Original article

CPAP acceptance and adherence in OSA patients in lower northern region part of Thailand

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Background: Continuous positive airway pressure (CPAP) is the mainstay in obstructive sleep apnea (OSA) treatment. Good CPAP adherence reduces many risks of diseases and improves the overall quality of life.

Objective: The purpose of this study was to determine the acceptance and adherence to CPAP therapy among Thai patients with OSA who attend an otorhinolaryngology sleep clinic.

Methods: This retrospective study was conducted at the otorhinolaryngology sleep clinic, Naresuan University Hospital, Thailand between January 2015 and October 2021. The study enrolled all patients over 18 years old with OSA diagnosis. The patients were scheduled for follow-up appointments at least two weeks after their initial treatment and at the intervals determined by their condition.

Results: There were 232 patients who matched the criteria for inclusion. The subjects of this study were predominantly obese elderly males. The mean Apnea-hypopnea index (AHI) was 40.8 ± 26.9 events/hour. The use of CPAP was accepted by 69.4% of the subjects. Short-term CPAP adherence was 77.2% in 123 patients, whereas long-term CPAP adherence was 72.5% in 102 patients. Male gender, lower body mass index (BMI), and a more favorable perception of the disease were all observed in the short-term adherence group. In the long-term adherence group, the high prevalence was found in patients using auto-positive airway pressure machines (APAP) and AHI was normalized after CPAP utilization.

Conclusion: The acceptance rate, as well as short and long-term adherence, was around 70.0%. Acceptance of CPAP is related to advanced age, having a bed companion, financial coverage for CPAP machine, positional sleep apnea, higher disease severity, and disease awareness. Male gender, higher BMI, a more favorable perception of the disease, use of APAP and the normalization of AHI after CPAP treatment had a significantly higher prevalence in adherence group compared to non-adherence group.

Keywords: Acceptance, adherence, CPAP, obstructive sleep apnea.

Obstructive sleep apnea (OSA) is a condition that causes snoring and upper airway obstruction due to decreased muscular tone of respiratory lumen. This pathology contribute to the development of cardiovascular diseases [1], cerebrovascular diseases [1], and neurocognitive diseases [2], that may impair one's quality of life.[3] Continuous positive airway pressure (CPAP) is the gold standard for treating OSA. The good adherence to CPAP therapy reduces daytime sleepiness, improves memory function, and decreases the risk of stroke[4] and cardiovascular diseases.[5, 6] Both short and long-term follow-up studies demonstrate that strict adherence to CPAP enhances quality of life.[2]

Adherence rates varied by region; for example, they ranged from 35.3 - 87.5% in western countries, but ranged from 38.0 - 89.8% in Asia. [7] In Southeast Asia, a study conducted by Lee CHK, *et al*.[8] in Singapore discovered that the adherence rate was 52.6% after a year, while another study done by Tan B, *et al*.[7] found that the adherence rate was 66.7% after a one-month follow-up and 78.5% after a year. Thailand is a Southeast Asian country that is unique in terms of socioeconomic status, health perception, and healthcare financing. Our socioeconomic status is relatively low in comparison to Singapore, but we do have government-supported CPAP machines.

There has been limited research on CPAP acceptability and adherence in Thailand. Soudorn C, *et al*.[9] discovered that heat humidification increased CPAP adherence and improved quality of life in Thai patients with moderate to severe OSA patients and nasal symptoms. The purpose of this study was to gain a better understanding of CPAP acceptance and

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adherence in Thai patients with OSA. This is the first study in Thailand to examine the factors influencing their decision to use CPAP in both the short and long term.

Materials and methods

This study is a retrospective, single tertiary center study conducted at otorhinolaryngology sleep clinic in Naresuan University Hospital located in lower northern region part of Thailand. Between January 2015 and October 2021, the study included all adult patients over 18 years old who were diagnosed with OSA. Contraindications to CPAP use, such as unconsciousness, trauma, severe facial burns, and air leak syndrome were all considered exclusion criteria.

All patients were assessed for clinical, physical, and upper airway examinations prior to polysomnography. As a baseline demographic data, age, gender, body mass index (BMI), marital status, bed partner, health insurance, presence of nasal symptoms, nocturnal symptoms, and other sleep disorder symptoms were collected via questionnaire. The patients were asked to complete the Epworth Sleepiness Scale (ESS) using the validated Thai version[10] to assess excessive daytime sleepiness.

The nasal airway was evaluated using rhinoscopy. Because nasal obstruction is frequently cited as a factor in CPAP non-adherence, researchers examined it prior to initiating CPAP therapy.[11] Prior to the CPAP trial, nasal obstruction was treated with oral antihistamines, intranasal corticosteroids, intranasal vasoconstrictors, and/or minor surgical procedures such as inferior turbinate reduction or septoplasty in patients with nasal pathologies.

During polysomnography, the Apnea-Hypopnea Index (AHI), nadir oxygen saturation, proportion of rapid eye movement (REM) sleep during diagnostic phase, and positional OSA were all measured by a sleep technician and confirmed by a sleep physician using the American Academy of Sleep Medicine (AASM) [12] criteria. The diagnosis of OSA is established according to the third edition of the International Classification of Sleep Disorders (ICSD) [13] and the patients were classified by Apnea-hypopnea index (AHI) into mild (AHI greater than 5/hour but less than 15/hour), moderate (greater than 15/hour but less than 30/hour), and severe (AHI greater than 30/hour) OSA. Positional obstructive sleep apnea is defined as an AHI at least twice as high in supine position as in other positions.

When the patients were diagnosed with OSA, the treatment was tailored to their individual requirements. CPAP acceptance defined as CPAP use for at least the first 2 weeks. CPAP pressure was optimized using CPAP titration polysomnography, split night polysomnography, or a one-week auto-titration PAP (APAP). According to the Centers for Medicare and Medicaid Services (CMS)[14], adequate CPAP adherence was defined as at least 4 hours of use per night for 70.0% of days in a 30-day consecutive period. Short-term adherence was measured 2 to 12 weeks after starting CPAP, and long-term adherence was assessed using data from patients who had been using CPAP for more than a year. The CPAP data software records were corrected to reflect the AHI after CPAP utilization, the average hour of use, and the percentage of time spent using CPAP for more than 4 hours.

Statistical analysis

Data were analyzed using SPSS version 23.0 (IBM Corp., Armonk, NY). Continuous data were shown as mean ± standard deviation (SD). Categorical data were presented as frequency and percentage. Independent *t* - test and Chi-square test or Fisher's Exact Test were used to compare continuous and categorical data. $P < 0.05$ are considered statistically significant.

Results

Table 1 shows that 232 patients met the inclusion criteria, with the mean age of 50.1 ± 12.5 years old; 162 were male; 79.7% of the patients were classified as overweight to obese due to a BMI of more than 25 kg/m^2 according World Health Organization definition. cardiovascular disease was diagnosed in more than half of patients (58.2%), 7.3% had pulmonary disease, 3.5% had cerebrovascular disease, and 4.0% had psychological disease. In terms of nasal pathologies, 40.0% of the patients experienced nasal congestion; 12.6% reported nasal itching; 24.2% experienced sneezing; and, 17.9% had rhinorrhea. Rhinitis was diagnosed in 21.1% of the patients. One hundred and seventeen patients had abnormal nasal obstruction that necessitated treatment. Medications such as intranasal corticosteroid, antihistamine and decongestant were prescribed to 57 patients (24.6%), 45 patients (19.4%) and 20 patients (8.6%), respectively.

In all 45.7% of the patients with co-morbid sleep disorders reported having restless legs; 35.3% had abnormal leg movements during sleep; 34.1% had dream enactment behavior, and 14.7% had sleep bruxism. Among the subjects, 173 (74.6%) were

government employees; and 176 (75.9%) had CPAP coverage through their government health insurance. The rest of the subjects had no CPAP coverage. One hundred and fifty-seven subjects (67.7%) presented to the clinic on their own after realizing the impact of the disease in their lives, while 8 patients (3.4%) were persuaded by their relatives. Sixty-seven patients (28.9%) were referred from internal medicine (26.3%) and ophthalmology (2.6%).

As shown in Figure 1, 161 (69.4%) of the 232 OSA patients accepted CPAP treatment. Among 163 patients, 139 (59.9%) were referred for auto-titration PAP, and 24 (10.3%) were admitted for CPAP titration polysomnography to determine the optimum CPAP pressure. The mean CPAP pressure was 9.0 ± 2.8 cmH_2O. The majority of patients preferred nasal interfaces with no humidification in a pap machine. Seventy-one patients (30.6%) rejected CPAP therapy. For patients who refused CPAP and chose alternative treatment modalities, the AHI was 18.1 ± 14.3 per hour and minimum oxygen saturation during sleep was 82.4 ± 9.3%.

As shown in Table 1, patients in the CPAP acceptance group are older, have a bed partner, and have financial coverage for CPAP machine. This group also included patients with a higher AHI, lower minimal oxygen saturation, and positional sleep apnea ($P < 0.05$).

All patients who agreed to use CPAP had their CPAP usage data taken from the machine. Some patients accomplished short-term or long-term data, while others completed both. Short-term CPAP adherence was assessed in 123 patients at a rate of 77.2%, while long-term CPAP adherence was assessed in 102 patients at a rate of 72.5%. The mean duration of follow-up for short-term evaluation was 8.2 ± 4.7 weeks with an average of 6.2 ± 2.2 hours of CPAP use, as shown in Table 2. Male gender, a lower BMI, and a positive perception of the disease were remarkable in short-term CPAP adherence group ($P < 0.05$). In long-term study, the data were collected from patients who had been followed for more than a year and revealed that the mean follow-up was 3.1 ± 2.6 years, with an average time spent using CPAP of 5.5 ± 2.1 hours. Patients who had an AHI of less than 5 per hour after treatment and used PAP machines with auto-adjust pressure mode had a significantly higher prevalence in adherence group compared to non-adherence group in long-term follow-up ($P < 0.05$).

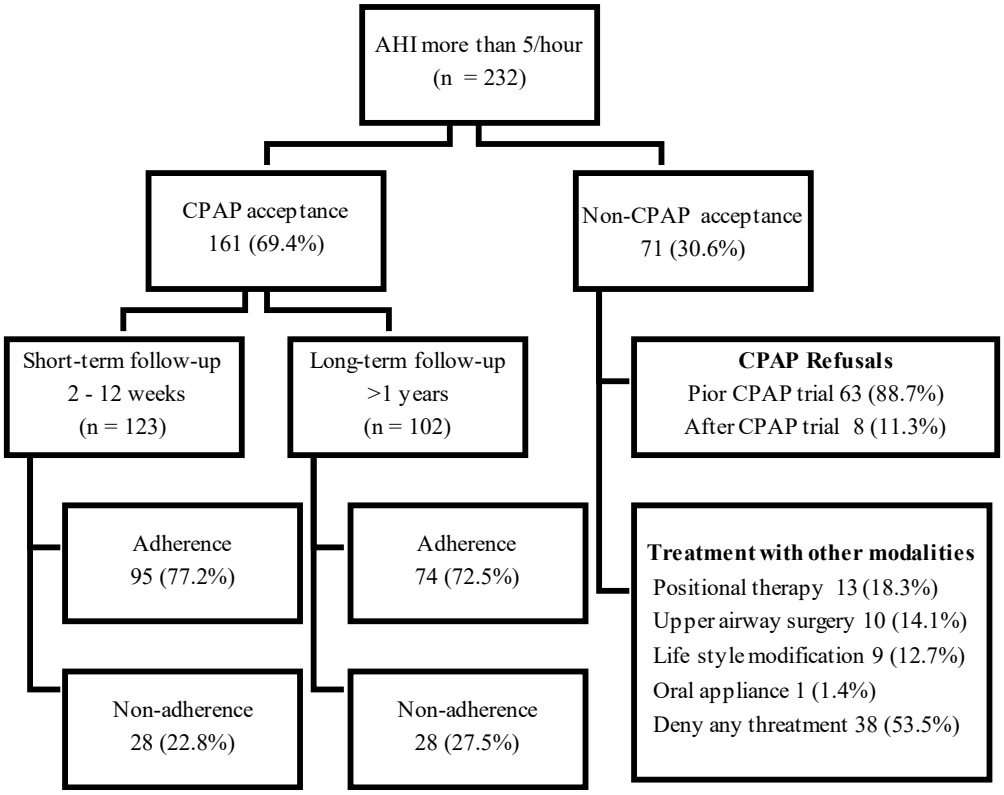

Figure 1. Patient enrolment flowchart.

Table 1. Patient baseline characteristics and CPAP acceptance.

Baseline characteristics	Number (n = 232)	Percentage	Acceptance (n = 161) (%)	Non-acceptance (n = 71) (%)	*P* - value
Gender					
Male	162	69.8	113 (70.2)	49 (69.0)	0.858
Female	70	30.2	48 (29.8)	22 (31.0)	
Age (years) Mean ± SD	50.1	± 12.5	51.9 ± 11.8	46.1 ± 13.2	0.001
BMI (Kg/m^2) Mean ± SD	30.0	± 7.1	30.1 ± 6.8	28.8 ± 7.5	0.093
Have bed partner	166	71.6	126 (78.3)	40 (56.3)	0.001
Shift work	7	3.0	3 (1.9)	4 (5.6)	0.122
Government financial coverage for PAP machine	176	75.9	132 (82.0)	44 (62.0)	0.001
Awareness of the disease	157	67.7	122(75.8)	35 (49.3)	0.001
Other sleep disorders	152	65.5	103 (64.0)	49 (69.0)	0.457
ESS score Mean ± SD	9.4	± 5.5	9.7 ± 5.8	8.6 ± 4.6	0.177
Sleepiness (ESS > 10)	94	40.5	70 (43.5)	24 (33.8)	0.167
AHI (/hour) Mean ± SD	40.8	± 26.9	45.9 ± 24.5	29.1 ± 28.6	0.001
OSA severity					
Mild (AHI 5 - 15/hour)	34	15.0	-	-	-
Moderate(AHI 15 - 30/hour)	62	27.4	-	-	-
Severe (AHI > 30/hour)	130	57.5	-	-	-
Minimum O2 sat (%) Mean ± SD	76.1	± 10.8	74.1 ± 11.2	80.6 ± 8.4	0.001
REM sleep stage (%) Mean ± SD	17.4	± 8.8	17.5 ± 9.4	17.1 ± 7.6	0.786
Positional OSA (n = 124)	76	32.8	47 (62.7)	29 (87.9)	0.008

Definition of abbreviations: BMI = body mass index; AHI = apnea-hypopnea index; ESS = Epworth sleepiness scale; OSA = obstructive sleep apnea; REM = rapid eye movement sleep stage

Table 2. CPAP adherence.

Factors	Short-term (n = 123)			Long-term (n = 102)		
	Adherence (n = 95) (%)	Non-Adherence (n = 28) (%)	*P* - value	Adherence (n = 74) (%)	Non-Adherence (n = 28) (%)	*P* - value
Gender						
Male	75 (78.9)	16 (57.1)	0.021*	53 (71.5)	23 (82.1)	0.277 [a]
Female	20 (21.1)	12 (42.9)		21 (28.5)	5 (17.9)	
Age (years) Mean ± SD	53.1 ± 12.0	50.0 ± 11.1	0.214	53.3 ± 11.4	51.6 ± 12.9	0.521 [c]
BMI (Kg/m^2) Mean ± SD	29.1 ± 5.9	32.5 ± 7.8	0.014*	30.2 ± 6.0	30.9 ± 8.2	0.599 [c]
Bed partner	76 (80.0)	23 (82.1)	0.801	58 (78.4)	25 (89.3)	0.207 [a]
Awareness of the disease	80 (84.2)	17 (60.7)	0.007*	59 (79.7)	23 (82.1)	0.784 [a]
CPAP type						
APAP	54 (57.4)	17 (60.7)	0.758	43 (59.7)	10 (35.7)	0.031 [a]*
CPAP	40 (42.6)	11 (39.3)		29 (40.3)	18 (64.3)	
Optimal CPAP pressure (cmH2O) Mean ± SD	9.0 ± 2.7	8.9 ± 3.2	0.939	9.2 ± 2.7	8.9 ± 2.9	0.629 [c]
AHI after treatment (/hour)	4.2 ± 11.6 (n = 84)	7.7 ± 20.4 (n = 23)	0.296	2.4 ± 1.9	5.4 ± 4.7	0.001 [c]*

[a] Chi-Square Tests, [b] Fisher's Exact Test, [c] Independent *t* - test, $P < 0.05$

Definition of abbreviations: BMI = body mass index; AHI = apnea-hypopnea index; CPAP = continuous positive airway pressure; APAP = auto-titrating positive airway pressure.

The reasons for initially refusing CPAP were elicited from 45 patients in the non-adherence group. One 3 patients gave no reason for their decline, and 24.4% were unaware of the importance of using the machine.

Discussion

Acceptance and adherence to CPAP have varied over time. The systematic review[15] included studies from 1996 - 2011. In 1996 - 2000, an adherence rate was about 50.0%; this rate dropped to 30.0 - 40.0% in 2001, and remained low until 2011. Tan B, *et al*.[7] included studies from 2001 to 2018 divided by regions due to racial disparities, socioeconomic status, attitudes toward health, healthcare financing, and climate factors. According to data from the Western population, the rate of adherence was 35.3 - 87.5%, while the Eastern populations reported acceptance rates of 40.0 - 87.0% and adherence rates of 38.0 - 89.8%.

The acceptance and adherence rates in this study were relatively high in comparison to the data from the studies in Asia, at approximately 70.0%. Several Japanese literatures have reported varying results in CPAP adherence. One study reported 38.0% CPAP adherence rate after a six-month follow-up period,[16] while another at 40.3% and 52.7% after a 2-month and one-year follow-up, respectively.[11] The study conducted in Singapore revealed a 52.6% adherence rate at one year.[8] A subsequent study revealed a 44.9% adherence rate after a one-month trial and 78.5% adherence rate after a year.[7] According to a study conducted in Iran, the acceptance rate was 27.8 and the adherent rate was 22.0. Patients' inability to afford a CPAP device, perception of symptom reduction, and dissatisfaction with treatment all contributed to the low rates.[17]

Patients with nasal problems may benefit from nasal pre-CPAP therapy. Since CPAP works by generating flow through the nasal cavity and splinting the upper airway, the nose is a critical factor in improving CPAP adherence. Nasal steroids were found to be beneficial to CPAP use in a meta-analysis study,[18] but not statistically significant in a short-term 4-week follow-up. Pathological nasal resistance, including nasal symptoms and parameters, were also found to be unreliable predictors of long-term adherence in a study conducted by Inoue A, *et al*.[11] Tokunaga T, *et al.*[19] reported an adherence rate of 89.0% in a long-term 2-year follow-up study in an otorhinolaryngological clinic in Japan which is comparable to our study. This is possible because patients were successfully treated at the beginning of the CPAP trial in accordance with the clinical guidelines issued by the American Academy of Sleep Medicine in 2006[20], which asserted that managing nasal pathologies during the CPAP therapy initiation phase is critical and may help ensure long-term adherence.

Furthermore, the high CPAP adherence could be a significant proportion of patients presented with concerns about their own disease, they demonstrated a high rate of CPAP acceptance and short-term adherence. As illustrated in studies conducted in China[21] and Singapore[8], patient perception and disease knowledge can impact CPAP acceptance and adherence. A sleep clinic places importance on the patient's perception of the disease, and all patients receive counseling and information about their condition and treatment options prior to making any decisions.

The majority of the study subjects were elderly males with obesity, which is consistent with the global prevalence of OSA. Male gender and a lower BMI were found in short-term CPAP adherence group; however, these factors had no effect on CPAP acceptance or long-term adherence. Similar to the findings in Tan B, *et al*.'s study [7], this literature discovered that a higher BMI is associated with less-than-optimal short-term CPAP adherence. Patient characteristics such as age, gender, obesity, neck circumference, and bed partner had no substantial effect on long-term adherence, which is consistent with McArdle N, *et al*.[22] Since the spouse or bed partner was a positive factor for CPAP acceptance, support persons during the early stages of CPAP utilization may play an important role in encouraging the patient to accept the PAP machine.

The severity of the disease is determined objectively by AHI, minimal oxygen saturation, and subjectively by ESS. Patients with a higher AHI and a lower mean nadir oxygen saturation demonstrated increased acceptance, but not adherence, to CPAP. The mean ESS scores or sleepiness symptoms had no impact on CPAP acceptance and adherence. These findings contrasted with those of Jacobsen AR, *et al*.[23] of Denmark, who found an adherence rate as high as 89.0% in patients with deteriorating polysomnographic results such as increased AHI, oxygen desaturation index, and ESS. According to Riachy M, *et al*.[24] studies in Lebanon, a higher

oxygen desaturation index at baseline was also associated with improved six-month CPAP adherence. One possible explanation for the discrepancy between our results and those of others is that the patients in our study were all of high severity. During the decision-making process, patients in our study with less severe OSA may choose another non-PAP therapy and reject CPAP.

In comparison to standard PAP devices, patients with better long-term adherence used APAP devices. The use of APAP and the normalization of the AHI following PAP treatment were associated with long-term adherence, but the results were inconclusive in the short-term period. According to Tokunaga T, *et al*.[19], improved AHI was one of the factors that contributed to a high rate of long-term 2-year adherence. This could be because APAP automatically adjusts its pressure in response to weight changes, which is especially important in patients with long interval follow-ups.

The type of mask interface can play a significant role in determining compliance with CPAP therapy. Almost all patients in our study preferred a nasal interface. Riachy M, *et al*. [24] reported that nasal masks had a higher rate of short-term adherence than other types of masks. Financial considerations may have an effect on CPAP acceptance. The PAP machine is relatively expensive, particularly for low-income patients. The majority of patients in our study were government employees whose PAP machines and interfaces were paid for by the government health care system. This may explain why our study had a high rate of CPAP acceptance, in contrast to other Southeast Asian countries[7, 8] where these devices are not supported by the health-care system.

While numerous studies have been conducted on CPAP acceptance and adherence, only a few have included more than a hundred patients or had an extensive follow-up period.[7,8] Our study enrolled more than 200 patients and included a 6-year follow-up period. Furthermore, this study evaluated CPAP adherence using data from the CPAP machine, which is more precise and does not overestimate adherence when compared to self-reported CPAP usage.

The findings in this research are subjected to several limitations. First, subjects were recruited from a single tertiary center, demonstrating high disease severity and representative of the urban population, thereby limiting generalizability. Second, due to mechanical constraints, the nasal assessment was conducted subjectively by a specialist who was unable to objectively report other nasal parameters. Third, the scoring criteria for polysomnograms may vary from year to year and some data on other sleep disorders may be missing due to the retrospective nature of this study. Finally, data on the patient-CPAP provider relationship, and symptomatic improvement following treatment, both of which may be factors in CPAP adherence, were not collected in this study.

Conclusion

The acceptance rate for CPAP was found to be 69.4%. Acceptance of CPAP is related to advanced age, having a bed companion, financial coverage for PAP machine, higher disease awareness, positional sleep apnea and higher disease severity. The short- and long-term adherence rates were both approximately 70.0%. Male gender, lower BMI, and a more favorable perception of the disease were all observed in the short-term CPAP adherence group. Patients used APAP and AHI was normalized after CPAP utilization was found in the long-term CPAP adherence group.

Conflict of interest statement

Each of the authors has completed an ICMJE disclosure form. None of the authors declare any potential or actual relationship, activity, or interest related to the content of this article.

Data sharing statement

The present review is based on the reference cited. Further details, opinions, and interpretation are available from the corresponding authors on reasonable request.

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