Running Head: Frequency of insomnia in OSAHS

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

Smith, Simon PhD[1]., Sullivan, Karen PhD[2]., Hopkins, Wendy, BPsych(Hons)[2], & Douglas, James[1]

1 = The Prince Charles Hospital, Brisbane

2 = Queensland University of Technology, Brisbane

AUSTRALIA

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Correspondence concerning this article should be addressed to Simon Smith at the School of Psychology, University of Queensland, St Lucia Q 4070 AUSTRALIA, Fax +617 3365 4466 Tel +617 3365 6408. Electronic mail should be sent to s.smith@psy.uq.edu.au

Abstract

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 suggested there may be substantial comorbidity between these disorders [1]. 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. 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 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 (PSG), were mixed but generally showed greater sleep disturbance among those with OSAHS-plus compared to those with OSAHS-only. 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.

Introduction

Obstructive Sleep Apnoea Hypopnea Syndrome (OSAHS) and Insomnia are the two most common sleep disorders [2,3], yet the co-occurrence 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 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 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 via PSG were found to have clinically significant Insomnia on the basis of case note review. However, the Sahai et al. study [7] 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 (ie. PSG data) to assess OSAHS, the assessment of OSAHS in these studies could have have been improved by the inclusion of other standardised measures of OSAHS symptoms 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 variables such as depression 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 may 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 decreased mood [9-11], and that factors thought to perpetuate and maintain 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, and to do so in a manner that addressed a specific weakness identified in previous OSAHS-insomnia research (specifically, the failure to use standardized Insomnia assessment tools; the failure 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. The second aim of this study was to explore the implications of OSAHS-insomnia comorbidity on factors known to affect subjective reports of sleep quality (ie. mood and sleep cognition) and sleep behaviour. Specifically, it was expected that having insomnia plus OSAHS would result in more adverse health effects than having OSAHS alone.

Method

Participants

Participants were consecutive 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 to 87]). The mean length of sleep disturbance in this sample was 11.97 +/- 10.99 years. Participants did not receive compensation for their participation.

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 two-weeks. The questionnaires included in the battery 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 went on to PSG diagnostic study and data on objective sleep parameters were extracted from consenting patient's 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.

Survey Screen for the Prediction of Apnea (SSPA). The 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 five to seven times per week (score of four), with a don't know response scored as five. 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.

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. The DBAS-10 is a 10-item analog scaled questionnaire that focuses on respondent's personal rating of statements of beliefs and attitudes about sleep. It measures five subscales: misconceptions of the causes of insomnia; misattributions or amplifications of the consequences of insomnia; unrealistic sleep expectations; diminished perceptions of control and faulty beliefs about sleep-promoting practices [11]. 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). Response options range from strongly disagree to strongly agree with respondents asked to place a mark along the ten centimeter line to indicate the extent of agreement with given statements. For the three factors, higher scores indicate increased dysfunctional beliefs and attitudes about sleep. Adequate reliability has been reported for the three DBAS-10 factors [14], and the validity of factors has been demonstrated previously (i.e., DBAS-10 factor

scores are sensitive to treatment effects and are highly correlated with the DBAS total score [14]).

Insomnia Severity Index (ISI). The Insomnia Severity Index (ISI[1]; [11]) is a self-report questionnaire measuring a time interval of two weeks. 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 DSM-IV. These include the severity of sleep onset, sleep maintenance and early morning awakenings, satisfaction with the current sleep patterns, interference with daily functioning, noticability of sleep impairment and the degree of worry or distress [15]. Scores range from 0 to 28, with higher scores indicating more severe insomnia. Morin [11] recommends that scores ranging from zero to seven be classified as no clinically significant Insomnia, eight to 14 as subthreshold Insomnia, 15 to 21 as moderate clinical Insomnia and 22 to 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 of the items ask respondents to indicate, on a scale of not at all (zero) to very much (four), the extent to which participants 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 the cause of their sleep problem.

The last additional ISI item asks the respondent to circle statements that best apply to the problems experienced after a poor night's sleep. Four categories including statements concerning fatigue and sleepiness, cognitive functioning, mood problems and

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

physical problems are presented for the patient to circle. This item ascertains the daytime consequences of the patients sleep problem. The five additional items were not included in the ISI total score.

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 the mental health of participants. Using a four-point Likert scale respondents are required to rate the frequency of DASS-21 symptoms over a time frame of the last 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. The psychometric properties (reliability and validity) of the DASS-21 total scores and subscales have been investigated previously and are considered adequate [16, 17].

The Pittsburgh Sleep Diary (PghSD). The Pittsburgh Sleep Diary (PghSD [18]) is a 24-item diary measuring the subjective patterns of sleep. The PghSD comprises two components relating to waketime and bedtime behaviours. The format of the diary contains items measured on five-point Likert scale, visual analogue scale or fill-in-the-blanks format. Respondents are required to fill out the sleep diary for 14 consecutive days each morning and night. The bedtime component of the diary assesses four areas including the timing of breakfast, lunch and dinner; the consumption of caffeine, alcohol and tobacco; the use of medications and the timing and duration of exercise and naps. The waketime component of the diary assesses four areas including the timing of bed, turning out of lights, sleep onset latency and awakening; the method of final waking; the incidence, duration and reasons for wake after sleep onset and sleep quality, mood on final awakening and

alertness on awakening. The PghSD has adequate test-retest reliability, is sensitive to differences in sleep patterns due to age, gender, weekends, personality and circadian type, and yields moderate stable correlations with PSG measures of sleep [18].

Procedure

Patients were invited to participate in the study by their Sleep Physician during routine clinical appointments. The questionnaire battery included a patient information sheet detailing the study and their involvement along with a consent form requiring the patient signature confirming voluntary involvement in the study. The questionnaire battery was given to the patients who agreed to take part in the study and was completed on site. The sleep diary was taken home to complete and returned to the hospital via return-paid mail. With the participants' consent, information regarding respiratory disturbance index (RDI; a measure of OSAHS severity), sleep efficacy (%), and age was then obtained from their hospital charts.

Results

Data Analysis Review

The data analysis for this project was 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 Cramėr's V.

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 minutes 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. There were three patients who did not subsequently receive a diagnosis of OSAHS and data from these participants was therefore excluded from subsequent between group analyses. A frequency table was produced to assess the number of patients who had significant Insomnia out of the OSAHS patient group. As expected there was a high prevalence of Insomnia in OSAHS patients, with 41 (39%) of the OSAHS patients having significant Insomnia according to the research criteria.

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 ($r = .787$, $p = 0.001$). These findings suggest that as reported sleep-apnea symptoms increase, so do reported Insomnia symptoms.

Group formation and demographics

To test further investigate the aims of this study, 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-plus-insomnia (OSAHS-plus; $n = 41$). A comparison of the demographic characteristics of these two groups (OSAHS-only and OSAHS-plus) revealed no significant differences on key variables such as length of sleep problem and RDI.

Adverse impacts of insomnia-OSAHS comorbidity

Mood in OSAHS patients with and without insomnia: Depression, Anxiety, Stress Scale 21 (DASS-21). The predictions of this study in relation to mood were that patients in the OSAHS plus group would report more increased mood disturbances than the OSAHS-only group. This hypothesis was assessed by comparing the mean total DASS-21 scores between the two OSAHS groups. An independent-samples *t* test was conducted to evaluate the relationship between mood disturbance and the presence of Insomnia in OSAHS. The independent variable, the Insomnia factor, included two levels: OSAHS-only and OSAHS-plus. The dependent variable was DASS-21 total scores.. The independent-samples *t* test was significant, $t(1, 54.47) = -6.56$, $p = .001$. The strength of the relationship between the two groups and the DASS-21 scores, as assessed by $\eta^2 = .29$, was strong, with the Insomnia factor accounting for 33 % of the variance of the dependent variable. As expected, patients in the OSAHS-plus Insomnia group reported significantly

more mood disturbance than those patients 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 on the DASS-21, 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. DASS-21 subscale analyses revealed significant group differences on all three subscales (depression: $t(1, 56.72) = -4.90$, $p = .000$, $\eta^2 = .19$; anxiety: $t(1, 57.50) = -6.06$, $p = .000$, $\eta^2 = .26$; stress: $t(1, 56.90) = -6.12$, $p = .000$, $\eta^2 = .27$), suggesting that participants in the OSAHS-plus group experienced more symptoms of depression, anxiety, and stress than participants with OSAHS-only.

Insert Table 1 About here

Dysfunctional Beliefs in OSAHS patients with and without insomnia

Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS-10). The prediction in relation to sleep beliefs was that patients in the OSAHS-plus group would report more dysfunctional beliefs about sleep than the patients in the OSAHS-only group. The effect of Insomnia on dysfunctional beliefs about sleep 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-plus. The analysis revealed a significance difference in the level of dysfunctional beliefs about sleep between the two groups, $t(1, 103) = -4.85$, $p = .000$, $\eta^2 = .19$, with patients in the OSAHS-plus 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 those with OSAHS-plus had

significantly more concerns about the long-term consequences of poor sleep on their behaviour, t (1, 103) = -4.63, p = .000, η^2 = .17, and reported higher levels of the need for control over their sleep t (1, 103) = -3.29, p = .001, η^2 = .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 (2001) a cutoff point for the DBAS that discriminated well between young adults with or without Insomnia was a mean VAS score of 35. Both of the OSAHS groups had mean VAS scores greater than 35, suggesting the presence of dysfunctional beliefs and attitudes about sleep in both OSAHS-only and OSAHS-plus patients at a level that is clinically relevant.

Habitual Sleep in OSAHS patients with and without Insomnia

Finally, the prediction in relation to habitual sleep was that patients in the OSAHS-plus Insomnia group would report greater disruption in habitual sleep compared to OSAHS-only patients. Measures of habitual sleep were derived from two sources: 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, participants with sleep diary information were selected from the main sample. Twenty-seven participants returned completed sleep diaries, including 15 participants from the OSAHS-only group and 12 participants with OSAHS-plus. To conduct analyses reliant on PSG data, participants for whom this information could be obtained were selected from the main sample. There were 88 patients with PSG data.

Habitual Sleep. In order to compare habitual sleep among those with OSAHS-only and OSAHS-plus, measures of sleep latency (SOL-mins), wake after sleep onset (WASO-mins) and number of wakes after sleep onset were calculated from sleep diary information. The variables wake after sleep onset (WASO-mins) and sleep onset latency (SOL-mins) were

predominately positively skewed. Analyses with the logarithm transformed variables had a significant impact on the results consequently the transformed data was used in all subsequent analyses. Group differences on WASO-mins, SOL-mins, and number of wakes after sleep-set were assessed via independent-samples *t*-tests. The results of these analyses are shown in Table 2. Analyses on the 14 nights of the sleep diary revealed that a significant difference existed between the OSAHS-only and OSAHS-plus group on two out of three variables (the exception was SOL-mins). Significant differences were in the same direction as previous results reported in this study suggesting that participants in the OSAHS-plus group take longer than those without comorbid insomnia to get to sleep and wake up more often after falling to sleep. Results relating to SOL-mins showed a trend in this direction, despite non-significance.

PSG data was used to compare the groups in terms of total sleep time (hours), total time awake (hours) and sleep efficiency (%). Independent-samples *t* tests were conducted in order to compare the means of the OSAHS-only and OSAHS-plus groups. The results of these analyses 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 group differences was such that those with OSAHS-plus had more indicators of poor sleep (worse sleep efficiency, more time spent awake, and less total sleep time) than those with OSAHS-only. Further, although significant differences between the OSAHS-only and OSAHS-plus groups were found on PSG-based measures, the general pattern of results from these variables suggests both groups experienced poor sleep.

Insert Table 2 About here

Discussion

The primary aim of the current study was to examine the prevalence of Insomnia symptoms in patients with OSAHS. A secondary aim of this study was to investigate the impact of comorbid OSAHS and insomnia on patient functioning. Prevalence of Insomnia in OSAHS

As expected, 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 in this study met the criteria for significant Insomnia. In general, this result is consistent with previous research suggesting a significant relationship 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 the finding that insomnia and OSAHS frequently co-occur 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 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 than these population estimates. Overall these findings suggest that persons with suspected OSAHS are at least twice as likely to have significant Insomnia as those in the normal population. In sleep clinic settings the methods used to identify comorbid insomnia may need to be revisited to improve detection rates. For example, the results of a recent clinical audit undertaken at the study sleep clinic showed that less than one percent of the previous 1000 patients attending the clinic received a primary or secondary sleep diagnosis of insomnia.

Adverse impact of comorbidity.

Given that Insomnia and OSAHS may co-occur, this raised questions about the nature of the relationship between these disorders, as well as other factors that may

contribute to sleep disturbance such as mood, habitual sleep, and sleep cognitions. The second aim of this study was to explore the impact of comorbid OSAHS and insomnia on these variables.

A preliminary analysis intended to investigate the relationship between reported Insomnia severity and sleep apnea severity was therefore conducted. The results of correlational analyses revealed significant positive relationships between these two variables. That is, as reported Insomnia severity increased, so did reported sleep apnea severity. Thus, it appears that the comorbidity of Insomnia in OSAHS patients is associated with increased sleep symptom severity. It should be noted that it is not possible to infer causal links between the variables on the basis of this analysis. In addition, on the basis of these results it is not clear how specific these effects are, with the significant associations possibly loading as a more general poor sleep factor. Nonetheless, in light of the finding that Insomnia and OSAHS do co-occur, the pattern of significant positive correlations between OSAHS and Insomnia symptoms suggests that Insomnia detection strategies should be implemented as part of routine practices in sleep clinics, including those that service OSAHS patients predominately.

In terms of adverse impacts of comorbidity, the general pattern of results expected in this study was that patients with OSAHS-plus would report more mood problems (depression, anxiety and stress), more habitual sleep problems, and more dysfunctional beliefs about sleep than people with OSAHS only. In general this hypothesis was supported, with the exception that a mixed pattern of results in terms of habitual sleep (one of the six indices of habitual sleep used in this study did not yield significant group differences). On the majority of measures used in this study however, namely depression, stress, anxiety, and most indices habitual sleep, OSAHS patients with comorbid insomnia typically reported significantly more impairment than those with OSAHS-only. The

findings in relation to mood suggest that whilst OSAHS-only patients reported were "normal" (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-plus group reported depression, anxiety and stress levels suggestive of pathology (i.e., anxiety in the severe range and depression and stress in the moderate range). Thus, the addition of insomnia in OSAHS patients appears to be associated with clinical levels of mood disturbance. Whilst some caution interpreting this finding is warranted on the grounds that the DASS is a screening measure only, this finding is consistent with previous research [10, 21, 22] that suggests a significant relationship between Insomnia and mood disturbance, and should be replicated. Further, this finding underscores the importance of identifying OSAHS patients with comorbid insomnia, given they appear to be at increased risk of having mood disorders and may require different treatment.

Findings in relation to dysfunctional sleep beliefs indicated both groups experienced a high level of dysfunctional sleep cognition on 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 published studies addressing the presence of dysfunctional beliefs in OSAHS patients. The findings of this study suggest that dysfunctional beliefs are present in OSAHS, contrary to the previous notions that these beliefs were only related to Insomnia [8, 11]. The implication of this result suggests that dysfunctional beliefs may contribute to, or perpetuate, the subjective complaint of OSAHS, or may be a consequence of OSAHS. Although further research is clearly needed to further elucidate the relationship between sleep cognition and insomnia and OSAHS, the findings of this study suggest there may be a role for targeting these in future OSAHS treatment programs.

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. In this study, two indices of habitual sleep were used. These were based either on sleep diary data (subjective estimate of habitual sleep) or PSG data (objective estimate of habitual sleep). One of the three indices of habitual sleep (SOL-mins), derived from sleep dairy data yielded a non-significant group difference, whilst the other two indices (WASO and time awake at night) yielded significant differences consistent with predictions. That is, data from sleep diaries suggested that patients in the OSAHS-plus 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 data in the expected direction were observed). Nonetheless, it seems reasonable to conclude that OSAHS patients who present with comorbid Insomnia typically report different habitual sleep patterns than those without comorbid insomnia. In addition, findings in relation to group differences in habitual sleep assessed using PSG suggest that that OSAHS-plus patients have significantly worse sleep (i.e., sleep efficiency, total time awake and time spent sleeping), than OSAHS patients with insomnia..

Possible reasons for the mixed pattern of results in relation group differences in habitual sleep include methodological factors, such as the way "subjective" information about habitual sleep was collected (via patient-completed sleep diary). Although sleep dairies are an accepted method of collecting this type of information and are widely used in Insomnia studies [18, 24, 26] future studies using OSAHS and Insomnia patients could include patient interviews to improve (or corroborate) sleep diary estimates of habitual sleep patterns.

In addition, it is important to note methodological issues associated with the way "objective" sleep information was collected in this study, since considerations of these issues serves to highlight the robustness of effects observed. That is, the validity of the single night of observation that was used as a basis for PSG comparisons between the OSAHS-only and OSAHS-plus groups might be questioned. PSG had been used in many Insomnia studies [27, 28] and is the standard objective measure of sleep. However, this method of collecting sleep information has limitations (see [29]), and as there was only one night of overnight sleep measurement this may have decreased the probability of detecting disrupted sleep, particularly if insomnia effects were minimized by the first night effect [29]. Further, although this effect was the same for all patients, the use of the first night data may have resulted in underestimation of sleep disturbance in the OSAHS-plus group, as there is high night-to-night variability in the sleep of people with [29]. Despite this, as indicated above, significant group differences were found on most variables. Future research controlling for first night effects, and using repeated measurement is suggested however, to determine the strength of effects with these additional controls.

In conclusion, the current study extends on, and provides results consistent with previous research into the relationship between Insomnia and OSAHS [1, 7]. Overall, greater confidence in the relationship between Insomnia and OSAHS was provided by 1) the confirmation of previous findings and 2) some improvement in methodology. In addition, the demonstration of a comorbid relationship between Insomnia and OSAHS in approximately one-in-three patients seeking treatment for suspected OSAHS provides a framework for many future research possibilities. The contribution of Insomnia to increased OSAHS symptom severity may impact on the effectiveness of CPAP. For example, continued Insomnia symptoms may reduce the perceived benefits of CPAP treatment, and reduce compliance (adherence) with treatment. Future studies are needed

to further our understanding of the nature of the relationship between Insomnia and OSAHS and its impact on treatments for these conditions.

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Table 1.

Comparison of Means of OSAHS-only and OSAHS-plus Patients and Normative Values of the DASS-21.

Group	Subscale	Mean (SD)	Normative Label
OSAHS-only	Depression	3.30 (3.23)	Normal
	Anxiety	2.98 (2.73)	Normal
	Stress	3.69 (3.42)	Normal
OSAHS-plus	Depression	8.07 (5.69)	Moderate
	Anxiety	7.88 (4.69)	Severe
	Stress	9.98 (5.98)	Moderate

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-mins	13.02 (22.87)	34.34 (51.59)	-7.25	.000*
SOL-mins	16.06 (36.02)	20.54 (34)	-1.79	.074
Number of wakes after sleep onset	13.02 (22.87)	34.34 (51.59)	-7.25	.000*
PSG-based measures of habitual sleep (n = 88)				
Sleep efficiency (%)	70.72 (13.54)	60.17 (22.79)	2.51	.015*
Time spent awake (hours)	2.01 (.94)	2.81 (2.00)	-2.24	.030*
Total sleep time (hours)	4.79 (1.29)	4.10 (1.69)	2.11	.039*

** Significant group difference*

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