

# ASSESSMENT OF DAYTIME SYMPTOMS IN SNORING SUBJECTS AND OBSTRUCTIVE SLEEP APNEA PATIENTS

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## SUMMARY

The *obstructive sleep apnea syndrome* (OSAS) is a type of sleep disorder that has called the attention of many researchers because of its widespread distribution among middle-aged subjects. The OSAS is a respiratory problem characterized by the existence of *apneas*, defined as 10 second minimum intervals during which no aerial flux exchange takes place through the upper airways and the *hypopneas* not characterized by an arrest, but by a reduction of aerial flux through the upper airways.

The most widespread index used in the diagnosis of the OSAS severity has been the apnea/hypopnea index (AHI). There is little consensus based on the apnea/hypopnea index regarding the clinical definition of the sleep apnea syndrome, as there is not a single criterion for the categorization of sleep apnea patients into severity levels.

Nowadays, it is estimated that about 70% of the patients referred to sleep laboratories suffer from snoring, and it is suspected that they might also suffer from sleep apnea. Obstructive sleep apnea patients may suffer from memory and cognitive problems, excessive daytime sleepiness, as well as mood disturbance, among other symptoms. Additionally, this disorder has severe medical and social consequences.

One of the most characteristic symptoms in sleep apnea is snoring. Although snoring is one of the symptoms of sleep apnea, it should be remembered it is a typical phenomenon among population in general. There is a primary kind of snoring, the most frequent type in less severe cases, which even occurs among the normal population. In this case, the noise accompanying inspiration is made with almost every breath. Secondly, there is another kind of snoring that is either intermittent or cyclic, and snoring does not come with every breath but silent periods are also frequent. The latter indicates apnea.

A considerable number of epidemiological studies regarding snoring have been produced of late. Several of them have concluded that snoring may have severe clinical consequences. Most patients suffering from obstructive sleep apnea start having simple snores. In the last decade there has been a marked increase of patients who manifest respiratory disorders related to sleep who do not fall into the category of apnea patients. Nevertheless, the morbidity of these clinical disorders is not yet known, a circumstance that makes treatment more difficult.

Only a reduced number of studies have tried to find out whether snorers show any kind of symptoms that could be used as a preventive measure against the development of sleep apnea.

For all the previous reasons, the aim of this study is to assess whether there are any differences in daytime sleepiness, reaction time, short-term memory, depression, trait anxiety, state anxiety and neuroticism between a group of patients with obstructive sleep apnea and a group of snoring individuals who had not been diagnosed as suffering from OSAS.

## Material and method

The sample was made up of 11 snorers (two women and nine men), in an age range between 29 and 58 ( $X=43.82$  and  $SD=8.67$ ), and 14 patients with OSAS (two women and 12 men), in the age range between 30 and 65 ( $X=49.64$  and  $SD=10.67$ ), who were selected from a clinical population. The AHI used for establishing an OSAS diagnostic was of 10 apneas/hypopneas per sleeping hour. The patients were diagnosed to be snorers if they showed an apnea/hypopnea index  $<10$ .

The following instruments were used in the evaluation of snoring subjects and obstructive sleep apnea patients: 1. Cardio-respiratory polygraph of every hour of sleep for each one of the patients. The procedure consists in night-time monitoring of the following parameters: a) electrocardiogram; b) respiratory movements (expansion and relaxation of the thorax and abdomen), which evaluate the respiratory force; c) oronasal flow and d) oxygen saturation. The snoring was measured through a tracheal microphone. 2. To measure the subjective daytime sleepiness, the Epworth Sleepiness Scale was used. 3. A BASIC software program was used to measure the simple perceptual reaction times in milliseconds. 4. The digits test of WAIS was used in straight and inverse order to evaluate the capacity of short term memory. 5. To evaluate the depressive symptoms, the Beck's Depression Inventory was employed. 6. The State/Trait Anxiety Inventory was used as a measurement of the state and trait anxiety levels. 7. As an index of neuroticism levels, the Eysenck Personality Inventory was used.

Subjects under clinical risk of an OSAS diagnosis were referred to a sleep unit by primary care physicians. Respiratory pathologies other than OSAS were ruled out before the subjects' inclusion. Among these were, in particular, obesity hypoventilation syndrome, and chronic obstructive pulmonary disease. All the patients underwent a medical examination and a medical interview in which a detailed clinical history of each patient was compiled. Once the medical examination was over, each patient was given an appointment to sleep one night in hospital. Subsequently, cardio-respiratory polygraphy, registering height hours of sleep, was administered to each patient with the objective to establish a diagnosis. The morning after, a manual analysis was made of the following

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parameters which indicate the presence or absence of the disturbance and its severity: total number of nocturnal obstructive apneas, total number of hypopneas, value of saturation during the night, mean and minimum levels of SaO<sub>2</sub>% and apnea/hypopnea index.

Afterwards, the sleep apnea diagnosis was established for those patients who showed an apnea/hypopnea index higher than 10. Snoring subjects with a lesser apnea/hypopnea index than 10 did not fit into the pathology of sleep apnea. Obstructive apneas were defined as the arrest of air flux during sleep along with the occurrence of respiratory movements lasting more than 10 seconds. Hypopnea was defined as an episode during which the partial obstruction of the upper airways produced a significant reduction of the air flux.

The following morning, the psychological variables were evaluated (daytime sleepiness, short-term memory, reaction time, depression, neuroticism, state and trait anxiety). This process was carried out in the same place and under the same conditions for every subject. The tests were completed between 8:30 and 11:30 in the morning. Additionally, an exclusion criterion was established as the suffering from any psychiatric illness past or present in any way that could influence the psychological functioning of the patient.

As a method of analysis of the results, a non-parametric analysis technique was used: the U Mann-Whitney test. All statistical analyses were made with the statistics package SPSS, 8.0, Spanish version.

## Results

Results from this study show that there are statistically significant differences between daytime sleepiness ( $p < 0.05$ ) and depressive symptoms ( $p < 0.01$ ) between both groups of subjects, whereas no statistically significant differences were found in terms of short term memory, reaction time, state anxiety levels, trait anxiety and neuroticism.

## Conclusions

The analysis of the results obtained reveals that the levels of daytime sleepiness are much higher in patients with OSAS than those in the snoring group. Some studies note that the fragmentation of sleep is responsible for excessive sleepiness during the day. Nevertheless, in this study we observed greater levels of obesity in patients with OSAS than in snoring patients, which could also explain the greater levels of sleepiness. In relation to the depression variable, the average scores show that depression levels are higher in apnea patients than in the snoring group. One of the possible explanations of this result is that the majority of apnea patients, due to the severity of the pathology, consequently present higher deficits in their daily social functioning, etc. Probably, the conditions previously described tend to influence an increase of depression levels.

**Key words:** Apnea, snoring, emotional state, sleepiness, memory, reaction time, neuroticism.

## RESUMEN

El síndrome de apnea obstructiva del sueño (SAOS) es un trastorno de la respiración que se produce durante el sueño, caracterizado por episodios repetidos de apnea (cese total del flujo aéreo) o hipopnea (cese parcial) con una duración mínima de 10 segundos.

La sintomatología asociada al trastorno es muy variada. La mayoría de los pacientes se queja de problemas cognitivos, difi-

cultades de concentración, excesiva somnolencia diurna, despertares frecuentes y aumento de la actividad motora durante el sueño, así como de cambios en el estado de humor y en el carácter. De todos los síntomas observados en el trastorno, el ronquido es el rasgo más universal de la apnea del sueño y una de las causas más comunes de referencia para la evaluación del trastorno. Hoy en día se estima que aproximadamente 70% de los pacientes que acude a los laboratorios de sueño padece ronquido, siendo en este grupo además bastante alta la sospecha de un posible diagnóstico de SAOS.

Algunos estudios han centrado su interés en evaluar si las personas que manifiestan ronquido crónico muestran algún tipo de sintomatología que pueda utilizarse como medida preventiva para el posterior desarrollo de la apnea del sueño. Aunque los resultados de estos estudios no son muy concluyentes, lo que sí parece confirmarse es que en muchos casos el ronquido puede llegar a producir consecuencias clínicas importantes. Por ello, y con base en la bibliografía revisada, el objetivo de la presente investigación es evaluar si hay o no diferencias en somnolencia diurna, tiempo de reacción, memoria a corto plazo, depresión, ansiedad estado-rasgo y neuroticismo entre un grupo de pacientes con SAOS y un grupo de pacientes roncadores crónicos.

## Material y método

Se utilizó una muestra compuesta por 11 roncadores crónicos (tres mujeres y ocho hombres), con un rango de edad que oscilaba entre los 29 y 58 años ( $X=43,82$  y  $DT=8,67$ ), y 14 pacientes con SAOS (dos mujeres y 12 hombres), cuyo rango de edad se encontraba entre los 30 y 65 años ( $X=49,64$  y  $DT=10,67$ ). Todos los sujetos fueron seleccionados en un centro hospitalario. Como puede observarse, en los datos se ponen de manifiesto las diferencias en cuanto a la distribución por sexos del trastorno, informadas en la bibliografía revisada.

La poligrafía cardiorrespiratoria fue la técnica utilizada para establecer el diagnóstico de SAOS. El procedimiento incluye un registro del electrocardiograma, movimientos torácicos y abdominales, flujo aéreo a través de nariz y boca, y nivel de saturación de oxígeno en la sangre. El ronquido se midió mediante un micrófono traqueal. Como medida de la somnolencia diurna, se utilizó la Escala de Somnolencia de Epworth. Se utilizó un programa en lenguaje BASIC para evaluar el tiempo de reacción perceptivo motor simple. Para evaluar la sintomatología depresiva, se utilizó la adaptación al castellano del Inventario de Depresión de Beck (BDI). El Cuestionario de Ansiedad Estado/Rasgo (STAI) fue utilizado para evaluar los dos niveles de ansiedad. Las puntuaciones en neuroticismo se obtuvieron por medio del Inventario de Personalidad de Eysenck. La prueba de dígitos del WAIS en orden directo e inverso se utilizó para evaluar la memoria a corto plazo.

Todos los pacientes con SAOS seleccionados tenían un índice de apneas-hipopneas mayor a 10 ( $IAH > 10$ ), en tanto que los sujetos roncadores crónicos, que no entraban dentro de esta patología del sueño, tenían un  $IAH < 10$ . Los sujetos eran remitidos por el médico de cabecera al centro hospitalario por sospecha clínica de SAOS, aunque también era necesario descartar otras patologías respiratorias, como síndrome de hipoventilación-obesidad o enfermedad pulmonar obstructiva crónica (EPOC).

A todos los pacientes se les realizaron una exploración y una entrevista médica para recabar todos los datos útiles para establecer el diagnóstico. Concluida la exploración, se citaba al paciente para dormir esa noche en la unidad de sueño, donde se realizaba la poligrafía cardiorrespiratoria de todas las horas de sueño. Así se obtenía, para cada uno de los pacientes, la siguiente información: a) número total de apneas obstructivas, duración mínima y máxi-

ma e índice de apneas; b) número total de hipopneas, duración mínima y máxima e índice de hipopneas; c) número de desaturaciones a lo largo de la noche y la caída media; d) nivel medio y mínimo de SAO<sub>2</sub>%, y e) índice de apneas-hipopneas.

Finalizada la noche de sueño, se analizaban los resultados obtenidos en la poligrafía respiratoria para decidir si el paciente presentaba o no apnea de sueño. Una vez realizado el diagnóstico, se procedía a la evaluación psicológica de cada uno de ellos. Todas las pruebas psicológicas se realizaron en el mismo lugar y en las mismas condiciones para cada uno de los sujetos. Las pruebas se aplicaron de forma individual.

### Resultados

Como técnica para el análisis de los resultados, se utilizó una técnica no paramétrica; concretamente la prueba U de Mann-Whitney. Los resultados de este estudio indican que existen diferencias estadísticamente significativas en somnolencia diurna ( $p < 0,05$ ) y en sintomatología depresiva ( $p < 0,01$ ) entre ambos grupos de sujetos. Por otra parte, no se observaron diferencias entre ambos grupos en el resto de variables evaluadas.

### Conclusiones

Los resultados obtenidos en el estudio muestran que los pacientes con SAOS presentan mayores niveles de somnolencia diurna así como puntuaciones más elevadas en depresión en comparación con el grupo de roncadores crónicos. En el resto de variables evaluadas las diferencias entre ambos grupos de sujetos no fueron estadísticamente significativas.

**Palabras clave:** Apnea, ronquido, estado emocional, somnolencia, memoria, tiempo de reacción, neuroticismo.

## INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is a respiratory problem characterized by a recurrent obstruction of the upper airway during sleep. Although various definitions have been given of sleep apnea, it is a disorder characterized by the existence of two breathing episodes that occur during night-time resting hours. First, the existence of apneas, defined as 10 second minimum intervals during which no aerial flux exchange takes place through the upper airways; and second, there are hypopneas not characterized by an arrest, but by a reduction of aerial flux through the upper airways (9).

In recent years, there has been a growing interest in this sleep pathology due to its incidence among the middle-aged population and the significant medical and social consequences it entails. Nowadays, it is estimated that about 70% of the patients referred to sleep laboratories suffer from snoring; and it is suspected that they might also suffer from sleep apnea (24).

Obstructive sleep apnea patients may suffer from memory and cognitive problems (20, 22) and excessive daytime sleepiness (30, 31, 32), as well as from mood disturbance (2), among other symptoms.

One of the most characteristic symptoms in sleep apnea is snoring (4). Although snoring is a symptom

of sleep apnea, it should be remembered that it is a typical phenomenon among population in general. There is a primary kind of snoring, the most frequent type in less severe cases, which even occurs among the normal population. In this case, the noise accompanying inspiration is made with almost every breath. There is another kind of snoring that is either intermittent or cyclic, and snoring does not come with every breath but silent periods are also frequent. The latter indicates apnea (19).

A considerable number of epidemiological studies regarding snoring have been produced of late. Several of them have concluded that snoring may have severe clinical consequences (24). Most patients suffering from OSAS show simple snores. In the last decade there has been a marked increase of patients who manifest respiratory disorders related to sleep who do not fall into the category of apnea patients. Nevertheless, the morbidity of these clinical disorders is not yet known, a circumstance that makes treatment more difficult (18).

Only a reduced number of studies have tried to find out whether snorers show any kind of symptoms that could be used as a preventive measure against the development of sleep apnea. One of these assessed the symptomatology of a group of apnea patients compared to that of a group of simple snorers, reaching the conclusion that it was very difficult to differentiate between these two disorders by taking symptoms as the only reference. Simple snorers and apnea patients show some deterioration both in their social and professional life, which in turn increases their anxiety levels (15). Sforza et al. (33) used the Hospital Anxiety and Depression Scale with no significant difference between snorers and OSAS patients.

On the other hand, some difference have also been found between snoring and the presence of post-traumatic anxiety dreams, something that is totally independent from the use of sedatives or antidepressant drugs, or from alcohol, tobacco or coffee consumption. Besides, the incidence of anxiety dreams seems higher in snorers who do show respiratory pauses (13).

Based on the revised studies, it is not clear which symptoms are present in snoring patients without OSAS, a very important aspect to face in preventing posterior apnea. We do not forget that in the clinic it has been observed that a very high percentage of snoring patients chronically return to the sleep unit years later with a diagnosis of apnea. For all the previous reasons, the aim of this study is to assess whether there are any differences in daytime sleepiness, reaction time, short-term memory, depression, trait anxiety, state anxiety and personality between a group of patients with obstructive sleep apnea and another of snoring individuals who had not been diagnosed as suffering from OSAS.

## METHOD

### Subjects

The sample was made up of 11 snorers (two women and nine men), in an age range between 29 and 58 ( $X=43.82$  and  $SD=8.67$ ), and 14 patients with OSAS (two women and 12 men), in the age range between 30 and 65 ( $X=49.64$  and  $SD=10.67$ ), all of whom were selected from a clinical population. As it can be appreciated, the facts clearly show the differences regarding the distribution between the sexes already reported in the literature. The sample was selected from a hospital center.

The apnea/hypopnea index (AHI) used for establishing an OSAS diagnostic was of 10 apneas/hypopneas per sleeping hour (8, 10, 12). The patients were diagnosed to be snorers if they showed an apnea/hypopnea index  $<10$ .

### Instruments

All tests used in the evaluation of snoring subjects and obstructive sleep apnea patients were carried out in a sleep laboratory. The following instruments were used:

- Cardio-respiratory polygraph of every hour of sleep for each one of the patients (MODELS SEFAM U-280). The polysomnograph is the most recommended method of evaluation. However, due to the high frequency of the disorder and the high cost of this diagnostic procedure, new alternatives just as effective in diagnosing the disorder have been suggested (1, 10); among these is the cardio-respiratory polygraph (12, 35). It is also important to point out that the advantage of using these new simplified techniques is not only reflected in the diagnosis, but also in making it possible for the disorder to be treated in a greater number of patients. The cardio-respiratory polygraph consists in the night-time monitoring of the following parameters: a) electrocardiogram; b) respiratory movements (expansion and relaxation of the thorax and abdomen), which evaluate the respiratory force; c) oronasal flow, and d) oxygen saturation (12). The snoring was measured through a tracheal microphone. Candela et al. (6) reported that the cardio-respiratory polygraph showed a good agreement with polysomnography for the measurement of respiratory events and provided a high diagnostic yield.
- For the measurement of subjective daytime sleepiness, the Epworth Sleepiness Scale (ESS) was used (16). The ESS is a validated eight-question survey asking the perceived likelihood of falling asleep in various situations (sitting and reading, watching TV, etc.).
- Reaction Time Task (3). The task consisted of pushing a key as fast as possible following the appearance of a white letter A on a black background in the center of the computer monitor. The stimulus was pre-

sented 50 times in each test in an aleatory form with a time interval that oscillated between 0,5 and 3 milliseconds. The program also detected and eliminated any anticipated responses (those produced before the presentation of the stimulus until 130 ms after the stimulus appearance). Eliminated trials were repeated later in the stimulus sequence.

- The WAIS digits test was used in straight and inverse order to evaluate the capacity of short-term memory (37, 38).
- To evaluate depressive symptoms, the Beck's Depression Inventory (7) was employed.
- The State/Trait Anxiety Inventory was used as a measurement of the state and trait anxiety levels (34).
- As an index of neuroticism levels, the Eysenck Personality Inventory was used (11).

### PROCEDURE

Subjects under clinical risk of an OSAS diagnosis were referred to a sleep unit by primary care physicians. Respiratory pathologies other than OSAS were ruled out before the subjects' inclusion; in particular, obesity hypoventilation syndrome, and chronic obstructive pulmonary disease. All the patients underwent a medical examination and a medical interview in which a detailed clinical history of each one was compiled. The clinical history recorded information concerning the patient's symptomatology, family and personal backgrounds, use of alcohol and tobacco, time when symptoms such as snoring and sleepiness began to appear, and information related to other associated disorders.

Once the medical examination was over, every patient was given an appointment to sleep one night in hospital. Subsequently cardio-respiratory polygraphy, registering eight hours of sleep, was administered to each patient to establish a diagnosis. The morning after, a manual analysis was made of the following parameters which indicate the presence or absence of the disturbance and its severity: total number of nocturnal obstructive apneas, total number of hypopneas, value of saturation during the night, mean and minimum levels of  $SaO_2\%$  and apnea/hypopnea index.

Afterwards, the sleep apnea diagnosis was established for those patients who showed an apnea/hypopnea index higher than 10. Snoring subjects with a lesser apnea/hypopnea index than 10 did not fit into the pathology of sleep apnea. Obstructive apneas were defined as the arrest of air flux during sleep along with the occurrence of respiratory movements lasting more than 10 seconds. Hypopnea was defined as an episode during which the partial obstruction of the upper airways produced a significant reduction of the air flux.

The following morning, the psychological variables were evaluated (daytime sleepiness, short-term memory, reaction time, depression state, trait anxiety, state anxiety and neuroticism). The tests were completed between 8:30 and 11:30 in the morning. In the experimental procedure, all the recordings were carried out in the same place and in the same conditions for all of the subjects, controlling variables such as light, temperature, noise in the room from the recordings, food ingestion, and time at which each evaluation was completed. Additionally, an exclusion criterion was established regarding the suffering from any psychiatric illness past or present in any way that could influence the psychological functioning of the patient.

As a method of analysis of the results, a non-parametric analysis technique was used: the U Mann-Whitney test. The aim was to compare average scores in daytime sleepiness, reaction time, short-term memory, depression, trait anxiety, state anxiety and neuroticism among snoring subjects and obstructive sleep apnea patients. All statistical analyses were made with the statistics package SPSS, 8.0, Spanish version.

## RESULTS

Table 1 shows the mean and standard deviations, the apnea/hypopnea index, the SaO<sub>2</sub> level, and the body mass index (BMI) of the snoring group and the obstructive sleep apnea group.

### Results in daytime sleepiness, reaction time and short term memory

The dates were analysed by the Mann-Whitney U-test. In relation to the daytime sleepiness variable, results indicate there are statistically significant differences ( $p < 0.05$ ) between snorers and obstructive sleep apnea patients. As it can be seen in table 2, daytime sleepiness for obstructive sleep apnea patients is higher than that observed in the sample of snoring subjects.

With respect to the reaction time and short-term memory variables (table 2), the results indicate there were no statistically significant differences between the group of snorers and the apnea subjects in both variables.

**TABLE 1. Mean scores and Standard Deviations (SD) of apnea/hypopnea index (AHI), SaO<sub>2</sub> level and body mass index (BMI) of the snoring group and obstructive sleep apnea patients.**

	Snorers		OSAS	
	Mean	SD	Mean	SD
AHI	3.79	1.51	68.46	18.28
SaO <sub>2</sub>	94.86	0.43	89.50	4.37
BMI	28.95	0.96	33.74	3.44

**TABLE 2. Summary of the Mann-Whitney analysis of the average scores reached by chronic snoring subjects and OSAS subjects for the variables: sleepiness, reaction time and short-term memory.**

Variable	Snorers	OSAS	U	P
Daytime sleepiness	X=10.63 SD=4.24	X=14.28 SD=3.29	40.5	0.04*
Reaction time	X=337.74 SD=77.38	X=386.72 SD=108.42	51.0	0.15
Short-term memory	X=9.09 SD=2.62	X=8.50 SD=1.50	75.0	0.93

X= Mean and SD= standard deviation.  
\* $p < 0.05$ ; \*\*  $p < 0.01$

### Results of depression, state-trait anxiety and neuroticism variables

As table 3 shows, there were statistically significant differences in depressive symptoms ( $p < 0.01$ ) between snorers and apnea patients. The average scores show that depression levels are higher in apnea patients than in the snoring group.

Regarding the state-trait anxiety levels (table 3), the results show that there were no statistically significant differences, either in state anxiety levels or in trait anxiety levels. By looking the average scores for each of the variables analyzed, we may find that scores, both regarding the state anxiety and the trait anxiety variables, are smaller in the snoring group, though these differences are not statistically significant. Finally, in relation to the personality variable (neuroticism), results show there were no statistically significant differences in terms of neuroticism between both groups of subjects.

## DISCUSSION

The analysis of the results obtained reveals that the levels of daytime sleepiness are much higher in OSAS patients, mainly due to the higher amount of awakening they show during the night (14). The fundamental causes of interrupted sleep are found in repeated apneas during the night and intermittent nightly desaturations (22). Nevertheless, apart from discon-

**TABLE 3. Summary of the Mann-Whitney analysis of the average scores reached by chronic snoring subjects and OSAS subjects for the variables: depression state-trait anxiety, and neuroticism.**

Variable	Snorers	OSAS	U	P
Depression	X=8.18 SD=3.45	X=13.35 SD=5.04	29.00	0.007**
State anxiety	X=17.72 SD=6.60	X=20.14 SD=9.33	67.00	0.60
Trait anxiety	X=21.54 SD=9.02	X=25.07 SD=10.11	62.50	0.43
Neuroticism	X=13.27 SD=3.16	X=13.28 SD=4.90	77.00	1.00

X= Mean and SD= standard deviation.  
\* $p < 0.05$ ; \*\*  $p < 0.01$

tinuous sleep, certain changes in sleep patterns have been found in OSAS patients. In fact, a smaller amount of REM sleep and a decrease in the proportion of slow deep sleep, were found, specially regarding sleep phase IV, something that cannot be found in snoring subjects (8). This may explain the higher levels of daytime sleepiness.

These facts cannot be corroborated with our study given that the polygraph recording does not permit to establish the number of awakenings per hour of sleep, nor the states of sleep. Nevertheless, an important aspect to take into account is the greater level of obesity observed in patients with OSAS (BMI= 33.74) in comparison with the sample of snoring subjects (BMI= 28.95). Orr et al. (25) carried out a study which compares the differences between patients with OSAS who present hypersomnia and those who do not. In the study, both groups significantly differed only in the severity of the hypoxia during sleep and in body weight. Later studies have observed that patients with morbid obesity have a greater risk of suffering hypersomnolence (26).

Several studies have pointed out that subjects with excessive sleepiness show a deficit in their cognitive and psychomotor functions (28). Some authors have also indicated that, among sleep disorders, apnea is the one that deteriorates the most cognitive performance of subjects (20, 21). Another variable involved has been the presence of hypoxia during sleep (17).

In contrast to what these data might suggest, results of the study show no differences in short-term memory levels between sleep apnea subjects and snoring subjects, despite higher daytime sleepiness levels and the higher oxygen reduction level that the first group shows. One plausible explanation for this can be that, in certain cases such as sleep apnea, it is very difficult to differentiate the effect the sleep disorder has by itself from the effects caused by the associated pathology (27). A second possibility which has been suggested makes reference to the evaluation instrument used. Certain studies have demonstrated that short-term memory is one of the most sensitive variables to partial or total sleep deprivation. However, it has also been observed that these deficits are found in greater degree in tasks which require a bigger effort and not in tasks performed in a relatively automatic manner.

Apart from the cognitive function, the daytime sleepiness affects the psychosocial adaptation of patients. Both disorders affect the patient's quality of life, although the deterioration is higher in apnea patients due to the higher degree of severity of this syndrome. In the case of apnea, depression has been one of the symptoms more readily associated with the sleep disorder, although marked disagreement is noticed among authors regarding the real prevalence of the symptom.

Watson et al. (36) correlated Beck's Depression Inventory and the sleep apnea syndrome. These authors obtained significant correlations among depression symptomatology, the total number of obstructive apneas and the frequency of apnea/hypopnea per sleeping hour. Regarding the prevalence of depression in snoring subjects, Pillar and Lavie (23) found that snoring women have higher levels of depression and anxiety than those suffering from light OSA.

Changes in personality and character have been found to be other symptoms associated with this sleep disorder (9). Nevertheless, studies carried out in this line have not been conclusive. Some authors have found that apnea patients show significantly higher levels of neuroticism and anxiety compared with a control group (29), whereas others have found that apnea patients obtain normal scores in all personality scales (5). The fact that results are sometimes so controversial might be due to variations in the notions of disorder and personality change. In many cases, the results of the study are biased by the personality trait assessed and the personality instrument used. On the other hand, it should be remembered that in many cases daytime sleepiness by itself, together with the tiredness that the patient shows during the day, may lead to confusion and be misinterpreted as personality variations.

Finally, according to these results, it is difficult to establish differences between snoring subjects and subjects suffering from apnea with respect to some variables, which underscores the need of assessing this population in terms of symptomatology. This preliminary diagnosis, together with the set of hygiene measures such as quitting alcohol and tobacco, weight reduction, etc. could be used as a preventive measure for the development of sleep apnea.

## CONCLUSIONS

1. The analysis of the results obtained reveals that the levels of daytime sleepiness are much higher in patients with OSAS than in the snoring group. Some studies note that the fragmentation of sleep is responsible for excessive sleepiness during the day (14). Nevertheless, in this study we have observed greater levels of obesity in patients with OSAS than in snoring patients, which could also explain the greater levels of sleepiness. Previous investigations have observed that patients with greater obesity presented a greater risk of suffering hypersomnolence (26).
2. In relation to the depression variable, the average scores show that depression levels are higher in apnea patients than in the snoring group. One of the possible explanations of this result is that most ap-

nea patients, due to the severity of the pathology, consequently present higher deficits in their daily social functioning, etc. It is very likely that conditions previously described tend to influence an increase of depression levels.

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