

A Case–Control Study on Psychological Symptoms in Sleep Apnea-Hypopnea Syndrome

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Objectives: To investigate the psychological status of patients with sleep apnea-hypopnea syndrome (SAHS) and to evaluate the association of SAHS with psychological symptoms, using the Symptom Checklist-90 (SCL-90) scale.

Methods: The study comprised 30 SAHS patients (25 men, 5 women) and 30 matched, healthy control subjects. They all completed the SCL-90 and the Epworth Sleep Scale (ESS) and underwent a whole-night polysomnographic (PSG) examination. We used *t*-tests for group comparisons of nocturnal PSG characteristics, daytime sleepiness, and psychological symptoms. We employed Spearman's rank correlation analysis to indicate the effects of several nocturnal PSG variables (for example, total sleep time, percentage of wake at sleep, Apnea and Hypopnea Index [AHI], and oxygen desaturation) or subjective daytime sleepiness on psychological symptoms in SAHS.

Results: SAHS patients suffered from fragmented sleep and decreased arterial oxygen saturations, compared with healthy control subjects. The General Severity Index (GSI) of SCL-90 was significantly higher in SAHS patients than in healthy control subjects, as were measures of somatization, obsession–compulsion, depression, anxiety, and hostility ($P < 0.05$). The severity of psychological symptoms in SAHS patients was negatively related to total sleep time and percentage of stage 2 nonrapid eye movement (NREM) sleep; it was positively related to percentage of wake time after sleep onset, percentage of stage 1 NREM sleep, and ESS scores.

Conclusion: In our study population, SAHS patients had decreased psychological well-being, which could be explained by fragmented sleep or excessive daytime sleepiness.

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Clinical Implications

- Sleep apnea-hypopnea syndrome (SAHS) is associated with psychological symptoms.
- The severity of psychological symptoms in SAHS is related to fragmented sleep or Epworth Sleep Scale (ESS) scores.
- We found no significant relations between severity of psychological symptoms and Apnea and Hypopnea Index (AHI) or oxygen saturation in SAHS patients.

Limitations

- The sample was relatively small.
- We did not stratify the sample into subgroups according to age, sex, AHI, or body mass index (BMI).
- The study lacked an objective measurement for daytime sleepiness, such as the Multiple Sleep Latency Test (MSLT) or Maintenance of Wakefulness Test (MWT).

Key Words: *sleep apnea-hypopnea syndrome, psychological symptoms, polysomnography, hypoxemia, sleep fragment*

Sleep apnea-hypopnea syndrome (SAHS) is a common sleep disorder prevalent in approximately 2% to 4% of adult people, and 20% to 40% of elderly people (1). Its frequency increases with age and body mass index (BMI), and it is about 2 to 4 times more prevalent in men than in women.

Previous literature showed that patients with SAHS suffer from excessive daytime sleepiness (EDS) (2), cognitive impairment (3,4), and decreased psychological well-being (5,6). Some relational studies proposed a possible causal relation between the nocturnal polysomnographic (PSG) features of SAHS and daytime function (5).

Previous reports have linked SAHS with depression, anxiety, and other psychological problems (6). Some investigators believe that the impairments can be reversed following appropriate treatment (7). Others, however, have found that some psychological impairment persists even after treatment (8), most probably owing to irreversible anoxic central nervous system damage. Conversely, the association between SAHS and psychological abnormalities could not be confirmed in other studies (9,10). Although patients with SAHS suffer from fragmented sleep and decreased arterial oxygen saturation, the relation between SAHS and mental changes or psychological abnormalities in some of these patients is still uncertain, as are the determinant factors of these impairments. In addition, the degree to which the psychological symptomatology of sleep apnea can be correlated with the demographic, clinical, and PSG features of the disorder is of both clinical and scientific interest.

Given the uncertainty in the literature, we investigated psychological symptoms in 30 SAHS patients and 30 healthy control subjects. We then reevaluated the association between SAHS and psychological symptoms in 30 SAHS patients. This enabled us to examine the roles of nocturnal PSG variables and EDS in the possible linkage.

Subjects and Methods

Subjects

The study population consisted of 30 patients who met diagnostic criteria for SAHS (11) and were referred to the sleep laboratory of the Second Xiangya Hospital, Central South University, China, between September 1, 1999, and April 30, 2001. Patients were aged between 21 and 68 years (mean 40.7, SD 12.1 years) and had suffered for many years before referral, with a median duration of complaint of 5 years (range 0.5 to 32 years). We recruited 30 healthy control subjects, all matched for age, sex, BMI, and education. All subjects gave written informed consent, and the study protocol was approved by the Ethics Committee of Central South University.

Questionnaires

Each subject completed 3 questionnaires and subsequently underwent a whole-night PSG examination. In the first questionnaire, subjects answered general questions concerning anthropometric data (such as height and weight), health information and habits (such as smoking, alcohol consumption,

Table 1 Comparison of demographic data for sleep apnea-hypopnea syndrome (SAHS) patients and healthy control subjects

	SAHS patients (n = 30) n (%)	Healthy control subjects (n = 30) n (%)	χ^2
Sex	25 (83.3)	25 (83.3)	—
Men	5 (16.7)	5 (16.7)	—
Women			
Age (years)	8 (26.7)	9 (30.0)	0.082
20–39	18 (60.0)	18 (60.0)	—
40–60	4 (13.3)	3 (10.0)	0.162
> 61			
Body Mass Index (kg/m ²)	5 (16.7)	6 (20.0)	0.111
< 24.0	23 (76.7)	24 (80.0)	0.098
24.01–30.0	2 (6.7)	1 (3.3)	0.351
> 30.01			
Smoking	16 (53.3)	11 (36.7)	1.071
Alcohol consumption	11 (36.7)	8 (26.7)	0.693
Snoring	28 (93.3)	8 (26.7)	27.778 ^a

^aP < 0.01

and underlying disease), and specific questions about symptoms and signs of SAHS (such as snoring, cessation of breathing during sleep, and daytime somnolence) and other sleep disorders.

The second questionnaire was the Symptom Checklist-90 (SCL-90) (12), a well-established, self-report, clinical rating scale that assesses outpatient symptomatic psychological disturbance. It comprises the following 9 primary symptom scales: somatization, obsession-compulsion, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. We used the General Severity Index (GSI) of SCL-90, calculated by dividing the total score by 90, to indicate current psychological status.

The third scale used was Epworth Sleepiness Scale (ESS) (13), which comprises 8 questions that evaluate subjective daytime sleepiness. With ESS \geq 8, a patient may be considered to experience excessive daytime subjective sleepiness.

Nocturnal PSG Measurements

After completing the questionnaires, subjects were clinically interviewed by a general physician and underwent full-night polysomnography. Surface electrodes were used to record EEG (at positions of C3-A2 and C4-A1 of the international 10-20 system), electrooculogram (EOG), submental electromyogram (EMG), and echocardiogram (ECG) in a standard fashion. Thoracic and abdominal respiratory movements were measured by inductance plethysmography; oronasal airflow was measured using thermocouples, and arterial oxygen saturation (SaO₂) was measured using pulse oximetry. Microphone snoring sounds and body movements

were also monitored. All signals were recorded onto a computerized system using a 16-channel polygraph configuration.

Sleep records were analyzed for sleep stages and occurrence of apneas according to standard criteria (14). An apnea was defined as a complete cessation of airflow for at least 10 seconds. Hypopnea was defined as a decrease in airflow of at least 50%, with a concomitant fall of at least 4% in arterial oxygen saturation, followed by an arousal response (as indicated by EEG alpha waves, increased submental EMG levels, or increased body movements). The Apnea and Hypopnea Index (AHI) was calculated by dividing the total number of apnea and hypopnea episodes by the hours of sleep.

Statistical Analysis

We used *t*-tests and chi-square tests for group comparisons. Pearson correlation analysis was performed to determine the correlation between psychological symptoms and some nocturnal PSG variables or total scores of ESS in SAHS. We required a 0.05 level of significance for a variable to be included in the comparisons and correlation analysis. All the statistics were compiled using SPSS 10.0 software (15).

Results

Demographics

Table 1 shows the characteristics of SAHS patients and healthy control subjects. From this data, we noted that snoring was the most frequently self-reported symptom among SAHS patients. It was also more frequently reported by SAHS patients than by those in the control group. There were no significant differences between the 2 groups in age, sex, BMI, smoking, and alcohol consumption.

Nocturnal PSG Variables and Subjective Daytime Sleepiness

Compared with healthy control subjects, SAHS patients had increased stage 1 sleep and wakefulness after sleep onset and decreased slow wave sleep ($P < 0.05$). They also had a higher AHI and lower minimum oxygen saturation than did healthy control subjects. Further, the subjective daytime sleepiness in SAHS patients was more severe than in control subjects, based on the total ESS scores (Table 2.)

Table 2 Comparison of nocturnal polysomnographic (PSG) variables and Epworth Sleep Scale (ESS): SAHS patients and healthy control subjects

Variables	SAHS Patients (n = 30)	Control subjects (n = 30)	t-value
Total sleep time (min)	409.6 (69.5)	431.1 (52.3)	1.778
Nonrapid eye movement (NREM) (min)	370.3 (73.8)	386.5 (40.7)	1.214
% Stage 1 sleep ^a	24.8 (18.5)	9.2 (4.6)	4.849 ^c
% Stage 2 sleep ^a	50.9 (23.7)	53.1 (8.5)	0.267
% Slow wave sleep ^a	14.4 (4.1)	20.6 (3.7)	2.218 ^b
Rapid eye movement (REM) (min)	22.4 (6.3)	23.8 (3.5)	0.192
% REM sleep ^a	5.1 (3.4)	7.6 (4.5)	0.556
% Wake ^a	25.8 (7.4)	5.4 (4.1)	2.406 ^b
NREM latency (min)	6.2 (4.8)	8.7 (7.4)	1.207
REM latency (min)	131.8 (92.1)	121.5 (86.2)	0.493
Apnea and Hypopnea Index	48.0 (29.7)	1.6 (1.3)	8.981 ^c
Minimum oxygen saturation	66.5 (11.4)	89.3 (12.4)	11.493 ^c
ESS	12.07 (3.88)	5.67 (1.95)	5.71 ^c

^aValues for sleep stages are expressed as a percentage of sleep period time; ^b $P < 0.05$; ^c $P < 0.01$.

Psychological Symptoms

Table 3 evaluates the GSI and the 9 scales of SCL-90 for the 2 groups. The GSI of the SCL-90 and scores for somatization, depression, anxiety, and hostility were significantly higher in SAHS patients than in control subjects ($P < 0.05$). The most prominent symptom in SAHS was somatization: the mean SCL-90 somatization score was 1.08. There were no statistical differences between the 2 groups with respect to interpersonal sensitivity, phobic anxiety, paranoid ideation, and psychoticism.

We ranked the positive SCL-90 items (that is, the score of each item above 1.0) and listed the most common 10 items according to the frequency of each item in both groups. Then, we employed the chi-square test to analyze the most common positive items in the SAHS patients and in control subjects. The comparison showed that 53.3% to 86.7% of patients with SAHS suffered from psychosomatic symptoms. The most common positive symptoms in SAHS patients were decreased energy, feeling blocked while working, unstable sleep, faint in some parts of the body, pain in waist or back, headache, repeated checking, recalling things repeatedly, and difficulty in conversation. Further, except for the item "recalling things repeatedly," these items occurred significantly more frequently in SAHS patients than in control subjects ($P < 0.05$) (Table 4).

Table 3 Comparison of General Severity Index (GSI) and 9 scales of Symptom Checklist-90 (SCL-90) between SAHS patients and control subjects

	SAHS patients (n = 30) Mean (SD)	Control subjects (n = 30) Mean (SD)	t-value
GSI of SCL-90	5.25 (4.94)	1.42 (1.00)	2.76 ^a
Somatization	1.08 (0.98)	0.24 (0.23)	3.07 ^a
Obsession–compulsion	0.95 (0.70)	0.26 (0.27)	3.53 ^b
Interpersonal sensitivity	0.72 (0.75)	0.34 (0.26)	1.82
Depression	0.88 (0.86)	0.25 (0.15)	2.62 ^a
Anxiety	0.74 (0.88)	0.16 (0.17)	2.38 ^a
Hostility	0.90 (1.07)	0.17 (1.19)	2.46 ^a
Phobic anxiety	0.60 (0.55)	0.23 (0.25)	0.83
Paranoid ideation	0.53 (0.47)	0.24 (0.18)	0.53
Psychoticism	0.42 (0.45)	0.27 (0.15)	0.46

^aP < 0.05; ^bP < 0.01

Table 4 Comparison of the 10 most common positive items of SCL-90: SAHS patients and control subjects

	SAHS patients n = 30 n (%)	Control subjects n = 30 n (%)	χ ²
1. Lack of energy and fatiguability	26 (86.7)	13 (43.3)	12.4 ^a
2. Feeling of being blocked while doing everyday work	24 (80.0)	11 (36.7)	11.6 ^a
3. Unstable sleep	24 (80.0)	7 (23.3)	19.3 ^a
4. Feeling faint in some parts of body	21 (70.0)	4 (13.3)	19.8 ^a
5. Pain in waist or back	20 (66.7)	4 (13.3)	17.8 ^a
6. Trouble with recalling things repeatedly	19 (63.3)	12 (40.0)	3.3 ^b
7. Headache	19 (63.3)	6 (20.0)	11.6 ^a
8. Have to repeatedly check what one has done	18 (60.0)	2 (6.7)	19.2 ^a
9. Feeling heavy in limbs	17 (56.7)	5 (16.7)	10.3 ^a
10. Difficulty in carrying on a conversation.	16 (53.3)	5 (16.7)	8.9 ^a

^aP < 0.01; ^bP < 0.05

Correlation Between Psychological Symptoms and Nocturnal Variables or Daytime Sleepiness

We used Spearman’s rank correlation to analyse psychological symptoms and some nocturnal PSG variables or ESS. In SAHS patients, the results showed a strong negative correlation between psychological symptoms and nocturnal PSG variables such as total sleep time, percentage of stage 1 sleep, and NREM latency; a positive correlation was shown with percentage of wake after sleep onset and percentage of stage 2 sleep ($r > 0.3, P < 0.05$). Further, significant but weak positive relations were also found between psychological symptoms

and ESS score ($r > 0.2, P < 0.05$). However, we could not find significant relations between psychological symptoms and AHI and minimum oxygen saturation ($r < 0.2$) (Table 4).

Discussion

Our study examined the psychological status of SAHS patients and the association between nocturnal variables or subjective daytime sleepiness and several psychological profiles. The main findings that emerged from this study follow:

1. Compared with healthy control subjects, SAHS patients suffered from problems of sleep maintenance and architecture. We found an increased percentage of stage 1 sleep and wakefulness after sleep onset and diminishing slow wave sleep in SAHS patients. Further, all the SAHS patients suffered from intermittent respiratory disturbances and decreased arterial oxygen saturations.

2. SAHS patients had a higher GSI of the SCL-90 than did control subjects, as well as higher scores on 5 symptom scales; specifically, somatization, obsession–compulsion, depression, anxiety, and hostility. The most prominent psychological symptom among SAHS patients was somatization.

3. In our sample, 53.3% to 86.7% of patients with SAHS suffered from psychosomatic symptoms. In SAHS patients, most of the 10 most common positive items of the SCL-90 were significantly higher than in control subjects ($P < 0.05$).

4. The severity of psychological symptoms in SAHS patients was negatively related to total sleep time, percentage of stage 1 NREM sleep, and latency of NREM sleep. It was positively correlated to percentage of wake time after sleep onset and percentage of stage 2 NREM sleep or ESS.

The SCL-90 questionnaire used in our study reflects a broad range of concomitant clinical psychological symptoms. Using the SCL-90, our findings are comparable with the earlier Minnesota Multiphase Personality Inventory (MMPI) data reported by Kales (16). Most subjects demonstrated increased mental stress, depression, anxiety, hypochondria, and somatization.

Table 5 Correlation between 5 scales of SCL-90 and nocturnal variables or ESS in SAHS

	GSI of SCL-90	Somatization	Obsession–Compulsion	Depression	Anxiety	Hostility
Total sleep time	−0.729 ^a	−0.725 ^a	−0.679 ^a	−0.732 ^a	−0.758 ^a	−0.658 ^a
NREM time	−0.767 ^a	−0.778 ^a	−0.669 ^a	−0.781 ^a	−0.762 ^a	−0.722 ^a
% Stage 1 sleep	0.597 ^a	0.640 ^a	0.594 ^a	0.573 ^a	0.666 ^a	0.577 ^a
% Stage 2 sleep	−0.345 ^b	−0.398 ^b	−0.333 ^b	−0.351 ^b	−0.456 ^b	−0.204 ^b
% Slow wave sleep	−0.152	−0.115	−0.112	−0.149	−0.053	−0.028
REM time	−0.046	−0.163	0.010	−0.032	−0.244	0.076
% Wake	0.605 ^a	0.552 ^a	0.637 ^a	0.591 ^a	0.498 ^a	0.686 ^a
NREM latency	−0.300 ^b	−0.341 ^b	−0.273 ^b	−0.350 ^b	−0.303 ^b	−0.353 ^b
AHI	0.004	0.123	−0.201	0.023	0.174	−0.101
Minimum oxygen saturation	0.016	−0.055	0.237	−0.017	−0.062	0.071
ESS	0.217 ^b	−0.212 ^b	0.217 ^b	0.227 ^b	−0.209 ^b	0.158 ^b

^a*P* < 0.01; ^b*P* < 0.05

However, some researchers have reported that depression is the most prevalent symptom of SAHS. Guilleminault and others reported that 24% of their sample had elevated depression scales on the MMPI (17). Similarly, Beutler and others found that SAHS patients could be discriminated from healthy control subjects on the basis of elevated MMPI depression scale scores (18). The degree to which the depressive symptomatology of SAHS can be correlated with the demographic, clinical, and PSG features of the disorder is both clinically and scientifically interesting.

Few studies have revealed a correlation between somatization and SAHS. However, our study showed somatization to be a more severe symptom than others, according to the SCL-90 scales (the mean score of the SCL-90 somatization scale was as high as 1.08). This may be explained by the fact that Chinese often prefer to report body disability rather than emotional upset, especially when it accompanies physical disorders: when they suffered some mild physical diseases as well as mood disorders, these patients preferred not to report associated emotional upset but concentrated instead on the physical symptoms. Moreover, when it is confused by sleep disorders, depression is known to be a very difficult state to examine or diagnose. A more profound study is needed to evaluate sleep, mood disorder, and somatization. Further, we evaluated the depressive syndrome in a larger sample with SAHS, using the Beck Depression Inventory (BDI). Possibly, the Structured Clinical Interview for DSM-III-R (SCID) would be the better scale to determine the frequency of formal diagnoses of various psychological symptoms in SAHS.

Few studies have addressed the relation between SAHS and anxiety symptoms. In fact, only Borak and others showed a correlation between anxiety and AHI ($r = 0.68$) in 20 patients with severe SAHS (19). Using the MMPI, Platon and others reported a slight association between anxiety and SAHS in 23 patients, compared with 17 healthy control subjects (20). However, our study indicated that anxiety may rather be

related to fragmented sleep than to AHI or daytime sleepiness. The controversial results may be explained by different sample sizes and the roles of sex, age, and severity of SAHS.

Psychological symptoms of SAHS patients are likely to be correlated of sleep fragmentation or excessive daytime sleepiness ($r > 0.2$). They did not correlate importantly with the AHI or with minimum oxygen saturation of SAHS ($r < 0.2$). These findings may be consistent with those of Millman and others (5,21). We therefore conclude that it is sleep fragmentation rather than apnea or hypoxia that may be the risk factor for psychological symptoms in SAHS. Bardwell and others, however, reported a positive correlation between psychological symptoms and nocturnal hypoxia in patients with SAHS (22), while Kingshott and others reported a lack of strong relations between conventional nocturnal measures and daytime psychological well-being or cognitive performance in SAHS patients (23). Several comments can be offered to explain the controversial results regarding the association between SAHS and such psychological symptoms as somatization, depression, and anxiety. For example, the results of studies examining this linkage depend on sample size, sex distribution within study population, and the main method used to evaluate psychological status. Further, some patients have learned to adapt to their disease and upgrade performance when required. Such factors are likely to vary among individuals. The intersubject variances that naturally exist will mask any possible relations between nocturnal PSG variables and daytime psychological status. Conversely, we could not ascertain direction of causality with the Pearson correlation analysis: is bad sleep caused by anxious or somatic symptoms or do psychological symptoms affect sleep? Perhaps other methods, such as logistic regression analysis in a larger sample, can provide a more definite answer.

Conclusions

In our study, the existence or the severity of SAHS was associated with somatization, depression, anxiety, obsession-compulsion, and hostility. The severity of psychological symptoms in SAHS was negatively related to total sleep time and NREM sleep time; it was positively related to percentage of wake time during whole night sleep, or ESS.

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Résumé : Une étude cas-témoin sur les symptômes psychologiques du syndrome de l'hypopnée et de l'apnée du sommeil

Objectifs : Estimer l'état psychologique des patients souffrant du syndrome de l'hypopnée et de l'apnée du sommeil (SHAS) et évaluer l'association du SHAS avec les symptômes psychologiques, à l'aide de l'échelle liste de vérification des symptômes-90 (SCL-90).

Méthodes : L'étude comprenait 30 patients ayant le SHAS (25 hommes, 5 femmes) et 30 sujets témoins en santé. Ils ont tous rempli la SCL-90 et l'échelle du sommeil d'Epworth (ESS), et ont subi un examen polysomnographique (PSG) durant toute une nuit. Nous avons utilisé les tests t pour comparer entre les groupes les caractéristiques nocturnes du PSG, la somnolence diurne et les symptômes psychologiques. Le coefficient de corrélation des rangs de Spearman a servi à indiquer les effets de plusieurs variables nocturnes du PSG (par exemple, la durée totale du sommeil, le pourcentage d'état de veille durant le sommeil, l'index d'apnée et d'hypopnée [IAH] et la désaturation en oxygène) ou de la somnolence diurne subjective sur les symptômes psychologiques du SHAS.

Résultats : Les patients du SHAS souffraient d'un sommeil fragmenté et d'une diminution de la saturation du sang artériel en oxygène, comparativement aux sujets témoins en santé. L'indice de gravité générale (GSI) du SCL-90 était significativement plus élevé chez les patients du SHAS que chez les sujets témoins en santé, tout comme les mesures de somatisation, d'obsession-compulsion, de dépression, d'anxiété et d'hostilité ($P < 0,05$). La gravité des symptômes psychologiques chez les patients du SHAS était négativement reliée à la durée totale du sommeil et au pourcentage de la phase 2 du sommeil non paradoxal (NREM). Elle était positivement reliée au pourcentage d'état de veille après le début du sommeil, au pourcentage de la phase 1 du sommeil NREM et aux scores à l'ESS.

Conclusion : Dans la population de notre étude, les patients du SHAS avaient une diminution du bien-être psychologique, qui pourrait s'expliquer par un sommeil fragmenté ou une somnolence diurne excessive.