

# Emotional Content of Dreams in Obstructive Sleep Apnea Hypopnea Syndrome Patients and Sleepy Snorers attending a Sleep-Disordered Breathing Clinic

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SCIENTIFIC INVESTIGATIONS

**Study Objectives:** To assess prospectively the emotional content of dreams in individuals with the obstructive sleep apnea hypopnea syndrome (OSAHS) and sleepy snorers.

**Methods:** Prospective observational study. Forty-seven patients with sleepiness and snoring attending a sleep-disordered breathing clinic, completed a morning diary concerning pleasantness/unpleasantness of their dreams for 10 days, and then had AHI assessed by a limited-channel home sleep study. Participants and groups: Sleepy snorers, AHI < 5: n = 12 (mean age = 51.00 years [SD 7.01], 7 males); AHI 5 -14.9, n = 14 (mean age = 49.71 y [9.73], 12 males); AHI ≥ 15, n = 21 (mean age = 56.33 [11.24], 16 males).

**Results:** All groups reported similar numbers of dreams and nightmares during the diary period. The AHI ≥ 15 group were significantly higher on dream unpleasantness than were the sleepy snorers (p < 0.05); and when only males were analyzed, this difference was also significant (p = 0.01). As AHI in-

creased across the 3 groups, there was a significant decrease in variability of dream emotions (Levene test for homogeneity of variance between the 3 groups, p = 0.018). Mean daytime anxiety and daytime depression were significantly correlated with mean dream unpleasantness and with mean number of nightmares over the diary period.

**Conclusions:** Patients with AHI ≥ 15 had more emotionally negative dreams than patients with AHI < 5. The variation in mean dream emotion decreased with increasing AHI, possibly because sleep fragmentation with increasing AHI results in fewer and shorter dreams, in which emotions are rarer.

**Keywords:** Obstructive sleep apnea, snorers, dreams, nightmares

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## BRIEF SUMMARY

**Current Knowledge/Study Rationale:** Patients with sleep apnea have dreams that are more negative emotionally than do people without apnea; however, for patients with apnea, increasing AHI is associated with a decrease in frequency of nightmares. This study aimed to clarify the relationship between AHI and emotional tone of dreams, assessing dream content prospectively over 10 nights in the home.

**Study Impact:** Increasing AHI is associated with less pleasant dream emotional content, but also with less variance in dream emotional tone. The smaller emotional variance at high AHI may be due to the disruptive effect of apneic arousals on sleep architecture.

Obstructive sleep apnea hypopnea syndrome (OSAHS) is caused by repeated episodes of upper airway obstruction during sleep, associated with increasing respiratory efforts, intermittent arterial oxygen desaturation, and sleep disruption. The main features of OSAHS are nocturnal respiratory pauses interrupted by loud intermittent snoring and excessive daytime somnolence caused by the sleep fragmentation. The definitions of sleep related respiratory disturbances, diagnosed on overnight limited-channel polygraphy (PG) sleep studies or polysomnography (PSG) have been clarified.<sup>1</sup>

The literature on the relationship between the apnea hypopnea index (AHI) and dream unpleasantness has mainly relied on retrospective assessment of nightmare frequency, and there are inconsistencies in that literature. The aim of this study was to assess prospectively in patients attending a sleep-disordered breathing clinic the relationship of sleep apnea severity as estimated by AHI with the frequency of nightmares and with the emotional tone of dreams.

Much of the literature reports that OSAHS patients have dreams that have negative emotional tone. For example, patients with OSAHS report their dreams to be predominantly negatively toned prior to continuous positive airways pressure (CPAP) therapy and more negatively toned on non-CPAP nights compared to CPAP treatment nights.<sup>2,3</sup> Also, Owens et al. reported that children aged 6–12 years with sleep apnea were significantly more

likely to be “terrified during a dream” than population norms,<sup>4</sup> and others report that a high proportion (66%) of patients with OSAHS reported nightmares “sometimes.”<sup>5</sup>

The rationale for this association of OSAHS with nightmares and with emotionally negative dreams is that there are significant correlations between waking life well-being variables and nightmare frequency,<sup>6,7</sup> and OSAHS patients report poor waking life well-being compared to healthy controls (e.g., elevated levels of depression,<sup>8,9</sup> cognitive impairments,<sup>10-12</sup> irritability, mood and personality changes,<sup>13</sup> and difficulties in personal relationships).

However, in a contrary finding,<sup>14</sup> untreated SAS patients had lower nightmare frequency than controls, although it should be noted that the controls were healthy and not matched for age,

body mass index (BMI), or sleepiness. Indeed, they included 2 groups of controls with mean ages 31.5 and 23.5 years, whereas the mean age for their OSAHS group was much older at 55.7 years, although age was then used as a covariate in the statistical analysis in order to control for the negative relationship between age and nightmare frequency.<sup>15</sup>

Whereas the predominant conclusion of the literature is that apnea patients have higher nightmare frequency than the general population, the literature within the range of apnea severity finds that apnea severity is negatively related to nightmare frequency, but again the literature is inconsistent. Schredl found no relationship between respiratory disturbance index (RDI; a measure similar to AHI) and either dream or nightmare frequency,<sup>14</sup> whereas they earlier had found that within a sample of people with OSAHS, a higher RDI was related to dreams with less negative emotions (also the dreams were more realistic, less bizarre, and less intense) than in those with lower RDI.<sup>16</sup> Pagel also found that individuals with lower sleep efficiency (on PSG) had lower nightmare frequency and lower dream recall than did individuals with sleep efficiency > 85%; individuals with AHI > 15/h had lower dream and nightmare recall than individuals with AHI < 5/h.<sup>17</sup> Also, as AHI score increases, the retrospectively assessed frequency of nightmares decreases linearly; and, among patients who did not receive CPAP, AHI was significantly greater ( $p = 0.001$ ) among those with infrequent nightmare recall (mean AHI = 19.8) compared to those with frequent nightmare recall (mean AHI 10.9).<sup>18</sup> It thus appears that although OSAHS is associated with a higher nightmare frequency and more emotionally negative dreams than controls, the relationship across the range of apnea severity is of higher apnea severity being associated with fewer nightmares.

This current study aimed to extend the above literature by assessing prospectively the relationship between AHI and occurrence of nightmares and emotional tone of all recalled dreams. The individuals studied fell into 3 groups: apnea hypopnea index (AHI) < 5, AHI between 5 and 14.9, and AHI  $\geq$  15. The AHI < 5 individuals had symptoms of snoring and daytime somnolence, but with AHI lower than the treatment range at which continuous positive airway pressure (CPAP) would normally be considered in the United Kingdom.<sup>19,20</sup> This group was included so as to compare the OSAHS patients with a group of similar BMI. As Pagel and Kwiatkowski state that their “surprising” finding of higher AHI being associated with a lower frequency of nightmares is due to their inclusion of a “high percentage of patients with severe OSA,” i.e., AHI > 30,<sup>18</sup> we include some analyses on a subgroup of patients with AHI > 30.

There are some key methodological points to be noted here. Previous studies<sup>14,17,18</sup> have mainly used retrospective assessments of dream and nightmare recall. However, such retrospective estimates have been shown to result in lower estimates for nightmare frequency than a diary method.<sup>7,15</sup> Also, in one sleep laboratory study on OSAHS and dreaming some participants reported just one dream, and one-third of the dreams reported included references to the laboratory.<sup>16</sup> Our study therefore used a diary assessment of dream and nightmare frequency over a longer period and was conducted in the participants’ own homes.

There remains controversy as to what control group(s) to use in studies on OSAHS. Many of the relationships between OSAHS variables and mood variables disappear after control-

ling for comorbid factors such as weight, sleepiness, and age,<sup>21</sup> so we included a “sleepy/snoring” control group who were seeking help for similar symptoms of snoring and tiredness and had similar BMI and age. Finally, we wanted to specifically include in the definition of nightmares that they wake the dreamer, and hence exclude bad dreams, where waking occurs for other reasons (e.g., alarm clock), and which may have a lower mean emotional intensity than do waking criterion nightmares.<sup>22</sup> This waking criterion definition is often used in the research and clinical literature, and is supported by the finding that individuals are highly confident in their decisions about whether the dream caused them to wake.<sup>23</sup>

To summarize, this study aimed to assess the relationship between severity of apnea (as measured by the AHI) and prospectively assessed emotional tone of dreams across 3 AHI severity groups. As there is a combination of increasing waking distress but also increasing sleep fragmentation as AHI increases, and as the previous literature using retrospective assessment is not consistent, the direction of the relationship between AHI and dream emotional tone was not specified.

## METHODS

The study conformed to the principles of the Declaration of Helsinki and was passed by our local ethics committee.

### Participants

Forty-nine consecutive patients attending a sleep-disordered breathing clinic in the UK with symptoms of daytime tiredness, snoring, and usually witnessed apneas were approached and all provided written consent. We did not approach patients with symptoms of other secondary causes of sleepiness (e.g., narcolepsy, restless legs, periodic limb movement disorder, shift-work disorder, depression or neurological disease, inadequate sleep, medication side-effects). Baseline demographic data, including BMI and Epworth Sleepiness Scores (ESS) were obtained at initial clinical consultation.

Patients were then given a 10-day sleep and mood diary to take and complete at home (while waiting for the sleep study). They returned their completed diaries approximately 14 days later, when attending to collect equipment for their home sleep study.

### Sleep Studies

Patients were diagnosed as OSAHS if they reported daytime tiredness and had a frequency of sleep disturbed breathing (AHI)  $\geq$  5/h,<sup>1</sup> recorded on limited-channel home sleep study (Embletta, ResMed, Sidney, NSW, Australia). This ambulatory monitor measures oronasal flow, thoraco-abdominal movements, finger pulse oximetry, body position, and an electrocardiogram. The Embletta system fulfills the American Academy of Sleep Medicine’s definition of a Type 3 portable monitoring device.<sup>1</sup> Apneas were defined as absence of airflow  $\geq$  10 sec (measured reduction of airflow to < 10% of peak airflow). Hypopneas were defined as  $\geq$  50% reduction in airflow from baseline for  $\geq$  10 sec, or with discernable reduction in airflow associated with 4% oxygen desaturation or arousal. AHI was derived as the total number of apnea and/or hypopnea events per hour of sleep. Most events appeared obstructive (i.e., with some

**Table 1**—Means (SD) of physiological and mood variables for the 3 patient groups

	AHI < 5 (n = 12)	AHI 5 - 14.9 (n = 14)	AHI ≥ 15 (n = 21)	
AHI	2.08 (1.48)	8.49 (3.26)	50.11 (27.87)*	$F_{2,44} = 32.74, p < 0.001$
RDI	2.38 (1.35)	8.64 (6.18)	43.91 (26.68)*	$F_{2,44} = 24.24, p < 0.001$
BMI <sup>a</sup>	31.16 (5.35)	32.69 (6.68)	37.30 (6.64)	$F_{2,43} = 4.10, p = 0.024$
ESS <sup>b</sup>	9.92 (4.58)	11.69 (4.57)	14.72 (5.95)	$F_{2,40} = 3.28, p = 0.048$
Anxiety <sup>c</sup>	4.61 (1.58)	4.89 (1.33)	4.96 (1.66)	$F_{2,41} = 0.20, p = 0.818$
Depression <sup>d</sup>	4.28 (1.33)	4.56 (1.87)	4.83 (1.86)	$F_{2,42} = 0.38, p = 0.689$

<sup>a</sup>AHI < 5, n = 11.

<sup>b</sup>AHI 5-14.9, n = 13; AHI ≥ 15, n = 18.

<sup>c</sup>AHI 5-14.9, n = 12, AHI ≥ 15, n = 20. <sup>d</sup>AHI 5 - 14.9, n = 13, AHI ≥ 15, n = 20.

\*p < 0.001 compared to each of the other 2 groups.

evidence of thoraco-abdominal movement), but there have been concerns that a portable system using abdominal and thoracic strain gauges cannot truly differentiate central from obstructive events, particularly hypopneas; thus we report total AHI. Traces were reviewed manually by a senior sleep technician with 15 years' experience to confirm episodes were not artifactual.

Of the 49 patients assessed, 2 had incomplete data for AHI. The remaining 47 patients were categorized as follows: AHI < 5: n = 12, (mean age 51.00 years (SD 7.01), 7 males); AHI from 5 to 14.9, n = 14, mean age = 49.71 (9.73), 12 males; AHI ≥ 15, n = 21 (mean age = 56.33 (11.24), 16 males). The AHI ≥ 15 criterion was used because this is classed as the minimum for CPAP treatment in the UK.<sup>20</sup>

### Dream Recall and Mood

The 10-day sleep and mood diary was used to record the incidence of dreams. A yes/no format was used to report incidence of dreams each morning. Patients were then asked 2 questions: (1) Did the emotions or events of the dream wake you up? And (2) How pleasant/unpleasant was the dream? The latter dream emotional tone question was responded to on a 7-point hedonic scale<sup>24</sup> ranging from 1 (very unpleasant) to 7 (very pleasant). The mid-point of the scale included an option for "neither pleasant or unpleasant or mixed." Assessments using this scale of mean dream unpleasantness and frequency of nightmares are associated with waking-life psychopathology.<sup>6,25</sup> Ratings by the patients rather than by independent judges of transcribed dream reports were used because the latter method would have been far more demanding of patient time and may result in positive emotions not being correctly evaluated.<sup>26</sup>

The diary also had 2 visual analogue scales (VAS) for "relaxed/anxious" and "happy/depressed," ranging from 0 – 100 mm, where very relaxed = 0 and very anxious = 100, and very happy = 0 and very depressed = 100.

### Statistics

We used SPSS Version 13.0. Tests for normality were applied. One-way ANOVAs, incorporating the Levene test for homogeneity of variance, were used to compare the 3 groups on medical diagnostic, mood, and dream variables. Univariate ANOVA simple contrasts were used for the planned comparisons between the 3 groups. Throughout, a p value < 0.05 was deemed significant. Some extra analyses on the subgroup with

AHI > 30 were also conducted. Mean anxiety and mean depression were correlated with nightmare frequency and with mean dream emotional tone using Pearson correlations, with diagnostic group partialled out. As the direction of the relationship between daytime negative mood and negative emotional content of dreams is robustly positive across the literature,<sup>6</sup> p values reported for the correlations are directional (1-tailed).

## RESULTS

**Table 1** illustrates medical diagnostic and VAS mood variables for the 3 groups. There were no significant sex differences on any of the variables, all *t* values < 1.5. AHI and RDI were very highly correlated (Pearson  $r = 0.97, p < 0.001, n = 47$ ). One-way ANOVAs showed an overall difference between the groups on BMI and ESS, but there were no significant differences on paired comparisons. The ESS mean for the AHI < 5 group was below the traditionally agreed hypersomnolence threshold of 10, but all felt tired. The 3 groups did not differ significantly on anxiety or depression. The mean anxiety and depression scores for each group represent approximately the midpoint of the VAS line between relaxed/anxious and happy/depressed.

**Table 2** shows the number of dreams, nightmares, and mean dream unpleasantness over the 10 nights of the study. Nightmares were defined as dreams scored as 1 or 2 on the hedonic tone scale (i.e., very or moderately unpleasant) and where the emotion of the dream woke the dreamer.<sup>23</sup> There were no significant sex differences on any of the variables, all *t* values < 1.2. The 3 groups did not differ significantly in the frequency of dreams or in frequency of nightmares. There was also no linear relationship with AHI in terms of percentage of each group who had at least one nightmare during the diary period (AHI < 5, 58.3%; AHI 5 to 14.9, 21.4%; AHI ≥ 15, 61.9%; the subgroup of AHI > 30 had a nightmare prevalence over the 10 days of 64%).

ANOVA showed a marginal difference in dream emotional tone between the 3 groups, with emotional tone for the AHI ≥ 15 group being significantly more negative than for the AHI < 5 group ( $p < 0.05$ ). When BMI was used as a covariate it did not have a significant association with dream emotional tone ( $F_{1,40} = 2.06$ ). If a subgroup of AHI > 30 is examined ( $n = 14$ ), mean dream emotional tone = 3.73 (SD 0.64) was more negative, but not significantly so ( $p < 0.1$ ), than for the AHI < 5 group.

**Table 2**—Means (SD) of dream variables for the 3 patient groups

	AHI < 5 (n = 12)	AHI 5 - 14.9 (n = 14)	AHI ≥ 15 (n = 21)	
Dream frequency per 10 days	6.17 (3.16)	4.79 (3.77)	6.76 (3.58)	$F_{2,44} = 1.33, p = 0.276$
Nightmare frequency per 10 days	0.92 (1.00)	0.64 (1.45)	0.95 (1.32)	$F_{2,44} = 0.26, p = 0.770$
Dream emotional tone <sup>a,b</sup>	4.35 (1.20)*	4.13 (1.05)	3.58 (0.67)*	$F_{2,42} = 2.90, p = 0.066$

<sup>a</sup>1 = very unpleasant to 7 = very pleasant.

<sup>b</sup>AHI 5 - 14.9, n = 12.

\* and \* groups differ  $p < 0.05$ .

**Table 3**—Means (SD) of physiological and mood variables for males in the 3 patient groups

	AHI < 5 (n = 7)	AHI 5 - 14.9 (n = 12)	AHI ≥ 15 (n = 16)	
AHI	2.53 (1.22)	8.36 (3.45)	46.81 (21.69)*	$F_{2,32} = 32.15, p < 0.001$
BMI <sup>a</sup>	30.60 (3.77)	32.03 (6.78)	36.62 (6.00)	$F_{2,31} = 3.14, p = 0.057$
ESS <sup>b</sup>	10.57 (2.94)	11.27 (4.80)	15.21 (5.85)	$F_{2,29} = 2.83, p = 0.075$
Anxiety <sup>c</sup>	4.64 (1.07)	4.78 (1.42)	4.69 (1.72)	$F_{2,29} = 0.02, p = 0.983$
Depression <sup>d</sup>	4.49 (1.09)	4.28 (1.90)	4.49 (1.91)	$F_{2,30} = 0.05, p = 0.951$

<sup>a</sup>AHI < 5, n = 6.

<sup>b</sup>AHI 5-14.9, n = 11; AHI ≥ 15, n = 14.

<sup>c</sup>AHI 5-14.9, n = 10; AHI ≥ 15, n = 15.

<sup>d</sup>AHI 5 - 14.9, n = 11; AHI ≥ 15, n = 15.

\* $p < 0.001$  compared to each of the other 2 groups.

**Table 4**—Means (SD) of dream variables for males in the 3 patient groups

	AHI < 5 (n = 7)	AHI 5 - 14.9 (n = 12)	AHI ≥ 15 (n = 16)	
Dream frequency per 10 days	7.00 (3.27)	4.00 (3.46)	7.50 (3.37)	$F_{2,32} = 3.92, p = 0.030$
Nightmare frequency per 10 days	0.71 (0.95)	0.75 (1.54)	1.06 (1.44)	$F_{2,32} = 0.24, p = 0.791$
Dream emotional tone <sup>a,b</sup>	4.72 (1.28)*	4.24 (1.12)	3.56 (0.58)*	$F_{2,30} = 4.13, p = 0.026$

<sup>a</sup>1 = very unpleasant to 7 = very pleasant.

<sup>b</sup>AHI 5 - 14.9 group, n = 10.

\* and \* groups differ  $p = 0.01$ .

As AHI increased, there was a significant decrease in variance in mean emotional tone (Levene  $W = 4.43, p = 0.018$ ; note, for AHI > 30 patients alone, SD 0.64, n = 14).

Within subject correlations showed anxiety and depression each day were not significantly predictive of dream emotional tone or incidence of a nightmare on the following night. However, between subject correlations, with diagnostic group partialled out, showed mean anxiety and mean depression correlated with nightmare frequency ( $r$  values = 0.29 and 0.26, respectively; both  $p$  values < 0.05;  $df = 40$ ) and with dream emotional tone ( $r = -0.31$  and  $-0.30$ , both  $p$  values < 0.05,  $df = 40$ ).

In order to reduce any variance due to gender differences the above analyses were repeated for the males only (there were too few females in the study to analyze their data separately). **Table 3** shows medical diagnostic and VAS mood variables for the males only in the 3 groups. There were marginal differences between the groups on BMI and ESS, but with no significant paired comparison differences; anxiety and depression did not differ significantly between groups.

**Table 4** shows the number of dreams, nightmares, and mean dream unpleasantness over the 10 nights of the study for the

male participants. There was no significant difference in frequency of nightmares between the 3 male groups. There was also no linear relationship with AHI in terms of percentage of each group who had at least one nightmare during the diary period (AHI < 5, 42.9%; AHI 5 to 14.9, 25.0%; AHI ≥ 15, 68.7%). However, the mean dream emotional tone differed significantly between the groups: the patients with AHI ≥ 15 had significantly more negative dream emotional tone than did the AHI < 5 group ( $p = 0.01$ ). This difference between these 2 groups remained significant when BMI was used as a covariate. Also, BMI did not have a significant association with dream emotional tone ( $F_{1,28} = 0.29$ ). If a subgroup of AHI > 30 is examined (n = 11), mean dream emotional tone = 3.77 (SD 0.38) was significantly more negative than for the AHI < 5 group ( $p < 0.05$ ).

As AHI increased, there was a significant decrease in variance of dream emotional tone (Levene  $W = 6.243, p = 0.005$ ; note, SD for AHI > 30 male patients alone = 0.38, n = 11).

Between subject correlations, with diagnostic group partialled out, showed mean anxiety and mean depression correlated with nightmare frequency ( $r_s = 0.46$  and  $0.43$ , respectively, both  $p$  values < 0.01,  $df = 28$ ) and with dream emotional tone ( $r_s = -0.54$  and  $-0.53$ , both  $p$  values < 0.002,  $df = 28$ ).

## DISCUSSION

Our first main finding is that the three AHI groups showed an increase in dream unpleasantness with increasing AHI. The AHI  $\geq 15$  group had dreams that were significantly more negative emotionally than the AHI  $< 5$  group. This was also true for males taken separately. The AHI  $> 30$  subgroup also had dreams that were more emotionally negative than the AHI  $< 5$  group, but this was only significant when the males were analyzed separately.

Although these findings accord with previous work reporting OSAHS dream tone to be negative,<sup>2,27</sup> they at first appear to conflict with the findings of Pagel and Kwiatkowski, where there was a monotonic decrease in percentage of patients with frequent recall of nightmares (i.e., at least one per week) across their 4 AHI groups: 71.4% of those with AHI  $< 5$  had frequent nightmares compared to 20.6% of those with AHI  $\geq 30$ .<sup>18</sup> In accounting for why our results differ from theirs, it cannot be a simple case of the high AHI patients in Pagel and Kwiatkowski forgetting their nightmares when they are assessed retrospectively, as their study did not find a lower level of dream recall with increasing AHI.

Our results may be compatible with Pagel and Kwiatkowski's findings of lower nightmare frequency with increasing AHI in that the lower variation in dream emotion with increasing AHI found here may result in fewer very unpleasant dreams, even though mean dream unpleasantness does increase. We therefore speculate that the non-nightmare dreams of the high AHI patients in their study<sup>18</sup> may be lacking sufficient range of emotion to produce nightmares, even if, as in this study, the dreams are emotionally more unpleasant than for low AHI patients. This present study extends previous knowledge by finding that increasing AHI is associated with a significant narrowing of variability in dream emotional tone. An explanation of this decrease in emotional variability could be that the sleep of patients with high AHI is so fragmented that it interferes with the process of dreaming, thus not allowing dream plots and dream emotion to develop. This may be due to the disturbed sleep architecture associated with very high apnea severity<sup>28,29</sup> leading to shorter dreams, or even an inability to produce dreams.<sup>18</sup> The most important mediating factor here may be length of REM sleep, as proposed by Schredl and Reinhard to account for inter- and intra-individual correlations of sleep length with dream recall and dream length.<sup>30</sup> However, as polysomnographic assessment of sleep was not used, this suggested explanation of sleep fragmentation cannot be confirmed in this study.

In addition to the simple mechanism of sleep fragmentation not allowing dream production, there may also be the involvement of a mechanism proposed by Merritt et al.<sup>31</sup> In a non-clinical sample (students aged 20-50 years) they found that positive emotions were most likely to appear in the first quartile of the dream and negative emotions in the last two quartiles. They noted that whereas 42% of reports containing emotions began with a positive emotion, only 24% ended with one, and that although 58% of their dreams began with a negative emotion, 76% of the final emotions were negative, suggesting that dream emotions tend to go "from bad to worse."<sup>31</sup> It is possible then that sleep is so fragmented in patients with severe OSAHS that there is not a sufficient amount of consolidated sleep for dreams

to go from bad to worse and, as a result, dreams remain predominantly moderately or neutrally toned.

There was not a significant difference in number of nightmares across the three groups, and no trend across the groups in the percentage of participants having at least one nightmare over the 10 days. These results thus differ from the decrease in nightmare frequency with increasing AHI found by Pagel and Kwiatkowski.<sup>18</sup> However, we did find a significant association of nightmare frequency and mean dream emotional tone over the diary period with mean anxiety and mean depression, which accords with much previous literature.<sup>5-7</sup>

Advantages of our study are that neither patient nor researcher knew the clinical sleep diagnosis at the time of dream reporting. This is important because, for a patient having a recent medical diagnosis and finding out that they need (usually life-long) treatment, this is likely to affect mood or dream content. In our study, exactly the same procedure was used for all the groups and the diaries were not started after treatment or other tests. However, we cannot dismiss the possibility that there may have been comorbidity or other differences between the groups, such as alcohol intake.

We acknowledge that we had a highly selected group of patients who (1) attended a sleep-disordered breathing clinic complaining of tiredness; (2) were primarily middle-aged, and (3) primarily male. These are however typical of patients seeking help for OSAHS and so are an important group to study in their own right. We did not use a non-sleepy control group as finding a group of similar age and BMI who do not have symptoms of OSAHS is difficult. We also acknowledge that obtaining dreams from a diary period of 10 nights resulted in fewer dreams than the recommended minimum of 20 dreams needed for fully reliable data in dream content research.<sup>32</sup> However, we do not think that our patients would have agreed to complete diaries for longer than these 10 nights, and we consider that the brief log method was appropriate, even though modality of recording can affect ratings of the dream experience.<sup>33</sup>

PSG monitoring would help more fully exclude other causes of tiredness (e.g. periodic limb movement disorder) and would also have the advantage of noting sleep stage and detecting respiratory related arousals (e.g., from loud snoring) where there is no discernible change in oronasal flow, thoraco-abdominal movements, or pulse rate.<sup>2</sup> It is acknowledged that there may be arousals associated with snoring,<sup>34,35</sup> that we have missed without PSG, but we have since manually reviewed all the limited channel studies and have not found many increased pulse rises in the sleepy snorers (unlike in the OSAHS group), which can be other (autonomic) manifestations of arousals. Moreover, attending a PSG laboratory itself and being monitored in unfamiliar surroundings affects dream and nightmare recall.<sup>16</sup> Limited-channel home sleep studies are cheaper and compare well against PSG in diagnosing most OSAHS/sleepy snorers.<sup>36,37</sup> They are recommended as first-line investigations in most UK clinics unless other diagnoses are being considered on clinical grounds.<sup>19</sup> Those people who remained symptomatic and had a negative Embletta (cardio-respiratory) study did not then proceed to a PSG so we cannot be sure about our false negative rate. However, false negatives also appear with PSG due to night-to-night variation in sleep patterns,<sup>19</sup> and our portable system has previously identified

correctly (compared to PSG) all patients with OSAHS, when applying an AHI  $\geq 15$  criterion.<sup>38</sup>

Understanding the sleep apnea-nightmare relationship is important because nightmares themselves can be a clinical issue (ICD-10 Classification of Mental and Behavioral Disorders, definition F51.5),<sup>39</sup> which may contribute to the overall poorer quality of life of people with OSAHS. Nightmare distress can involve being afraid to fall asleep for fear of having a nightmare, having difficulty falling back to sleep after a nightmare, and nightmares interfering with quality of sleep.<sup>40</sup> It is plausible that the lack of recuperative sleep obtained by OSAHS sufferers may be augmented by the presence of nightmares and by the fear of nightmares, and this combination worsens clinical well-being.

In summary, as apnea becomes more severe the range of dream emotions decreases. Nevertheless, for all patients and for males alone we found significantly more negative dream emotion in the AHI  $\geq 15$  group than in the AHI  $< 5$  group. It is unclear what the mediator between illness severity and dream unpleasantness is: anxiety and depression did not differ between the three groups, although means of these across the diary period were related to mean nightmare frequency and mean dream emotional tone. Also, BMI increased marginally with increasing AHI. That there may be physiological mediators operating during sleep is also a possibility. Future studies should assess waking life stress and well-being over the whole day using standardized instruments, rather than VAS-assessed mood on waking, as further steps to investigate possible mediators between AHI and dream unpleasantness.

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