10.2478/abm-2010-0113

Asian Biomedicine Vol. 4 No. 6 December 2010; 861-868

Original article

Sleep-disordered breathing and self-reported general health status in Thai patients

Prakobkiat Hirunwiwatkul, Patnarin Mahattanasakul
Department of Otolaryngology, Faculty of Medicine, Chulalongkorn University, King Chulalongkorn Memorial Hospital, Bangkok 10330, Thailand.

Background: Sleep-disordered breathing (SDB) has been a rapidly increasing health problem in Thai. Its effect on quality of life of Thai patients has not been adequately addressed.
Objective: Determine the relationship between SDB and self-reported general health status in Thai patients.
Materials and methods: A descriptive and cross-sectional study was used. Two hundred and sixtyeight patients (195 men and 73 women, age: 16-82 years) are recruited from King Chulalongkorn Memorial Hospital between January 2006 and December 2007. A health profile was obtained by self-administered questionnaire. SDB severity was assessed using an attended single-night comprehensive polysomnography.
Results: SDB was not directly associated with the general health status. Presence of excessive daytime sleepiness, which was the major symptom of obstructive sleep apnea, was associated with a decrease in all domains of Short Form 36. Age, sex, and body mass index were also related to a lower physical function. Hypertension and excessive daytime sleepiness were associated with the severity of SDB.
Conclusion: SDB is indirectly related to a lower general health status, and this relationship is of clinical significance.

Keywords: Quality of life, sleep apnea syndromes, sleep-disordered breathing (SDB), Thai

Sleep-disordered breathing (SDB) is a spectrum of abnormalities ranging from the mildest "primary snoring (PS)" to the most serious "obstructive sleep apnea (OSA)". Primary snoring is a disturbing social problem, but obstructive sleep apnea may be a serious and potentially fatal problem.

The prevalence of OSA collected from the "National Sleep Foundation" in America 2005 poll is 26% [1]. The risk of OSA increased up to age 65 years. Obese individuals were at higher risk for OSA. The predominant symptom is daytime somnolence, which overshadows many other problems such as morning headache, unrefreshed feeling on awakening, night-time sweats, agitated sleep, poor cognitive function, and clinical depression. Risk of hypertension [2-4], cerebrovascular disease [5, 6], ischemic heart disease [7-13] and automobile accident [14-15] significantly increased in severe cases of OSA. Treatment consists of weight reduction, body positioning during sleep, dental appliances, medical [16], and surgical treatment [17-24]. The most widely used and most effective treatment of OSA is continuous positive airway pressure (CPAP) therapy [25-29].

The assessment of patients' quality of life and satisfaction has become of paramount importance in health care. Historically, the impact of disease and the effect of treatments on the psychosocial and functional aspects of health, including mood, life satisfaction, cognition, and social roles, were largely ignored. The effect of sleep-disordered breathing on self-assessed health has not been adequately addressed. Limited studies have shown a reduction in the general health status from sleep-disordered breathing.

Health-related QOL questionnaires used for sleep-disordered breathing study vary greatly. The most widely used QOL questionnaire is the Medical Outcomes Survey Short Form-36 (SF-36) [29-33]. This questionnaire is a generic tool for assessment of

Correspondence to: Prakobkiat Hirunwiwatkul, MD, Department of Otolaryngology, Faculty of Medicine, Chulalongkorn University, King Chulalongkorn Memorial Hospital, Bangkok 10330, Thailand. E-mail address: prakobkiat@gmail.com

QOL in eight domains of health status. Others used in the literature are Euro-QOL [30], general health questionnaire (GHQ-28) [34], Functional limitations profile (FLP) [30], hospital anxiety and depression scale (HADS) [31, 34], Munich life-quality domain list (MLDL) [28], Nottingham health profile (NHP) [31], sickness impact profile (SIP) [24], and sleep apnea quality of life index (SAQLI) [35].

SF-36 is one of the most widely used instruments for assessing the health-related quality of life. It was developed by the Medical Outcome Trust (Boston, USA). Medical Outcomes Survey Short Form-36 (SF-36) comprises 36 questions measuring eight health constructs: 1) limitations in physical activities, 2) limitations in social activities, 3) limitations in usual role activities because of physical health problems, 4) bodily pain, 5) general mental health (psychological distress and well-being), 6) limitations in usual role activities because of emotional problems, 7) vitality (energy and fatigue), and 8) general health perceptions. Scores range from 0 to 100, with 100 as the best score. It has been validated and studied in various groups of patients and in the general population. Questions in each domain were designed as Likert scale. Data collection allowed for personal interview, telephone interview, or self-reports. In general, 5 to 10 minutes were taken for completion of the questionnaire. Scoring algorithms were described in the SF-36 Health Survey manual for adhering to assumptions of the methods used to construct SF-36 scales and comparing the results across studies.

The Thai version of SF-36 was developed and the validity and reliability was examined by Watcharee Leurmarnkul et al. [36]. The development included forward and backward translations.The instrument was conducted. The instrument was tested in 569 people aged 17 or older between May and November 1999. The average missing data rate for all eight domains was 1.4%. The percentage of the convergent and discriminant validity was 91.4% and 96.4%, respectively. The instrument was valid in terms of known-group validity. The internal consistency presented as Cronbach's alpha coefficients ranged from 0.63 to 0.77. The Thai version was proven to be consistent with the original.

In this study, we evaluated the relationship between SDB and self-reported general health status in Thai patients. This information may help physicians to understand self-perception in health status of SDB Thai patients.

Materials and methods

The sample populations were sleep-disordered breathing Thai patients who were scheduled for a sleep study at the sleep laboratory of King Chulalongkorn Memorial Hospital. Inclusion criteria were patients with sleep-disordered breathing that signed an informed consent. Exclusion criteria were illiterate patients who were not able to read and understand the content of the questionnaire. All eligible patients were enrolled consecutively. The research proposal was approved by the Ethics Committee, Faculty of Medicine, Chulalongkorn University. All subjects were informed of the objectives and the process of the study before deciding to participate. Data was collected between January 2006 and December 2007.

The tool for data collection was a self-administered questionnaire designed to obtain relevant data of health related QOL, daytime sleepiness and factors (demographic, physical illness, and sociopsychological variables) that have influence on the QOL of sleep disordered breathing patients in addition to severity of SDB. The questionnaire was self-administered by the patients during the waiting time before the sleep study started. The questionnaire was blinded to the physician or personnel who interpreted the sleep study.

A pretest was done for protocol modification in the pilot study. Thirty subjects were used in this study. This preliminary draft was developed and revised by the authors regarding the conceptual framework, literature reviews and subsequently tested to complete the final version of the questionnaire which covered essential elements. The first part covered demographic variables (including sex, age, and body mass index), physical illness variables (diabetes, hypertension, heart disease, and cerebrovascular disease, etc.), and sociopsychological variables (alcohol usage, smoking) that may influence QOL of SDB. The second part concentrated on patients' daytime sleepiness. A history of sleep behind the wheel with or without a traffic accident during the past year and Epworth sleepiness scale was used to determine the level of daytime somnolence. The last part is the Thai version of SF-36.

Polysomnography included recording of sleep-state parameters (EEG, EOG, and EMG), breathing (oral airflow, nasal airflow, ribcage, and abdominal excursions), heart rate (ECG), and oximetry. All records were manually scored by trained technicians using conventional criteria [37], and reviewed by one of two sleep clinicians. A polysomnographic study of acceptable quality was defined by adequate sleep and breathing signals throughout the night, consisting of at least four hours of objectively measured sleep. The definition of apnea and hypopnea was performed by standard criteria.

Respiratory disturbance index (RDI) was calculated from the total number of scored apnea and hypopnea divided by the number of hours of sleep. RDI determined severity of SDB. Severity of SDB was classified based on respiratory disturbance index (RDI) as follows. PS was considered if the RDI was <5.0. OSA was considered mild if the RDI was $\geq$5 per hour but <15 per hour, moderate if $\geq$15 per hour but <30 per hour and severe if $\geq$30 per hour.

Body mass index (BMI) was calculated from height and weight (kg/m^2). BMI was classified as underweight (BMI <18.5), normal weight (BMI=18.5-23.0), mild obese (BMI=23.1-25.0), moderate obese (BMI = 25.1-30.0), and severe obese (BMI >30.0) [38]. Diabetes, hypertension, heart disease, stroke, alcoholic usage, smoking status, and history of sleep behind the wheel during the past year were defined as absence or presence in the subject's history. Total Epworth score [39] of 0-13 was interpreted as no excessive daytime sleepiness (no-EDS), and 14-24 was interpreted as excessive daytime sleepiness (EDS), respectively.

Statistical analysis

Data exploration and data cleaning process were done before data analysis. Data was analyzed with SPSS software version15. Copyright of SPSS software, version15 and Medical Outcomes Survey Short Form-36 (SF-36) was supported by Department of Preventive Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand.

Results

Out of 268 Thai patients with SDB, we had no missing responses for the whole questionnaire. However, there were a few items missed in the questionnaire. There were seven missing RDI results for SDB severity variables from the sleep study.

Table 1 shows demographic characteristics of the SDB patients. Approximately 3/4 of SDB patients were male. Most of the SDB patients were middle-aged, ranged from 16 to 82 years. According to BMI classification, most of the SDB patients were moderately obese, ranged from 13.8 to 43.3. Alcohol usage was more common than smoking in SDB patients. Approximately, 25%, 8%, and 5% of the SDB patients were hypertensive, diabetic, and heart disease patients, respectively. Stroke was rather rare (0.4%) in SDB patients. About 10% of the SDB patients had a history of sleep behind the wheel in the past year. Approximately 1/4 of the SDB patients had excessive daytime sleepiness (EDS).

Table 1. Demographic variables, sociopsychological variables, physical illness, history of sleep behind the wheel, Epworth sleepiness scales, RDI, primary snoring or OSA patients in terms of number (percentage), mean (standard deviation), median (interquartile ranges) and range (minimum to maximum).

	Number (%)	Mean (SD)	Median (IQR)	Minimum-Maximum
Sex (female/male)	73 (27.2) / 195(72.8)			
Age		47.2 (11.6)	48 (39 - 55)	16 - 82
BMI		26.9 (4.5)	26.3 (24.0 - 29.3)	13.8 - 43.3
Alcohol usage	52 (19.4)			
Smoking	16 (6.0)			
Diabetes mellitus	22 (8.2)			
Hypertension	72 (26.9)			
Heart disease	14 (5.2)			
Stroke	1 (0.4)			
Sleep behind the wheel	24 (9.0)			
Epworth sleepiness scales		9.7 (5.0)	9.0 (6.0-13.0)	0 - 24
RDI		33.8 (25.0)	27.5 (1.2-14.9)	0 - 127.1
PS / OSA	31(12) / 230(88)			

BMI=body mass index, RDI=respiratory disturbance index, PS=primary snoring, OSA=obstructive sleep apnea.

Most patients had physical functioning (PF), physical role (RP), bodily pain (BP), general health (GH), vitality (VT), social function (SF), mental health (MH), emotional role (RE), scores of 60-90, 25-100, 41-84, 35-67, 45-70, 63-88, 0-100, and 56-80, and averaged scores of 75, 100, 62, 50, 55, 75, 61, and 68, respectively. Patients reported their health (RH) in the past year in scores, and overall physical QOL, overall mental QOL and overall QOL scores of 25-50, 48-78, 46-76, and 48-79 and averaged scores of 50, 65, 65, and 69, respectively. Quality of life variables in all domains were not different among different severity of SDB (**Table 2-4**).

Table 2. SF-36 quality of life scores in each domains and overall (physical, mental, and total).

	Median (IQR)	Mininum - Maximum
Physical functioning (PF)	75 (60 - 90)	5 - 100
Role, physical (RP)	100 (25 - 100)	0 - 100
Bodily pain (BP)	62 (41 - 84)	0 - 100
General health (GH)	50 (35 - 67)	0 - 97
Vitality (VT)	55 (45 - 70)	5 - 100
Social functioning (SF)	75.0 (62.5 - 87.5)	12.5 - 100.0
Mental health (MH)	66.7 (0 - 100.0)	0 - 100
Role, emotional (RE)	68.0 (56.0 - 80.0)	12.0 - 100.0
Reported health (RH)	50.0 (25.0 - 50.0)	0 - 100.0
Overall quality of life (QOL)		
• **Physical**	65.3 (47.8 - 77.8)	11.4 - 96.4
• **Mental**	65.4 (45.7 - 75.9)	13.3 - 97.6
• **Total**	68.6 (48.3- 79.1)	15.8 - 97.3

Table 3. Demographic variables, sociopsychological variables, physical illness, history of sleep behind the wheel, presence of excessive daytime sleepiness classified by RDI into PS, mild OSA, moderate OSA and severe OSA.

	Primary snoring (PS)	Obstructive apnea (OSA)		
		Mild OSA	Moderate OSA	Severe OSA
Female, n (%)	20 (27.8)	9 (12.5)	19 (26.4)	24 (33.3)
Male, n (%)	11 (5.8)	26 (13.8)	52 (27.5)	100 (52.9)
Age, mean (SD)	40.1 (12.9)	44.5 (11.8)	46.8 (11.5)	49.7 (10.6)
BMI, mean (SD)	24.8 (4.2)	25.4 (3.5)	26.0 (4.2)	28.4 (4.6)
Alcohol usage, n (%)	2 (3.8)	9 (17.3)	13 (25.0)	28 (53.8)
Smoking, n (%)	0 (0)	2 (13.3)	5 (33.3)	8 (53.3)
DM, n (%)	1 (4.5)	3 (13.6)	2 (9.1)	16 (72.7)
Hypertension, n (%)	3 (4.3)	5 (7.1)	11 (15.7)	51 (72.9)
Heart disease, n (%)	1 (7.1)	1 (7.1)	3 (21.4)	9 (64.3)
Stroke, n (%)	0 (0)	0 (0)	0 (0)	1 (100.0)
Sleep behind the wheel, n (%)	0 (0)	3 (12.5)	5 (20.8)	16 (66.7)
EDS (ESS = 14 – 24), n (%)	3 (5.1)	7 (11.9)	14 (23.7)	35 (59.3)

Table 4. SF-36 quality of life scores in each domains and overall (physical, mental and total) classified by RDI into PS, mild OSA, moderate OSA and severe OSA.

	Primary snoring (PS)	Obstructive sleep apnea (OSA) OSA		
		mild OSA	moderate OSA	severe OSA
PF, n (%)	74.7 (18.2)	76.1 (16.5)	73.6 (20.0)	70.5 (21.8)
RP, n (%)	68.6 (40.3)	64.3 (39.0)	65.5 (39.3)	68.6 (38.2)
BP, n (%)	59.7 (22.4)	64.2 (22.0)	60.5 (27.0)	63.8 (24.4)
GH, n (%)	46.6 (21.5)	52.5 (20.2)	50.1 (23.8)	51.1 (20.1)
VT, n (%)	57.6 (17.6)	55.6 (16.0)	56.8 (21.0)	57.9 (16.6)
SF, n (%)	72.6 (24.0)	72.1 (19.2)	73.4 (22.5)	71.7 (21.9)
RE, n (%)	64.5 (43.0)	48.6 (43.8)	62.0 (44.8)	62.4 (42.5)
MH, n (%)	63.4 (16.3)	68.1 (12.7)	67.5 (16.4)	69.0 (15.5)
RH, n (%)	48.4 (23.2)	43.6 (17.5)	42.3 (20.1)	46.4 (23.1)
Overall QOL				
***Physical,* n (%)**	61.4 (18.7)	62.5 (17.9)	61.3 (21.5)	62.4 (19.1)
***Mental,* n (%)**	60.9 (18.9)	59.4 (18.4)	62.0 (21.3)	62.4 (18.3)
***Total,* n (%)**	63.4 (18.9)	62.7 (18.4)	63.7 (21.5)	64.4 (18.8)

PH=physical functioning, RP=physical role, BP=bodily pain, GH=general health, VT=vitality, SF=social function, RE=emotional role, MH=mental health, RH=patients reported their health, QOL=quality of life.

No Significant correlation was found between RDI and any domains of QOL. Correlations (R) between RDI and domains of QOL (PF, RP, BP, GH, VT, SF, RE, MH, RH, overall physical QOL, overall Mental QOL, and overall total QOL) were -0.1 (p = 0.17), 0.0 (p = 0.64), 0.1 (p = 0.14), 0.1 (p = 0.35), 0.0 (p = 0.71), 0.0 (p = 0.89), 0.1 (p = 0.22), 0.1 (p = 0.07), 0.0 (p = 0.53), 0.0 (p = 0.64), 0.1 (p = 0.27), and 0.1 (p = 0.42), respectively.

Significant negative correlations were found between ESS and domains of QOL (PF, RP, BP, GH, VT, SF, RE, MH, RH, overall physical QOL, overall mental QOL, and overall total QOL; R=-0.3 (p <0.01), R=-0.4 (p <0.01), R=-0.3 (p <0.01), R=-0.3 (p <0.01), R= -0.3 (p <0.01), R=-0.3 (p <0.01), R=-0.3 (p <0.01), R=-0.3 (p <0.01), R=-0.2 (p <0.01), R=-0.4 (p <0.01), R=-0.4 (p <0.01), and R=-0.4 (p <0.01), respectively.

Significant correlation was found between sex, age, BMI, and PF (R=0.2, -0.3, -0.3, and p <0.01, <0.01, <0.01, respectively). Male had physical functioning more than female. Older age was associated with decrements in the physical functioning. More BMI was associated with decrements in the physical functioning. Significant positive correlation was found between alcohol usage and smoking (R=0.3, p <0.01). SDB patients with history of alcohol usage usually had history of smoking. Significant correlations fell between sex and alcohol usage, smoking (R=0.3, 0.2, and p <0.01, 0.01, respectively). Male had alcohol usage and smoking more than female. Significant positive correlations were found between age and DM, and hypertension (R = 0.2, 0.3, and p <0.01, <0.01, respectively). Older age was associated with the increased chance to have DM and hypertension. Significant positive correlations were between BMI and DM, and hypertension (R = 0.2, 0.3, and p = 0.01, <0.01, respectively). More BMI was associated with the increased chance to have DM and hypertension. Significant positive correlations were between sex, age, BMI and RDI (R = 0.2, 0.2, 0.4, and p <0.01, <0.01, <0.01, respectively). Male had more RDI than female. Older age was associated with more RDI. More BMI was associated with more RDI. Significant positive correlations were between hypertension and RDI (R = 0.3, p <0.01). Hypertensive patient had more RDI.

Discussion

Sample population from this survey was not a well-represented one of SDB Thai patients. Majority of the enrolled SDB patients were in the more severe groups where ratios of PS, mild OSA, moderate OSA, severe OSA were 12%, 13%, 27%, 48% respectively. Most SDB patients in Thai population should be in the less severe groups. This resulted from the following two reasons. The first reason was the setting of this hospital-based study and a tertiary care center where more severe patients came. Most PS or mild OSA patients did not consult a doctor. The second reason was selection bias. The cost of the sleep study was high for most patients. The patients with sleep study were likely to be more severe than patients without sleep study because of cost-effectiveness of the investigation. The results in this study might be different, being dependent upon community-based setting.

Male gender, aging, and overweight were known as common risk factors for development of SDB. Most SDB patients in this study were male, middle-aged, obese, and 33-53% of them were severe OSA. Seventy-two percent of the female group was OSA and 33% of women were severe OSA. These numbers were surprisingly high in comparison with the general population [1]. In SDB patients, alcohol usage was found more often than smoking. Approximately 20% of SDB patients had a history of alcohol usage and 6% had a history of smoking. In this study, the history of alcohol usage and smoking was not directly related to QOL or EDS.

Hypertension was the most common physical illness. Approximately, 25%, 8%, and 5% of enrolled patients had hypertension, DM, and heart disease, respectively. Stroke was found less than other physical illness. It was rather rare (0.4%). History of sleep behind the wheel in the past year fell within 10%, and approximately 1/4 of the patients had EDS indicated by Epworth sleepiness scales (ESS = 14-24). Theoretically, risk of hypertension, stroke, ischemic heart disease, and diabetes mellitus significantly increased in severe cases of SDB, and OSA resulted in frequent arousals during the night causing ineffective sleep, inadequate slow wave sleep, and EDS. These findings were supported by many studies and explained by the pathophysiology of OSA.

In the Medical Outcomes Survey Short Form-36, quality of life variables in all domains were not different in different levels of severity of SDB. Many factors had influence on QOL. In this study, only factors related to SDB were considered. Other variables (marital status, socioeconomic status, educational status, other physical or mental illness, or unknown factors) may be important to determine QOL. No significant correlations were found between all domains of QOL and RDI. However, significant positive correlations were between all domains of QOL and ESS. In the Wisconsin Sleep Cohort Study [40], there was a clinically significant relationship between SDB status and self-reported general health status measured by SF-36. Our study was a hospital-based study in a Thai population. For this reason, more severe patients were included in our study. Since race, male predominance, severity of SDB, and sample size are much different in both studies, it is very hard to compare their results.

Another study in Asians was done by Akashiba et al. [41]. They were assessing the quality of life (QOL) using SF-36 in patients with severe OSA and normal control subjects. They did not find any relationship between each domain on the SF-36 and the severity of OSA and ESS score. The strongest correlation (partial R^2 = 0.505) was between QOL and depression status. Our study was also done in Asians and had more sample size. No direct relationship existed between each domain of SF-36 and the severity of SDB. However, correlation was significant between all domains of SF-36 and ESS score in our study (R^2 = 0.16).

The Short Form-36 for QOL was not directly related to the severity of SDB in terms of respiratory disturbance index (RDI), but it was related to EDS in the Epworth Sleepiness Scales. The impact of SDB on self-assessments of health should be recognized by the healthcare system and the public. Middle-aged, male, and moderately obese patients should be evaluated for OSA because of high prevalence of disease in this profile. Hypertensive patients should be evaluated for presence of SDB. In other words, SDB patients also should be routinely screened for hypertension because the prevalence was high in SDB patients. Severe OSA patients had more EDS than mild cases. If severe OSA patients drive, it may be dangerous for public and themselves. SDB patients with obesity had poorer physical functioning. They should get treatment for obesity to improve their QOL.

Acknowledgement

The authors thank Dr. Manop Kanato for his consultation and data processing, and Chulalongkorn Sleep Laboratory for technical assistance and data collection. Copyright of SPSS software, version15 and Medical Outcomes Survey Short Form-36 (SF-36) was supported by Department of Preventive Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand.

The authors have no conflict of interest to report.

References

1. Hiestand DM, Britz P, Goldman M, Phillips B. Prevalence of symptoms and risk of sleep apnea in

the US population: Results from the national sleep foundation sleep in America 2005 poll. Chest. 2006; 130:780-6.

2. Young T, Peppard PE, Gottlieb DJ. Epidemiology of obstructive sleep apnea: a population health perspective. Am J Respir Crit Care Med. 2002; 165: 1217-39.
3. Shamsuzzaman AS, Gersh BJ, Somers VK. Obstructive sleep apnea: implications for cardiac and vascular disease. JAMA. 2003; 290:1906-14.
4. Phillips CL, Cistulli PAs. Obstructive sleep apnea and hypertension: epidemiology, mechanisms and treatment effects. Minerva Med. 2006; 97:299-312.
5. Yaggi H, Mohsenin V. Sleep-disordered breathing and stroke. Clin Chest Med. 2003; 24:223-37.
6. Thorpy M. Obstructive sleep apnea syndrome is a risk factor for stroke. Curr Neurol Neurosci Rep. 2006; 6:147-8.
7. Takama N, Kurabayashi M. Possibility of close relationship between sleep disorder breathing and acute coronary syndrome. J Cardiol. 2007; 49:171-7.
8. Jo JA, Blasi A, Valladares EM, Juarez R, Baydur A, Khoo MC. A nonlinear model of cardiac autonomic control in obstructive sleep apnea syndrome. Ann Biomed Eng. 2007; 35:1425-43.
9. Janssens W, Willems R, Pevernagie D, Buyse B. REM sleep-related brady-arrhythmia syndrome. Sleep Breath. 2007; 11:195-9.
10. Gami AS, Hodge DO, Herges RM, Olson EJ, Nykodym J, Kara T, et al. Obstructive sleep apnea, obesity, and the risk of incident atrial fibrillation. J Am Coll Cardiol. 2007; 49:565-71.
11. Dursunoglu N, Dursunoglu D, Ozkurt S, Tanriverdi H, Evrengul H, Kiter G. Severe sleep apnea syndrome diagnosed with acute myocardial infarction. Asian Cardiovasc Thorac Ann. 2007; 15:e3-6.
12. Peker Y, Carlson J, Hedner J. Increased incidence of coronary artery disease in sleep apnoea: a long-term follow-up. Eur Respir J. 2006; 28:596-602.
13. Bassetti CL, Milanova M, Gugger M. Sleep-disordered breathing and acute ischemic stroke: diagnosis, risk factors, treatment, evolution, and long-term clinical outcome. Stroke. 2006; 37:967-72.
14. Tippin J. Driving impairment in patients with obstructive sleep apnea syndrome. Am J Electroneurodiagnostic Technol. 2007; 47:114-26.
15. Ellen RL, Marshall SC, Palayew M, Molnar FJ, Wilson KG, Man-Son-Hing M. Systematic review of motor vehicle crash risk in persons with sleep apnea. J Clin Sleep Med. 2006; 2:193-200.
16. Hirunwiwatkul P. Efficacy and adverse effects of Xanthane nasal solution as treatment of primary snoring. Asian Biomed. 2008; 2:189-93.
17. Woodson BT, Steward DL, Weaver EM, Javaheri S. A randomized trial of temperature-controlled radiofrequency, continuous positive airway pressure, and placebo for obstructive sleep apnea syndrome. Otolaryngol Head Neck Surg. 2003; 128:848-61.
18. Hirunwiwatkul P, Aeumjaturapata S, Oraphin P. Results of temperature-controlled radiofrequency tissue volume reduction for the turbinate hypertrophy. J Med Assoc Thai. 2004; 87(Suppl 2):S91-4.
19. Hirunwiwatkul P. Pain-relieving effect of local steroid injection in uvulopalatopharyngoplasty. J Med Assoc Thai. 2001; 84(Suppl 1):S384-90.
20. Costa DJ, Mitchell R. Adenotonsillectomy for obstructive sleep apnea in obese children: a meta-analysis. Otolaryngol Head Neck Surg. 2009; 140: 455-60.
21. Greenburg DL, Lettieri CJ, Eliasson AH. Effects of surgical weight loss on measures of obstructive sleep apnea: a meta-analysis. Am J Med. 2009; 122:535-42.
22. Farrar J, Ryan J, Oliver E, Gillespie MB. Radiofrequency ablation for the treatment of obstructive sleep apnea: a meta-analysis. Laryngoscope. 2008; 118:1878-83.
23. Lin HC, Friedman M, Chang HW, Gurpinar B. The efficacy of multilevel surgery of the upper airway in adults with obstructive sleep apnea/hypopnea syndrome. Laryngoscope. 2008; 118:902-8.
24. Brietzke SE, Gallagher D. The effectiveness of tonsillectomy and adenoidectomy in the treatment of pediatric obstructive sleep apnea/hypopnea syndrome: a meta-analysis. Otolaryngol Head Neck Surg. 2006; 134:979-84.
25. Lindberg E, Berne C, Elmasry A, Hedner J, Janson C. CPAP treatment of a population-based sample-what are the benefits and the treatment compliance? Sleep Med. 2006; 7:553-60.
26. Bolitschek J, Schmeiser-Rieder A, Schobersberger R, Rosenberger A, Kunze M, Aigner K. Impact of nasal continuous positive airway pressure treatment on quality of life in patients with obstructive sleep apnoea. Eur Respir J. 1998; 11:890-4.
27. Kawahara S, Akashiba T, Akahoshi T, Horie T. Nasal CPAP improves the quality of life and lessens the depressive symptoms in patients with obstructive sleep apnea syndrome. Intern Med. 2005; 44:422-7.
28. Bolitschek J, Rieder A, Broinger G, Rosenberger A, Kunze M, Aigner K. N-CPAP rejecters-a specific group of noncompliant patients with obstructive sleep apnea

syndrome. Wien Klin Wochenschr. 2001; 113:245-8.
29. Profant J, Ancoli-Israel S, Dimsdale JE. A randomized, controlled trial of 1 week of continuous positive airway pressure treatment on quality of life. Heart Lung. 2003; 32:52-8.
30. Jenkinson C, Stradling J, Petersen S. How should we evaluate health status? A comparison of three methods in patients presenting with obstructive sleep apnoea. Qual Life Res. 1998; 7:95-100.
31. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992; 30:473-83.
32. McHorney CA, Ware JE Jr, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. Med Care. 1993;31:247-63.
33. McHorney CA, Ware JE Jr, Lu JF, Sherbourne CD. The MOS 36-item short-form health survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. Med Care. 1994; 32:40-66.
34. Jokic R, Klimaszewski A, Crossley M, Sridhar G, Fitzpatrick MF. Positional treatment vs continuous positive airway pressure in patients with positional obstructive sleep apnea syndrome. Chest. 1999; 115: 771-81.
35. Parish JM, Lyng PJ. Quality of life in bed partners of patients with obstructive sleep apnea or hypopnea after treatment with continuous positive airway pressure. Chest. 2003; 124:942-7.
36. Leurmarnkul W, Paranee M. Development of a quality of life questionnaire: SF-36 (Thai version). Thai J Pharm Sci. 2000; 24:92-111.
37. Iber C, Ancoli-Israel S, Chesson AL, Quan SF. The AASM manual for the scoring of sleep and associated events: rules, terminology, and technical specifications (1st ed.). Westchester, Am Acad Sleep Medicine, 2007.
38. International Obesity Task Force/World Health Organization. The Asian-Pacific perspective: redefining obesity and its treatment. Sydney: AHCA, 2000.
39. Chervin RD, Aldrich MS, Pickett R, Guilleminault C. Comparison of the results of the Epworth sleepiness scale and the multiple sleep latency test. J Psychosom Res. 1997; 42:145-55.
40. Finn L, Young T, Palta M, Fryback DG. Sleep-disordered breathing and self-reported general health status in the Wisconsin Sleep Cohort Study. Sleep. 1998; 21: 701-6.
41. Akashiba T, Kawahara S, Akahoshi T, Omori C, Saito O, Majima T, et al. Relationship between quality of life and mood or depression in patients with severe obstructive sleep apnea syndrome. Chest. 2002; 122: 861-5.