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Relationship between the quality of life and the severity of obstructive sleep apnea syndrome

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The effects of sleep disorders on the quality of life (QOL) have been documented in the literature. Excessive sleepiness and altered circadian rhythms may negatively affect ability to learn, employment, and interpersonal relations, and directly degrade QOL. The objective of the present study was to evaluate the impact of obstructive sleep apnea syndrome of varying severity on QOL. The study was conducted on 1892 patients aged 18 years or older referred by a physician to the Sleep Institute, São Paulo, with complaints related to apnea (snoring, excessive daytime sleepiness, hyperarousal, and fatigue). They were submitted to overnight polysomnography for the diagnosis of sleep disorders from August 2005 through April 2006. The patients completed the Epworth Sleepiness Scale and QOL SF-36 sleep questionnaires. They were classified as non-physically active and physically active and not-sleepy and sleepy and the results of polysomnography were analyzed on the basis of the apnea hypopnea index (AHI). The apneic subjects showed a reduction in QOL which was proportional to severity. There was a significant decrease in all domains (physical functioning, role physical problems, bodily pain, general health perceptions, vitality, social functioning, emotional problems, general mental health) for apneics with AHI >30, who generally were sleepy and did not participate in physical activities ($P < 0.05$). The present study provides evidence that the impact of sleep disorders on QOL in apneics is not limited to excessive daytime sleepiness and that physical activity can contribute to reducing the symptoms. Thus, exercise should be considered as an adjunct interventional strategy in the management of obstructive sleep apnea syndrome.

Key words: Physical activity; Obstructive sleep apnea syndrome; Quality of life; Sleepiness

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Introduction

The effects of sleep disorders on quality of life (QOL) have been documented in the literature. Excessive sleepiness and altered circadian rhythms may affect education, employment, and interpersonal relations, and directly degrade QOL, particularly in relation to functional capacity, health and sensation of well-being (1).

As one of the principal sleep disturbances listed by the International Classification of Sleep Disorders (ICSD), obstructive sleep apnea syndrome (OSAS) is characterized by an increase in respiratory effort to breathe against relative or absolute airway obstruction with reduction or cessation of airflow for at least 10 s and identified by measuring an intrathoracic pressure that is more negative than during non-obstructed breathing. Diagnostic criteria for OSAS include symptoms of five or more (≥5) obstructive breathing events (apneas, hypopneas, or respiratory effort-related arousals), or more than 15 obstructive breathing events without any symptoms documented by overnight monitoring (2).

Although sleep apnea is the most common cause of excessive sleepiness (3), it leads to significant impairments in QOL, cognitive performance, and social functioning (4). More reliable diagnostic parameters for the syndrome have only been available in the last twenty years as precision laboratory metrics have developed. Given the negative impact of OSAS on QOL, the American Academy of Sleep Medicine (5) has recommended the Medical Outcomes Study Short-Form-36 (SF-36) as the most widely used instrument consistently showing low scores especially in the vitality/energy, role-emotional, mental health, and social functioning domains (6,7), which have shown improvement after continuous positive airway pressure treatment, thus suggesting their validity for assessing QOL in OSAS (7).

Although some studies have examined the relation between OSAS and QOL (8-10), there is a lack of documented research focusing on factors that can alter the severity of OSAS such as sleepiness and physical activity.

Physical activity provides several health benefits by decreasing the risk of mortality from chronic diseases such as cardiovascular disease, diabetes, hypertension, and cancer (11-13). In this respect, the objective of the present study was to evaluate the relationship between QOL and severity of OSAS, considering sleepiness and physical activity as a predictor of better perception of QOL.

Patients and Methods

All experimental procedures were submitted to and approved by the Ethics Committee of the Federal University of São Paulo (process #1302/06). The procedures complied with the ethical standards set by the committee responsible for human experimentation and with the Helsinki Declaration of the World Medical Association (1964, amended in 1975 and 1983). Written informed consent was obtained from all participants.

We prospectively assessed the QOL of primary care patients suspected of having sleep apnea who were referred by a physician and subsequently underwent overnight polysomnography for OSAS diagnosis.

We recruited all patients aged 18 years or older (N = 1892) attending the Sleep Institute at AFIP in Brazil for the diagnosis of sleep disorders from August 2005 through April 2006. The inclusion criteria were the presence of complaints related to apnea (snoring, excessive daytime sleepiness, hyperarousal, and fatigue). Exclusion criteria were previous treatment for OSAS, presence of acute illness or medications within the last 2 weeks.

Measurements

Patients came to the Institute of Sleep for polysomnography at 9:00 pm and were asked to complete a Sleep Questionnaire (14), the Epworth Sleepiness Scale (15), and the QOL SF-36 Health Survey (16). All questionnaires were self-administered an hour prior to overnight polysomnography. After filling out the questionnaires, the patients were taken to their individual rooms, where polysomnography was set up for recording throughout the night.

Polysomnography

Sleep recording followed Rechtschaffen and Kales (17) standards for polysomnography. All volunteers were recorded for at least 8 h. Variables were systematically monitored using a multichannel data acquisition system (Embla, Flaga, Iceland): electroencephalogram (C3/A2, C4/A1, O1/A2, O2/A1), electrooculogram (R-OC/A1 and L-OC/A2), chin and anterior tibialis electromyogram (electrodes in mentonian and submentonian regions), and electrocardiography (modified V2 connection). Two plethysmograph belts were used to monitor thoracic and abdominal movements. Nasal and oral airflow was measured with a nasal pressure transducer and with a thermistor. Arterial oxygen saturation was measured by pulse oximetry. Synchronized video monitoring was used to monitor abnormal sleep breathing or movements. Data recorded were total sleep time (per min), sleep efficiency (%), sleep latency (per min), latency of rapid eye movement (REM/min), sleep stages 1 and 2 (%), stages 3 and 4 (%) and REM (%) and apnea and hypopnea respiratory events index (AHI/h). Polysomnography records were scored manually using conventional Rechtschaffen and Kales criteria with 30-s epochs. Diagnostic criteria for OSAS included an AHI of 5 or more determined by overnight monitoring, and evidence of disturbed or non-refreshing sleep, daytime sleepiness, or other daytime symptoms (5). The task force suggested AHI cut-off points of $5 \leq AHI < 15$, $15 \leq AHI < 30$ and $AHI \geq 30$ to indicate mild, moderate, and severe levels of OSAS (2). These recommendations have been recognized to be an expert consensus statement based on a paucity of objective data, and are intended to stimulate further research to identify the optimal approach to quantifying sleep-related breathing disorders (5).

Evaluation of physical activity

We asked about the frequency of physical activity per week in the Sleep Questionnaire. Patients reporting activity performed twice a week or more were rated as being physically active.

Evaluation of sleepiness

The Epworth Sleepiness Scale (ESS), which was used to investigate daytime sleepiness, provides a measure of propensity to sleep or doze during active and passive situations commonly encountered during the wake period. ESS scores <10 were considered to indicate normality and the patients reporting them were classified as not-sleepy, while scores ≥10 were rated as clinically significant sleepiness and the patients reporting them were rated as sleepy (15,18).

Evaluation of QOL

The "Medical Outcomes Study SF-36" is a 36-item generic QOL measure that assesses eight domains: 1) physical functioning; 2) role limitations due to physical health problems; 3) body pain; 4) general health perception; 5) vitality; 6) social functioning; 7) role limitations due to emotional health problems, and 8) mental health. The SF-36 Health Survey was translated and validated for the Brazilian population, and evidence of its reliability has been substantial to date (16). All scores ranged from 0 to 100, with a higher score indicating better QOL. Domains were analyzed separately (19).

Statistical analysis

Each variable was tested for the normality of the distribution by the Kolmogorov-Smirnoff test. Differences between two groups of quantitative variables were tested by the two-sided unpaired Student *t*-test (mean ± SD). Differences among more than two groups were assessed by one-way ANOVA followed by the Tukey post-test (mean ± SD). The data for the dependent variable physical activity, hypertension and diabetes did not present normal distribution and were analyzed by non-parametric tests. Groups were compared to one another by Kruskal-Wallis non-parametric analysis of variance (median and interquartile range), followed by the multiple comparisons test (20). To analyze QOL we used two-way factorial ANOVA taking into consideration the factors severity of OSAS, sleepiness and physical activity. The level of significance was set at 5% for all analyses, which were performed with the help of the STATISTICA software (StatSoft, Inc., USA).

Results

A total of 1892 patients volunteered for the study. After polysomnography, 508 patients presented no characteristic related to OSAS (AHI <5), while 1384 patients who presented sleep apnea-related symptoms (snoring, excessive daytime sleepiness, hyperarousal, and fatigue) with AHI ≥5 were selected for the study. The demographic, clinical and sleep pattern characteristics of the OSAS population are shown in Table 1.

Table 1. Anthropometric and sleep parameters of patients with obstructive sleep apnea syndrome (OSAS) classified according to the severity of the disease.

	No OSAS (AHI <5)	Mild OSAS (5 ≤ AHI < 15)	Moderate OSAS (15 ≤ AHI < 30)	Severe OSAS (AHI ≥30)
Number of patients	508	506	390	488
Age (years)	40 ± 12	45 ± 12*	46 ± 13*	48 ± 13*#
Gender (male)	52.95%	73.91%	82.82%	85.24%
Body mass index (kg/m²)	26.40 ± 5.42	28.02 ± 5.08	29.51 ± 5.39	31.45 ± 6.01*#+
Epworth sleepiness scale	10.54 ± 5.37	10.22 ± 5.17	11.12 ± 5.27	11.75 ± 5.52*#
Physically active (%)	31.03%	27.22%	21.59%	20.14%*
Hypertension (%)	14.76%	22.72%*	30.76%*	41.59%*#
Diabetes (%)	3.74%	4.74%	6.66%	8.81%
Sleep latency (min)	22.34 ± 24.68	20.60 ± 25.90	20.88 ± 23.02	20.27 ± 21.54
REM sleep latency (min)	111.88 ± 63.80	103.60 ± 57.81	107.43 ± 64.83	124.88 ± 73.72
Total sleep time (min)	352.38 ± 62.18	348.53 ± 64.76	344.85 ± 59.16	341.35 ± 69.28
Sleep efficiency (%)	82.42 ± 11.76	82.76 ± 11.93	81.14 ± 11.88	79.41 ± 14.08*#
Sleep stage I (%)	3.83 ± 4.14	4.56 ± 4.10	5.20 ± 4.44	6.05 ± 6.42*#+
Sleep stage II (%)	54.16 ± 13.08	52.57 ± 13.25	52.48 ± 13.86	61.18 ± 14.68*#+
Sleep stages III/IV (%)	22.46 ± 11.57	22.88 ± 11.59	22.51 ± 11.39	15.88 ± 11.48*#+
REM (%)	19.68 ± 7.04	19.97 ± 6.61	19.78 ± 7.45	16.90 ± 7.72*#+
Arousal index (h)	7.81 ± 5.53	11.71 ± 7.03	16.33 ± 7.45	40.61 ± 23.37*#+
AHI sleep (events/h)	2.17 ± 1.46	9.49 ± 2.91	21.53 ± 4.10	56.74 ± 22.79*#+

Data are reported as means ± SD or percent. REM = rapid eye movement; AHI = apnea hypopnea index; arousal index = microarousals/sleep time/h.
*P < 0.05 compared to AHI <5; #P < 0.05 compared to mild OSAS; +P < 0.05 compared to moderate OSAS (comparisons by ANOVA followed by the Tukey test, except for physical activity, hypertension and diabetes data, which were analyzed by the Kruskal-Wallis multiple comparison test).

Patients were significantly older than controls. Body mass index (BMI) and ESS were significantly higher in patients than in controls, and BMI was significantly higher for the severe group than for the groups with no OSAS symptoms or with mild and moderate symptoms. The polysomnography data showed that patients with severe OSAS had disturbances of sleep architecture classified as stages III/IV (%) and of REM (%) stage.

All domains in the SF-36 were significantly lower in the severe apneic group than in any other group. However, it is interesting to note that patients with moderate apnea who perform physical activity had better QOL results than the

Table 2. Effect of daytime sleepiness, physical activity and severity of obstructive sleep apnea syndrome (OSAS) on the quality of life.

SF-36 domain	Not-sleepy and PA (N = 302)	Sleepy and PA (N = 281)	Not-sleepy and non-PA (N = 622)	Sleepy and non-PA (N = 671)
No OSAS (AHI <5) (N = 508)				
1	85.68 ± 21.36	80.96 ± 24.08	77.26 ± 21.44*	74.72 ± 21.84*
2	71.84 ± 32.48	67.77 ± 36.73	72.04 ± 35.28	66.56 ± 38.10
3	70.55 ± 23.93	61.06 ± 25.87	67.10 ± 26.03	59.87 ± 28.49*
4	76.04 ± 18.99	76.13 ± 16.72	72.20 ± 21.08	71.07 ± 18.91
5	51.59 ± 24.94	44.15 ± 24.34	46.02 ± 22.03	41.22 ± 21.78*
6	75.56 ± 24.77	69.42 ± 24.56	71.58 ± 27.27	65.33 ± 27.92*
7	64.76 ± 41.17	59.02 ± 41.75	67.06 ± 40.14	60.30 ± 40.32
8	65.27 ± 22.19	58.84 ± 18.96	61.90 ± 22.25	58.65 ± 20.46
Mild OSAS (5 ≤ AHI < 15) (N = 506)				
1	85.89 ± 19.25	83.40 ± 20.59	77.05 ± 21.28*	73.31 ± 20.19*
2	76.48 ± 30.64	78.40 ± 31.89	69.36 ± 35.26	69.78 ± 2.77
3	73.42 ± 22.17	71.71 ± 24.57	62.80 ± 27.86*	61.01 ± 26.65*
4	80.08 ± 18.43	74.15 ± 19.27	71.68 ± 18.08*	70.53 ± 19.07*
5	57.50 ± 19.14	47.87 ± 22.08*	47.25 ± 22.15*	41.65 ± 21.19*
6	76.33 ± 22.87	75.75 ± 26.66	70.15 ± 25.12	68.94 ± 24.34
7	65.06 ± 42.01	72.71 ± 37.40	62.99 ± 40.58	61.53 ± 40.50
8	68.00 ± 18.69	66.18 ± 18.71	62.42 ± 21.52	58.84 ± 21.74*
Moderate OSAS (15 ≤ AHI < 30) (N = 390)				
1	83.30 ± 20.08	75.46 ± 23.29	77.56 ± 21.59	69.89 ± 23.80*#
2	83.23 ± 29.26	75.46 ± 33.11	77.89 ± 33.10	65.00 ± 36.94*#
3	74.12 ± 21.73	67.18 ± 24.95	66.35 ± 26.17	62.56 ± 24.92*
4	78.16 ± 18.53	73.46 ± 19.06	72.97 ± 18.01	71.27 ± 20.17
5	60.00 ± 22.20	49.72 ± 21.57	50.24 ± 21.11*	43.35 ± 22.14*
6	81.53 ± 20.50	71.29 ± 26.66	77.68 ± 23.67	63.48 ± 27.44*#
7	79.99 ± 36.23	65.41 ± 39.90	68.31 ± 41.91	54.98 ± 43.60*#
8	71.26 ± 18.47	62.74 ± 21.09	66.08 ± 20.23	67.80 ± 20.93*#
Severe OSAS (AHI ≥30) (N = 488)				
1	79.59 ± 20.88	72.41 ± 24.11	75.16 ± 22.93	64.56 ± 25.19*#
2	75.00 ± 37.50	75.40 ± 32.48	78.80 ± 30.37	62.92 ± 36.57#
3	67.46 ± 26.40	69.40 ± 26.85	71.33 ± 23.99	60.36 ± 26.39#
4	79.85 ± 15.61	70.19 ± 18.53	72.60 ± 20.04	66.79 ± 20.31*#
5	61.53 ± 24.89	48.54 ± 22.12*	50.39 ± 21.53*	41.80 ± 23.39*#
6	79.08 ± 21.10	72.78 ± 25.75	78.39 ± 25.81	62.92 ± 26.78*#+
7	70.05 ± 40.39	77.94 ± 33.58	76.59 ± 36.47	59.82 ± 43.12#+
8	76.73 ± 17.41	66.25 ± 17.66*	65.00 ± 21.78*	56.44 ± 20.88*#+

The quality of life (QOL) was measured with a self-administered SF-36 Health Survey that measures 8 domains: 1) physical functioning; 2) role limitations due to physical health problems; 3) body pain; 4) general health perceptions; 5) vitality; 6) social functioning; 7) role limitations due to emotional health problems, and 8) mental health. Patients assigned scores from 0 to 100 to each domain, with the higher scores indicating higher QOL. Data are reported as means ± SD. Domains were analyzed separately using ANOVA. The Epworth Sleepiness Scale provides a measure of the propensity to sleep or doze during active and passive situations. Patients were rated as sleepy or not-sleepy (14). AHI = apnea hypopnea index; PA = physically active. *P < 0.05 compared to not-sleepy and PA; #P < 0.05 compared to not-sleepy and non-PA; +P < 0.05 compared to sleepy and PA (ANOVA followed by the Tukey test).

not-sleepy and non-physically active groups. In all apneic groups, vitality was the domain most significantly affected in the not-sleepy non-physically active group and in the sleepy non-physically active group, showing that the practice of physical activity could be the factor determining a better vitality responsible for a better QOL. It is clear that the association of sleepiness and sedentarism plays an important role in reducing the QOL for OSAS patients. The characteristics of QOL are shown in Table 2.

Discussion

The study showed that excessive sleepiness and lack of physical activity affected the QOL of apneic patients, which was worse among sleepy non-physically active subjects and increasingly worse in the group with severe apnea. We provide evidence that the impact of OSAS on QOL is not limited to excessive daytime sleepiness and that physical activity can contribute to improve perception of QOL by OSAS patients.

There was a decrease in quality of sleep of severe apneics, along with a reduction in sleep efficiency, increased stages I (%) and II (%) and reduced stages III/IV (%) and REM (%) stage compared to the values of our control group. Changing sleep patterns have consequences for both physical and mental health (21). Moore et al. (22) recorded sleep variables for OSAS and showed that variables related to sleep fragmentation may have an important effect on several aspects of QOL, speculating that fatigue and excessive daytime sleepiness may be partially associated with diminished QOL. Briones et al. (9) also investigated 129 adults with mild to moderate sleep apnea and concluded that sleepiness affects perception of QOL. Our results showed that not-sleepy patients whose ESS score was less than 10 presented better results in most SF-36 domains than the sleepy group.

In a large series reported by Baldwin et al. (23) regarding the association between sleep disordered breathing (SDB) and QOL, high levels of sleep apnea (AHI >30) were found to be associated with reductions in physical functioning, general health perception, vitality and social functioning. Our study agrees but we detected lower scores for all 8 domains of QOL among patients with severe apnea compared to the other groups, confirming that QOL is inversely proportional to OSAS severity.

Several studies have shown that intensive exercise may benefit QOL in both sick (24) and healthy populations (25). Our results show that apneics performing regular physical activity for at least 2 h/week or more scored higher on all eight QOL domains than non-physically active apneics.

Quan et al. (26) observed that 3 or more hours of moderately vigorous or vigorous physical activity also appeared to provide some protection against SDB, but these associations were weaker, with physical activity working only as an adjunctive treatment modality for SDB. An epidemiologic study (N = 1104) also found that number of hours of exercise per week was inversely associated with apnea-hypopnea severity (27). Our study extends these findings by showing that even less structured or less intensive activity is positively correlated with higher perception of QOL in apneic adults. The practice of physical exercise is essential for delaying some aspects of aging because of the reduction of risks for the onset of various chronic diseases (28).

Our study is limited by the descriptive nature of this investigation that did not allow us to determine whether other factors such as the presence of illness, medication use and daily living habits might have influenced the results. Another aspect is that the subjective self-report of daily physical activity may not have been adequate to find significant associations between physical activity and OSAS severity.

The present study differs from others in that only patients who had not yet received any treatment were included and all data were collected at the same service using the same methods, giving the possibility of a large sample and a high accuracy of the results. It was felt that the inclusion of consecutive patients at the time of OSAS diagnosis and before the beginning of any therapy would provide a better reflection of the true impact of the disease on patients' QOL.

Finally, OSAS represents a major public health problem and current available resources allow only a minority of affected patients to be assessed and treated. Further research is required to demonstrate if the use of more specific physical exercise considering time of day, intensity and type of exercise could act as an adjuvant treatment for OSAS and its symptoms, i.e., sleepiness, improving the perception of QOL by OSAS patients.

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