ORIGINAL ARTICLE

Correlation of Therapeutic Pressure between Home Automatic Positive Airway Pressure and in Laboratory Polysomnography Manual Titration in Patients with Obstructive Sleep Apnea

Apiwat Pugongchai, MSc[1,2], Kanyada Leelasittikul, MSc[1,2], Narongkorn Saiphoklang, MD[1,2,3]

[1] Medical Diagnostics Unit, Thammasat University Hospital, Pathum Thani, Thailand; [2] Sleep Center of Thammasat, Thammasat University Hospital, Pathum Thani, Thailand; [3] Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Faculty of Medicine, Thammasat University, Pathum Thani, Thailand

Background: Continuous positive airway pressure (CPAP) is an effective treatment for obstructive sleep apnea (OSA). Automatic positive airway pressure (APAP) used at home may serve as an alternative method to determine the optimal pressure for patients requiring CPAP treatment. However, data on the association between effective treatment pressure obtained from laboratory polysomnography (in-lab PSG) and home-based APAP are limited.

Objective: To determine the correlation between effective CPAP pressure derived from in-lab PSG and home APAP.

Materials and Methods: A prospective cohort study was conducted among adults (18 years and older) diagnosed with OSA who required CPAP therapy. Patients underwent in-lab PSG with manual CPAP titration to determine the effective treatment pressure, followed by home APAP use for two weeks to identify the 95th percentile pressure as the effective pressure.

Results: Fifty OSA patients (82% male) were included. The mean age was 48.9±14.6 years, and the mean body mass index was 28.7±6.1 kg/m^2. Polysomnographic data showed an effective treatment pressure of 10.4±2.9 cmH_2O, and an apnea-hypopnea index was 55.1±29.0 events per hour, with 76% classified as severe OSA. Home APAP data demonstrated an effective treatment pressure of 10.8±1.8 cmH_2O. There was a positive correlation between effective pressure obtained from home APAP and in-lab PSG (r=0.472, p=0.001). The predictive equation for in-lab effective pressure was predicted pressure (cmH_2O) = 2 + (0.78 × home APAP pressure). Bland-Altman analysis showed good agreement between the two methods, with a mean difference of –0.428 cmH_2O and 96% of data points within the limits of agreement.

Conclusion: Home APAP pressure was moderately positively correlated with in-lab PSG effective pressure. The accuracy of home APAP showed good agreement with in-lab manual CPAP titration, suggesting that home APAP may be a feasible alternative for determining effective therapeutic pressure in OSA treatment.

Keywords: APAP; Automatic positive airway pressure; Continuous positive airway pressure; CPAP; Obstructive sleep apnea; OSA

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Obstructive sleep apnea (OSA) is a condition caused by obstruction of the upper airway during sleep. It can occur at any age, but the incidence is highest in middle-aged individuals. This disease is more prevalent in males than females[1,2]. The main risk factor is obesity, which is found in 70% of OSA patients[2]. Common symptoms include snoring, gasping during sleep, excessive daytime sleepiness, and lack of concentration while working. Diagnosis of OSA relies on the patient's medical history, symptoms, and risk assessment using sleep questionnaire. Polysomnography (PSG), also known as a sleep test, is the standard tool for diagnosing OSA[3].

Continuous positive airway pressure (CPAP) is a standard and most effective treatment for moderate to severe OSA[2,4,5]. CPAP delivers air pressure through a mask into the airway to keep it open during sleep to prevent apnea[4,5]. There are two CPAP systems: 1) fixed (manual)-CPAP, and 2) automatic positive airway pressure (APAP). Fixed-pressure CPAP provides constant optimal pressure determined by a

Correspondence to:

Saiphoklang N.

Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Faculty of Medicine, Thammasat University, 99/209 Paholyotin Road, Klong Luang, Pathum Thani 12120, Thailand.

Phone & Fax: +66-2-9269793

Email: m_narongkorn@hotmail.com

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full night in-laboratory CPAP titration (in-lab PSG) or a split-night in-lab PSG. APAP provides variable pressure levels that are automatically adjusted according to the patient's condition, such as airflow resistance, body position, and nasal congestion. APAP can improve compliance and reduce daytime sleepiness more effectively than fixed CPAP[4]. Some previous studies found no significant difference between fixed pressure derived from 90th to 95th percentile pressure from APAP versus fixed pressure derived from in-lab CPAP titration[6-12], whereas others reported significant differences[13-20]. CPAP pressure titrated in-lab by an automatic device is often higher than that determined manually[16,18-20]. The evidence remains conflicting and inconclusive. Importantly, home APAP titration is more cost-effective than manual in-laboratory titration for determining optimal long-term CPAP pressure[9]. Therefore, the aim of this study was to evaluate the correlation between the effective CPAP pressure obtained from in-lab PSG and home APAP titration in Thai patients with OSA.

Materials and Methods

Study design and participants

A prospective cohort study was conducted in Thammasat University Hospital, Thailand, between April 2021 and January 2022. Subjects aged 18 years or older with suspected OSA who underwent split-night PSG were included. Exclusion criteria included congestive heart failure, myocardial infarction, obesity hypoventilation syndrome, chronic obstructive pulmonary disease, stroke, claustrophobia, tracheostomy, uncontrolled psychiatric disorders, and residual apnea-hypopnea index (AHI) of five or more events per hour during in-lab CPAP titration.

Demographic data [age, sex, height, weight, body mass index, neck circumference, Epworth sleepiness scale (ESS), and comorbidities] and in-lab PSG data (AHI, lowest oxygen saturation, 3% oxygen desaturation index, optimal CPAP pressure, and residual AHI after optimal CPAP trial) were recorded. Additionally, home APAP data, the 95th percentile pressure, residual AHI after APAP use, and duration of APAP use, were recorded.

Ethical approval was obtained from the Human Research Ethics Committee of Thammasat University (Medicine), Thailand (IRB No. MTU-EC-OO-6-087/63, COA No.142/2020). The study was conducted in full compliance with international guidelines, including the Declaration of Helsinki, the Belmont Report, CIOMS Guidelines, and the International Conference on Harmonization - Good Clinical Practice (ICH-GCP). All participants provided written informed consent.

CPAP manual titration during laboratory PSG

All subjects underwent split-night PSG using Compumedics Profusion® Sleep Software (Compumedics, Ltd., Victoria, Australia). Titration and scoring procedures followed the American Academy of Sleep Medicine guideline version 2.6[21,22]. PSG data were manually scored by a certified sleep technician and were reviewed and verified by a certified sleep specialist. CPAP titration was performed to determine the pressure needed to reduce the AHI to less than five events per hour and achieve at least 15 minutes of supine rapid eye movement (REM) sleep. Manual CPAP titration was conducted using Resmed Lumis® 150 VPAP ST-A (Resmed, Sydney, Australia) under full PSG monitoring, including electroencephalogram, electrooculogram, submental electromyogram, airflow (thermistor), snoring, body position, thoracic and abdominal movements, and oxygen saturation. CPAP began at 4 cmH_2O and gradually increased by 1 cmH_2O steps every 10 minutes until apnea-hypopnea events were eliminated. Optimal pressure, residual AHI, and all PSG data were recorded.

Home APAP titration

All subjects used Resmed AirStart® 10 APAP (Resmed, Sydney, Australia) for two weeks within three months after split-night PSG. APAP data were downloaded using ResScan® Software, version 5.9.0.9629 (Resmed, Sydney, Australia). The effective APAP pressure was defined as the 95th percentile of the recorded pressure. Effective pressure, residual AHI, and all APAP data were recorded. Good APAP compliance was defined as usage of four hours or more per night on 70% or more of nights[23].

Statistical analysis

Based on a previous study(16), the optimal CPAP pressure determined by in-lab APAP titration in OSA patients was 9.8±2.2 cmH_2O, whereas the optimal CPAP pressure determined by in-lab manual CPAP titration was 7.3±1.5 cmH_2O. The authors hypothesized that the two titration methods in this study study would yield similar optimal pressures. Thus, a sample size of 34 participants provided 90% power with 5% type I error.

Categorical data was presented as number (%). Continuous data was presented as mean ± standard deviation (SD) or median (interquartile range, IQR).

Student's t-test was used to compare continuous variables between in-lab PSG and home APAP groups. Pearson's correlation was used to determine the relationship between optimal pressure from the two groups and to develop a predictive equation for the optimal in-lab PSG pressure, Bland-Altman plots were used to assess agreement between the pressures obtained from in-lab PSG and home APAP. The 95% limits of agreement, representing the range where 95% of the future differences between the two methods would be expected, were calculated. Proportional bias was assessed by performing linear regression between the difference of the two measures and their mean. Two-tailed p-values of less than 0.05 were considered statistically significant. All analyses were performed using IBM SPSS Statistics, version 26.0 (IBM Corp., Armonk, NY, USA).

Results

Fifty OSA subjects were included. The mean age was 48.9±14.6 years, and 82% were male. The mean body mass index was 28.7±6.1 kg/m², and the mean ESS score was 8.7±4.7. The most common comorbidities were hypertension (40%), dyslipidemia (44%), and allergic rhinitis (36%). PSG data showed a mean AHI of 55.1±29.0 events per hour, an optimal CPAP pressure of 10.4±2.9 cmH_2O, and a residual AHI of 1.6±1.5 events per hour. Seventy-six percent of patients had severe OSA. The effective pressure of home APAP was 10.8±1.8 cmH_2O, residual AHI was 1.5±1.0 events per hour, and good APAP compliance was 58% (Table 1). There were no significant differences in optimal pressure or residual AHI between in-lab PSG and home APAP groups (Table 2).

In all patients, including those with severe OSA, the optimal pressure obtained by in-lab PSG showed a significant moderate positive correlation with the effective pressure obtained by the home APAP (Table 3). The predictive equation for optimal in-lab PSG pressure was predicted pressure (cmH_2O) = 2 + (0.78 × home APAP derived effective pressure) (Figure 1). The Bland-Altman analysis comparing pressures from in-lab PSG and home APAP showed very good agreement, with a mean difference of –0.428 cmH_2O (95% CI –5.548 to 4.692 cmH_2O). Only two out of 50 measurements (4%) were outliers, while 96% were within the limits of agreement (Figure 2). However, a proportional bias was detected (B=0.648, p<0.001).

Furthermore, both overall and severe OSA patients with good APAP compliance showed higher positive correlation than those without good compliance (Table 3). In patients with severe

Table 1. Baseline characteristics of patients with obstructive sleep apnea

Characteristics	Data (n=50)
Age (years); mean±SD	48.9±14.6
Male; n (%)	41 (82)
BMI (kg/m²); mean±SD	28.7±6.1
Neck circumference (cm); mean±SD	39.3±4.4
ESS (points); mean±SD	8.7±4.7
Comorbidity; n (%)	
Hypertension	20 (40)
Dyslipidemia	22 (44)
Allergic rhinitis	18 (36)
Heart disease	5 (10)
Diabetes	9 (18)
Obesity	9 (18)
COPD	1 (2)
Stroke	1 (2)
Polysomnographic data; mean±SD	
Total sleep time (minutes)	378.0±59.6
Sleep efficiency (%)	77.5±13.4
AHI (events/hour)	55.1±29.0
Lowest SpO_2 (%)	80.7±10.7
3% ODI (events/hour)	9.3±8.7
Optimal CPAP pressure (cmH_2O)	10.4±2.9
Residual AHI after optimal CPAP trial (events/hour)	1.6±1.5
OSA severity; n (%)	
Mild	2 (4)
Moderate	10 (20)
Severe	38 (76)
Home APAP titration data; mean±SD	
95th percentile pressure (cmH_2O)	10.8±1.8
Residual AHI after optimal CPAP use (events/hour)	1.5±1.0
95th percentile mask leak (L/minute)	22.7±13.3
CPAP use (hours/night)	4.7±1.9
Good compliance; n (%)	29 (58)

AHI=apnea-hypopnea index; APAP=automatic positive airway pressure; BMI=body mass index; COPD=chronic obstructive pulmonary disease; CPAP=continuous positive airway pressure; ESS=Epworth sleepiness scale; ODI=oxygen desaturation index; OSA=obstructive sleep apnea; SD=standard deviation; SpO_2=peripheral oxygen saturation

Table 2. Comparison of optimal pressure and residual AHI obtained from in-lab PSG and home APAP in patients with obstructive sleep apnea

Parameters	In-lab PSG mean±SD	Home APAP mean±SD	p-value
Pressure (cmH_2O)	10.4±2.9	10.8±1.8	0.252
Residual AHI (events/hour)	1.6±1.5	1.5±1.0	0.457

AHI=apnea-hypopnea index; APAP=automatic positive airway pressure; PSG=polysomnography; SD=standard deviation

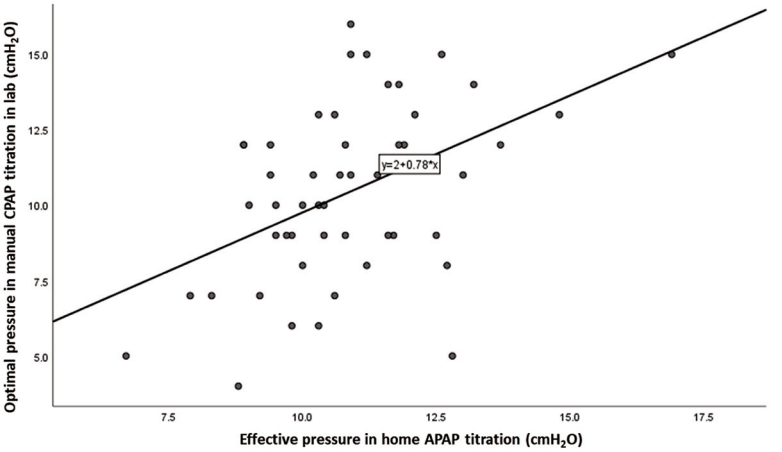

Figure 1. Correlation of optimal pressure between manual continuous positive airway pressure (CPAP) titration in the lab and home automatic positive airway pressure (APAP) titration in patients with obstructive sleep apnea. The equation for predicting an in-lab effective pressure is predicted pressure (cmH_2O) = 2 + (0.78 × home APAP derived effective pressure).

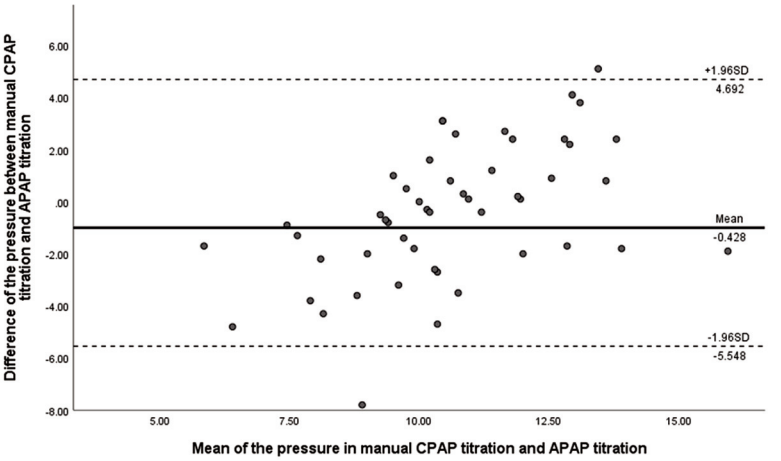

Figure 2. The Bland-Altman plot represents the difference in optimal pressure between manual continuous positive airway pressure (CPAP) titration in the lab and home automatic positive airway pressure (APAP) titration in patients with obstructive sleep apnea. The continuous line indicates the mean difference of optimal pressure between CPAP titration in the lab and home APAP titration (−0.428 cmH_2O), while the dotted lines indicate 95% confidence intervals (−5.548 to 4.692 cmH_2O).

SD=standard deviation

OSA, the predictive equation for optimal pressure was in-lab PSG (cmH_2O) = 4.28 + (0.64 × home APAP derived effective pressure) (Figure 3). In OSA patients with good compliance, the predictive equation was in-lab PSG (cmH_2O) = 1.49 + (0.83 × home APAP derived effective pressure) (Figure 4). Moreover, patients with moderate to severe OSA showed a significantly positive correlation between the optimal pressure obtained from in-lab PSG and home APAP (r=0.406, p=0.004) (Table 3).

Discussion

This is the first study to determine the relationship between optimal CPAP pressure obtained from in-laboratory pressure titration and home APAP in Thai patients with OSA. These results demonstrated a moderate positive correlation and acceptable agreement between the two titration methods, particularly among patients with severe OSA who had good APAP compliance. The mean difference in optimal pressure between the two methods was only 0.4 cmH_2O.

CPAP is a standard and most effective treatment for OSA[2,4]. Conventionally, the optimal pressure for treating OSA is determined through a standard PSG with manual CPAP titration in a sleep laboratory,

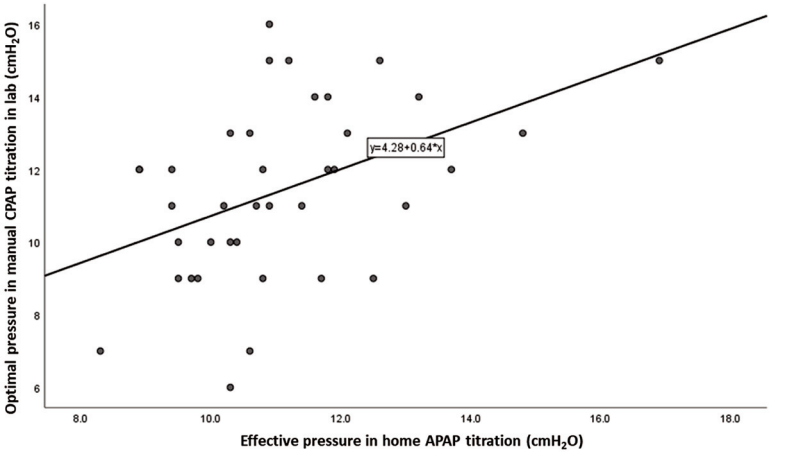

Figure 3. Correlation of optimal pressure between manual continuous positive airway pressure (CPAP) titration in the lab and home automatic positive airway pressure (APAP) titration in patients with severe obstructive sleep apnea (OSA). The equation for predicting an in-lab effective pressure is predicted pressure (cmH_2O) = 4.28 + (0.64 × home APAP pressure).

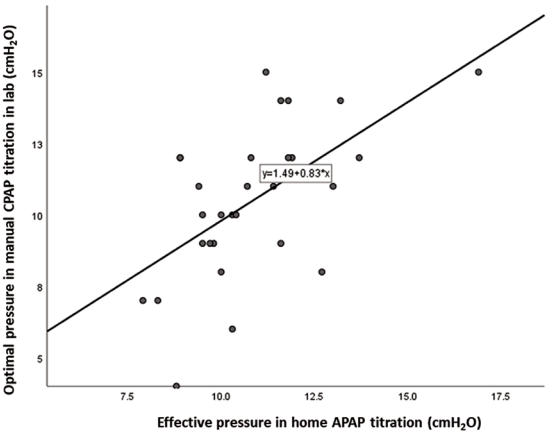

Figure 4. Correlation of optimal pressure between manual continuous positive airway pressure (CPAP) titration in the lab and home automatic positive airway pressure (APAP) titration in obstructive sleep apnea (OSA) patients with good compliance. The equation for predicting an in-lab effective pressure is predicted pressure (cmH_2O) = 1.49 + (0.83 × home APAP pressure).

Table 3. Correlation of optimal pressure between in-lab PSG and home APAP in patients with obstructive sleep apnea

Patients	Data (n=50) n (%)	Correlation coefficient	p-value
All	50 (100)	0.472	0.001
Good compliance	29 (58)	0.586	0.001
Poor compliance	21 (42)	0.340	0.132
Severe OSA	38 (76)	0.452	0.004
Good compliance	24 (48)	0.615	0.001
Poor compliance	14 (28)	0.116	0.693
Moderate to severe OSA	48 (96.0)	0.406	0.004
Good compliance	29 (58)	0.586	0.001
Poor compliance	19 (38)	0.098	0.689
Non-severe OSA	12 (24)	0.257	0.420
Good compliance	5 (10)	0.614	0.271
Poor compliance	7 (14)	0.015	0.975

APAP=automatic positive airway pressure, OSA=obstructive sleep apnea, PSG=polysomnography

either during a split-night PSG or full-night study. The latter is often performed as a follow-up if the optimal pressure cannot be determined in the initial study[3]. However, this approach is time-consuming and costly. Automatic titration, on the other hand, has been recommended as an alternative method for identifying the appropriate CPAP pressure in clinical practice, providing comparable outcomes with less time and lower cost[24]. Automatic titration has been shown to be as effective as manual titration in improving AHI and daytime sleepiness, with no significant difference in treatment acceptance or compliance[24]. Therefore, automatic titration represents a practical alternative for determining optimal therapeutic pressure.

In this study, the authors hypothesized that the difference in optimal pressure between home APAP and in-lab PSG titration would not exceed 2 cmH_2O. The findings confirmed this assumption, revealing an average pressure difference of 0.4 cmH_2O and a moderate positive correlation (r=0.47) between the two methods. These results align with previous studies by Elshahaat et al.[6] and Wongsritrang et al.[18], which reported weak to strong positive correlations between in-lab PSG and home APAP pressures, with differences ranging from 0.25 to 3.5 cmH_2O.

As the difference in optimal pressure between methods increases, the strength of correlation tends to decrease. However, variations in sleep position and sleep stages between home and laboratory environments may affect the titration results. The optimal pressure determined during in-lab PSG aims to maintain an AHI of less than five events per hour with at least 15 minutes of REM sleep in the supine position[22]. These controlled conditions differ from the more natural and variable sleep patterns that occur during home APAP use, potentially explaining minor discrepancies between the two methods.

Most participants (76%) in this study had severe OSA, while moderate and mild OSA accounted for 20% and 4%, respectively. Among patients with severe OSA, there was a significant moderate positive correlation (r=0.45) between pressures from home APAP and in-lab PSG titration. No significant correlation was found in patients with mild to moderate OSA, due to the small sample size in these subgroups.

Among patients with good APAP compliance (58% of all subjects), there was a significant moderate positive correlation between the home APAP pressure and the pressure obtained during in-lab PSG titration (r=0.586). In contrast, no significant correlation was observed among patients with poor compliance. Furthermore, in severe OSA patients with good compliance, the correlation was slightly stronger (r=0.615). These findings suggest that consistent APAP use enhances the reliability of home titration, yielding results closer to those obtained from in-lab PSG, particularly in severe OSA cases. As a strong correlation was observed only in patients with good compliance, inaccurate pressure delivery by APAP may contribute to poor compliance.

Previous studies have shown that effective pressures determined by APAP and in-lab manual titration often do not differ significantly[4,6-12,18,19,25]. However, some studies have reported discrepancies between the two methods[14-17]. For instance, one study found that APAP-derived pressures were approximately 2.5 cmH_2O higher than those determined by manual titration[16], whereas others reported the opposite trend[14,17].

With regard to compliance, some studies have indicated that APAP use is associated with slightly better adherence compared with manual CPAP[4,12,25], with an average increase of about 11 minutes per night[4,12]. Fietze et al. also reported that APAP was used approximately 48 minutes longer than manual CPAP[10]. However, several studies found no significant differences in compliance between the two systems[10,12,14,15,26].

Clinical outcomes, including quality of life and daytime sleepiness, did not differ significantly between APAP and manual CPAP users[10,12,14,17,18]. The initial use of APAP, however, has been reported to improve sleep quality[10]. Although APAP devices are generally more expensive than manual CPAP machines, the overall cost-effectiveness of APAP is favorable, as it reduces the need for in-lab titration and associated expenses[6,8,9,27,28].

This study has limitations. First, the sample size was small, although it was sufficient to demonstrate a statistically significant correlation between the two titration methods. Second, only one commercial CPAP model was evaluated; therefore, the findings may not be generalized to other devices. Third, predictors of a strong correlation between the 95th percentile pressure and in-lab titration pressure, such as positional-related OSA, were not investigated; thus, this study could not identify factors associated with agreement between the two methods. Finally, potential factors associated with the predictive equation for optimal in-lab pressure, such as body mass index and AHI, were not evaluated and may have acted as confounders in this study. Future studies with larger sample sizes and multiple CPAP brands are needed to confirm these results. Additionally, the predictive equation for in-lab PSG pressure derived from home APAP data should be validated in an independent cohort.

Conclusion

Home APAP pressure showed a moderate positive correlation with in-lab PSG effective pressure. The optimal pressures obtained from home APAP were consistent with those from in-lab PSG manual titration. These findings suggest that APAP may serve as a practical tool for determining effective therapeutic pressure in OSA treatment, potentially reducing the need for in-lab titration.

A larger prospective study is warranted to validate the accuracy of home APAP-derived pressures and to refine the predictive equation for estimating in-lab PSG effective pressure.

What is already known about this topic?

OSA is a common disorder characterized by recurrent upper airway obstruction during sleep. CPAP is the standard and most effective treatment, with optimal pressure typically determined by in-laboratory PSG. APAP offers an alternative home-

based method for pressure titration, though previous studies have reported inconsistent findings regarding its equivalence to manual in-lab titration.

What does this study add?

This study demonstrates that home APAP titration shows a moderate positive correlation and good agreement with in-laboratory manual CPAP titration in OSA patients. The difference in optimal treatment pressure between the two methods was minimal at 0.4 cmH_2O, particularly among patients with severe OSA and good APAP compliance. These findings suggest that home APAP titration can be a practical and cost-effective alternative to in-lab PSG for determining optimal therapeutic pressure in OSA management.

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Authors' contributions

Conceptualization, all authors; Methodology, all authors; Software, NS; Validation, NS; Formal analysis, AP and NS; Investigation, AP and KL; Resources, all authors; Data curation, NS; writing-original draft preparation, AP and NS; writing-review and editing, all authors; Visualization, AP and NS; Supervision, NS; Project administration, AP and KL; Funding acquisition, AP. All authors have read and agreed to the published version of the manuscript.

Data availability statement

Data is contained within the article.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Human Research Ethics Committee of Thammasat University No. 1 (Faculty of Medicine) (IRB No. MTU-EC-OO-6-087/63; COA No. 142/2020; date of approval: July 2, 2020). All participants provided written informed consent.

Clinical trial registration

This study was registered at the Thai Clinical Trials Registry, TCTR20210331002.

Use of artificial intelligence

ChatGPT (OpenAI, October 2025 version) was used to improve the readability and language of the revised manuscript.

Funding disclosure

The financial support was provided by Thammasat University Hospital, Thailand.

Conflicts of interest

The authors declare no conflicts of interest.

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