the degree of worry or distress related to the sleep problem [15]. Scores range from 0 to 28, with higher scores indicating more severe insomnia. Bastien [15] recommends that scores ranging from 0 to 7 be classified as 'no clinically significant insomnia,' 8–14 as 'subthreshold insomnia,' 15–21 as 'moderate clinical insomnia' and 22–28 as 'severe clinical insomnia.' The psychometric properties of the ISI (reliability and validity) have been investigated previously and found to be adequate [15].

Five additional items originating from an earlier version of the ISI were added to the index for this study. Four items ask respondents to indicate, on a scale of 'not at all' (zero) to 'very much' (four), the extent to which they believe racing thoughts, muscle tension/pain, bad sleep habits and natural aging processes affect their sleep. These questions were included to assess factors that patients may identify as causes of their sleep problems. The last additional item asks the respondent to circle statements that best apply to the problems experienced after a poor night's sleep; four categories include: fatigue and sleepiness, cognitive functioning, mood problems and physical problems. This item ascertains the daytime consequences of the patient's sleep problem. These five additional items were not included in the ISI total score.

3.4. Depression Anxiety Stress Scale-21 (DASS-21)

The Depression Anxiety Stress Scales (DASS [16]) consists of 21 items measuring the three negative emotional states of depression (seven items), anxiety (seven items) and stress (seven items). The DASS-21 was included in this study to provide a screening assessment of the level of psychopathology among participants, as an indicator of mental health. Using a four-point Likert scale respondents are required to rate the frequency of DASS-21 symptoms during the previous week. The DASS yields a total score as well as separate indices of depression, anxiety and depression, and has been normed on an Australian sample [17]. The psychometric properties (reliability and validity) of the DASS-21 total scores and subscales have been investigated previously and are considered adequate [16,17].

3.5. The Pittsburgh Sleep Diary (PghSD)

The Pittsburgh Sleep Diary (PghSD [18]), a 24-item diary measuring the subjective patterns of sleep, is comprised of two components relating to waketime and bedtime behaviours. Items are measured on five-point Likert scale, visual analogue scale or fill-in-the-blanks format. Respondents are required to fill out the diary for 14 consecutive days, each morning and night. The bedtime component of the diary assesses four areas including the times of breakfast, lunch and dinner; the consumption of caffeine, alcohol and tobacco; the use of medications and the times and duration of exercise and naps. The waketime component of the diary assesses four areas including the time of going to bed, turning out the lights, sleep onset latency (SOL) and awakening; the method of final waking; the incidence, duration and reasons for wake after sleep onset (WASO); sleep quality; mood and alertness on final awakening. The PghSD has adequate test-retest reliability and is sensitive to differences in sleep patterns due to age, gender, weekends, personality and circadian type; it yields moderate stable correlations with PSG measures of sleep [18].

4. Procedure

Consecutive adult patients referred by general practitioners for investigation of OSAHS at a Sleep Investigations Unit were invited during routine clinical appointments with sleep physicians to participate in the study. All patients asked to participate consented. The questionnaire battery, completed on site, included a patient information sheet detailing the study and their involvement, along with a consent form confirming voluntary involvement. The sleep diary was completed at home and returned to the hospital via return-paid mail. Information regarding respiratory disturbance index (RDI; a measure of OSAHS severity), sleep efficiency (%), and age was then obtained, with their consent, from participants' hospital charts.

[1] The ISI was originally known as the Sleep Impairment Index (SII [12]).

5. Results

5.1. Data analysis review

The data analyses for this project were conducted using SPSS for windows (version 11) statistical software. A small amount of missing data on age and RDI variables ($n = 1$ and $n = 5$, respectively) was replaced with the series mean in accordance with procedures described in Tabachnick and Fidell [19]. All tests of statistical significance were calculated at the alpha level of 0.05. Effect sizes between groups were calculated with eta squared (η^2) or Cramęr's V.

5.2. Prevalence of insomnia in OSAHS patients

To examine the prevalence of significant insomnia in patients with OSAHS, data was sorted by selecting those patients that met the research criteria for significant insomnia. The criteria for insomnia included (1) an ISI score of 15 or more (corresponding to moderate insomnia) (2) length of sleep complaint longer than 6 months (3) SOL or WASO longer than 30 min on PSG and (4) at least one negative daytime consequence of sleep disturbance. The criterion for the diagnosis of OSAHS was derived from PSG data and review by a sleep physician, reflecting routine clinical practice at the study site. Data from three patients who did not subsequently receive a diagnosis of OSAHS were excluded from subsequent between-group analyses. A frequency table was produced to assess the number of patients from the OSAHS group having significant insomnia. As expected, there was a high prevalence of insomnia in OSAHS patients, with 41 (39%) having significant insomnia according to research criteria.

5.3. Impact of comorbid OSAHS and insomnia

Preliminary analyses were calculated to explore the general relationship between sleep symptom measures prior to exploring comorbidity or testing for group differences. Bivariate correlations were used to examine the extent to which the reported Sleep Apnea Symptom Measure (SSPA), and insomnia severity measure (ISI) were related ($r = 0.787$, $P = 0.001$).

5.4. Group formation and demographics

Two groups were formed using the results from prevalence analyses, in a manner that has been used in previous OSAHS-insomnia studies [1]. The groups comprised those with OSAHS-only ($n = 64$) and those with OSAHS-insomnia (OSAHS-plus; $n = 41$). A comparison of the demographic characteristics of these two groups revealed no significant differences on key variables such as length of sleep problem and RDI.

5.5. Adverse impacts of insomnia-OSAHS comorbidity

5.5.1. Mood in OSAHS patients with and without insomnia

Depression, anxiety, stress scale 21 (DASS-21). To assess the prediction that patients in the OSAHS-insomnia group would report more mood disturbances than those in the OSAHS-only group we compared the mean total DASS-21 scores between the two groups. An independent-samples t test was used to evaluate the relationship between mood disturbance and insomnia in OSAHS. The independent variable (insomnia factor) included two levels: OSAHS and OSAHS-insomnia. The dependent variable was DASS-21 total scores. The independent-samples t test was significant, $t(1, 54.47) = -6.56$, $P = 0.001$, with the insomnia factor accounting for 30% of the variance of the dependent variable($\eta^2 = 0.29$).

As expected, patients in the OSAHS-insomnia group reported significantly more mood disturbance than those in the OSAHS-only group ($M = 25.88$, SD 14.34 and $M = 9.92$, SD 7.57, respectively).

To further explore the nature of group differences, a series of independent-samples t-tests was run using the three DASS-21 subscale scores (i.e. depression, anxiety, and stress). The results of these analyses are shown in Table 1. They reveal significant group differences on all three subscales, suggesting that those in the OSAHS-insomnia group experienced more symptoms of depression, anxiety, and stress than those with OSAHS-only.

5.5.2. Dysfunctional beliefs in OSAHS patients with and without insomnia

Dysfunctional beliefs and attitudes about sleep scale (DBAS-10). The prediction that patients in the OSAHS-insomnia group would report more dysfunctional beliefs

Table 1
Comparison of Means of OSAHS-only and OSAHS-plus patients and normative labels of the DASS-21

	OSAHS-only M (SD)	OSAHS-plus M (SD)	t-value	P-value	η^2
DASS-21 scales					
Depression	3.30 (3.23) Normal	8.07 (5.69) Moderate	−4.90	<0.001*	0.19
Anxiety	2.98 (2.73) Normal	7.88 (4.69) Severe	−6.06	<0.001*	0.26
Stress	3.69 (3.42) Normal	9.98 (5.98) Moderate	−6.12	<0.001*	0.27

*Significant group difference.

about sleep than the patients in the OSAHS-only group was tested in an independent-samples t test. The dependent variable was the DBAS-10 total scores, with the independent factor consisting of two levels: OSAHS-only and OSAHS-insomnia. The analysis revealed a significant difference between the two groups ($t(1, 103) = -4.85$, $P = 0.000$, $\eta^2 = 0.19$), with patients in the OSAHS-insomnia group reporting more dysfunctional beliefs about sleep than those with OSAHS-only ($M = 62.92$, SD 18.40 and $M = 44.56$, SD 19.27, respectively). Further exploration of group differences using DBAS-10 subscale scores revealed that those with OSAHS-insomnia had significantly more concerns about the long-term consequences of poor sleep on behavior ($t(1, 103) = -4.63$, $P = 0.000$, $\eta^2 = 0.17$) and higher levels of the need for control over sleep ($t(1, 103) = -3.29$, $P = 0.001$, $\eta^2 = 0.09$) than those without comorbid insomnia (OSAHS-plus: M (consequences) = 16.01, SD 7.22; M (control) = 10.59, SD 5.19; OSAHS-only: M (consequences) = 9.33, SD 7.21; M (control) = 6.88, SD 5.90).

According to Smith and Trinder, [23] a DBAS cutoff point of 35 (mean VAS score) discriminated well between young adults with or without insomnia. Both of our groups had mean VAS scores > than 35, suggesting the presence of dysfunctional beliefs and attitudes about sleep at a level that is clinically relevant.

5.5.3. Habitual sleep in OSAHS patients with and without insomnia

Finally, we predicted that OSAHS-insomnia patients would report greater disruption in habitual sleep than OSAHS-only patients. Measures of habitual sleep were derived from the PghSD (subjective report of habitual sleep parameters) and PSG (objective measure of habitual sleep behaviour). To conduct analyses reliant on data from sleep diaries, 27 participants who returned completed sleep diaries, including 15 from the OSAHS-only group and 12 from the OSAHS-insomnia group, were selected from the main sample. To conduct analyses reliant on PSG data, 88 patients for whom this information could be obtained were selected from the main sample.

Habitual sleep. To compare habitual sleep among OSAHS-only and OSAHS-insomnia patients, measures of sleep latency (SOL-min), wake after sleep onset (WASO-min) and number of wakes after sleep onset were calculated from sleep diary information; WASO-min and SOL-min were predominately positively skewed. Logarithm transformed variables had a significant impact on the results, and were consequently used in all subsequent analyses. Group differences of WASO-min, SOL-min, and number of wakes after sleep-set were assessed via independent-samples t-tests. The results of these analyses are shown in Table 2. As expected, analyses of the 14 nights of the sleep diary revealed a significant difference between the OSAHS-only and OSAHS-insomnia groups on two out of three variables (the exception was SOL-min), suggesting that OSAHS-insomnia patients take longer to get to sleep and wake up more often after falling to sleep. Results relating to SOL-min showed a trend in this direction, despite non-significance.

PSG data were used to compare the groups in terms of total sleep time (h), total time awake (h) and sleep efficiency (%). The results of independent-samples t tests comparing the means are shown in Table 2. Significant group differences were found on all of the PSG-based scores used in this study. The direction of these differences indicate that those with OSAHS-insomnia had more indicators of poor sleep (worse sleep efficiency, more time spent awake, and less total sleep time). Further, although significant differences between the groups were found on PSG-based measures, the general pattern of results from these variables suggests that both groups experienced poor sleep.

6. Discussion

A significant proportion of OSAHS patients in this study reported at least moderate levels of clinical insomnia, defined according to stringent and conservative criteria. Specifically, 39% of OSAHS patients met the criteria for significant insomnia. In general, this result is consistent with previous research suggesting a significant relationship

Table 2
Group differences on PghSD- and PSG-based measures of habitual sleep for participants with OSAHS-only ($N = 29$) and OSAHS-plus ($N = 28$)

	OSAHS-only M (SD)	OSAHS-plus M (SD)	t-value	P-value
PghSD-based measures of habitual sleep ($n = 57$)				
WASO-min	13.02 (22.87)	34.34 (51.59)	−7.25	<0.001*
SOL-min	16.06 (36.02)	20.54 (34)	−1.79	0.074
Number of wakes after sleep onset	13.02 (22.87)	34.34 (51.59)	−7.25	<0.001*
PSG-based measures of habitual sleep ($n = 88$)				
Sleep efficiency (%)	70.72 (13.54)	60.17 (22.79)	2.51	0.015*
Time spent awake (h)	2.01 (0.94)	2.81 (2.00)	−2.24	0.030*
Total sleep time (h)	4.79 (1.29)	4.10 (1.69)	2.11	0.039*

*Significant group difference.

between OSAHS and insomnia, with the estimated prevalence of insomnia among patients with OSAHS in this study falling between previous estimates of OSAHS-insomnia comorbidity in similar samples [1,7]. The significance of this finding can be demonstrated by considering the prevalence of insomnia alone in the general population. According to population estimates of insomnia recently reviewed by Ohayon [20], the prevalence of clinically significant insomnia is between 9 and 15% in the normal population. The rate of significant insomnia in the current sample of OSAHS patients is substantially higher. Overall, these findings suggest that persons with suspected OSAHS are at least twice as likely to have significant insomnia as those in the general population.

A second aim of this study was to explore the impact of comorbid OSAHS and insomnia on the variables of mood, habitual sleep, and sleep cognitions. Preliminary analysis to investigate the relationship between reported insomnia severity and sleep apnea severity revealed significant positive relationships between these two variables. That is, it appears that the comorbidity of insomnia in OSAHS is associated with increased sleep apnea symptom severity. In terms of adverse impacts of comorbidity, it was expected that patients with OSAHS-insomnia would report more problems with mood problems, have worse habitual sleep, and report more dysfunctional beliefs about sleep than patients with OSAHS only. In general this hypothesis was supported, with the exception of a mixed pattern of results relating to habitual sleep (i.e. one of the six indices of habitual sleep used in this study did not yield significant group differences). However, in the majority of measures used (depression, stress, anxiety, and most indices of habitual sleep), OSAHS- insomnia patients typically reported significantly more impairment than those with OSAHS alone. The findings related to mood suggest that, while OSAHS-only patients reported 'normal' levels (i.e. endorsed symptom levels of depression, anxiety and stress that placed them in the non-clinical range when compared to published normative data for the DASS), [16] patients in the OSAHS-insomnia group reported levels suggestive of pathology (i.e. anxiety in the severe range and depression and stress in the moderate range). Thus, comorbidity of insomnia and OSAHS appears to be associated with clinical levels of mood disturbance. While some caution in interpreting this finding is warranted on the grounds that the DASS is a screening measure only, it is consistent with previous research. Refs. [10,21,22] and further underscores the importance of identifying OSAHS-insomnia patients, who are apparently at increased risk of mood disorders that may require direct treatment strategies. At the site of this study, a clinical audit revealed that less than 1% of the previous 1000 patients had received a primary or secondary sleep diagnosis of insomnia, and potential mood problems were not formally assessed.

Findings related to beliefs about sleep indicated that both groups had a high level of dysfunctional sleep cognition, according to the DBAS-10 (see [23] for information about levels of impairment on the DBAS). Interestingly, although previous studies have indicated a relationship between dysfunctional beliefs and insomnia [8,11,25,26], there have been no previous studies identifying the presence of dysfunctional beliefs in OSAHS patients. Further research is needed to examine the potential role of dysfunctional beliefs in OSAHS.

As stated previously, the findings in relation to habitual sleep were somewhat mixed, but generally consistent with predictions that OSAHS-insomnia patients would be more impaired on these measures than patients with OSAHS-only. One of the three indices of habitual sleep (SOL-min), derived from sleep dairy data, yielded a non-significant group difference, while the other two (WASO and time awake at night) yielded significant differences consistent with predictions. That is, data from sleep diaries suggested that patients in the OSAHS-insomnia group had increased WASO, and spent more time awake during the night than OSAHS-only patients, but did not take significantly longer to fall asleep (although non-significant trends in the expected direction were observed in the data). Nonetheless, it seems reasonable to conclude that OSAHS patients with insomnia typically report different habitual sleep patterns than those without insomnia. In addition, PSG findings related to group differences in habitual sleep suggest that OSAHS-insomnia patients have significantly worse sleep (i.e. sleep efficiency, time spent sleeping, total time awake), than OSAHS patients without insomnia.

Reasons for the mixed pattern of habitual sleep results may include methodological factors, such as the way subjective information was collected. Although patient-completed sleep dairies are widely accepted and used in insomnia studies [18,24,26], future studies of OSAHS and insomnia patients could include structured patient interviews and actigraphy to improve (or corroborate) sleep diary estimates of habitual sleep patterns.

The validity of using a single-night PSG as the basis of comparison between the OSAHS-only and OSAHS-insomnia groups might be questioned. PSG has been used in many insomnia studies [27,28] and is the standard objective measure of sleep. However, this method has limitations (see [29]), and a single night of sleep measurement may have reduced the likelihood of detecting disrupted sleep, particularly if features of insomnia were minimized by paradoxical first night effects [29]. Although this potential was the same for all patients, the use of the first night data may have resulted in an underestimation of sleep disturbance in the OSAHS-insomnia group; there is high night-to-night sleep variability in insomnia [29]. Despite these limitations, significant group differences were found on most variables. Future research should control for first night effects and use repeated measurements as additional controls.

The demonstration of a comorbid insomnia in approximately one-in-three patients seeking treatment for suspected OSAHS has potential clinical implications. For example, unresolved insomnia symptoms may reduce the perceived benefits of continuous positive airway pressure (CPAP) therapy, and thus reduce adherence to therapy. Other clinical implications are suggested by the model of complex insomnia presented by Krakow et al. [30] to describe plausible interactions between insomnia and sleep disordered breathing that may produce a range of clinical presentations for both conditions.

In conclusion, the current study extends and is consistent with the results of previous research into the relationship between insomnia and OSAHS [1,7], strengthening the findings by confirmation and some improvement in methodology. Future studies are needed to further our understanding of the nature of this relationship and its impact on both clinical presentation and treatment for these conditions.

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