The impact of national health insurance on the compliance of positive airway pressure therapy in patients with obstructive sleep apnea

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Highlights:

• This study aimed to assess the NHI effect on PAP compliance in patients with OSA.

• Automatic adjusting mode and NHI were independent predictors of PAP compliance.

• The NHI group showed significantly higher compliance at 1 and 3, but not 9 months.

• The NHI group showed higher adherence rate and lesser follow up loss for 9 months.

• NHI has positively affected PAP therapy in patients with OSA.

Abstract

Objectives

Compliance with positive airway pressure (PAP) in patients with obstructive sleep apnea (OSA) directly affects its treatment efficacy. Since July 2018, polysomnography and PAP therapy have been covered by the national health insurance (NHI), which has reduced the price barrier and promoted PAP therapy in Korea. This study aimed to compare changes in PAP compliance before and after NHI implementation.

Methods

This study is a retrospective analysis in a tertiary hospital setting in Korea. From 2011 to 2019, patients with OSA (apnea-hypopnea index≥5) treated using a PAP device for ≥ 1 month were included. They were allocated to the pre-insurance (PI) (having started PAP before July 2018) and
NHI groups (having received a PAP reimbursement by the NHI service). We collected and analyzed medical records and PAP use information for between-group comparisons of compliance. We defined compliance as (A) percentage of usage days, (B) percentage of days with usage for ≥ 4 night hours, and (C) average daily usage hours.

Results

We included 146 and 100 patients in the PI and NHI groups, respectively. Automatic positive airway pressure (APAP) mode and NHI were independent predictors of compliance B at the 3- and 9-month follow-up points. The NHI group showed significantly higher compliance A at 3, but not 9 months. For compliance B, the NHI group showed significantly higher compliance than the PI group at 1 month and 3 months, but not at 9 months. Compared with the PI group, the NHI group showed significantly higher compliance C only at 3 months.

Conclusions

The NHI has positively affected PAP therapy in patients with OSA. Insurance policy may affect compliance within the first 3 months.

Key Words: National health insurance; Positive airway pressure; Compliance; Obstructive sleep apnea
Introduction

Since positive airway pressure (PAP) was first introduced in the 1980s, it has become the most effective treatment for patients with moderate to severe obstructive sleep apnea (OSA) [1]. PAP maintains upper airway patency by acting as a pneumatic splint during sleep, which reduces the respiratory events and improves outcomes, including daytime sleepiness, cognitive performance, blood pressure, glucose control, cardiovascular status, quality of life, and mortality [2-5]. For these effects to have benefit, the PAP device should be regularly used [6-7]. The widely recognized definition of good compliance to PAP therapy is PAP device usage for an average of 4 hours per night for ≥ 70% of the monitoring days [7]. Cost-related issues are significant barriers to PAP compliance that is directly affected by the national deduction system applied to PAP therapy [8-10]. Before July 2018, patients with OSA requiring PAP therapy had to purchase or rent the PAP device at their own expense. Since July 2018, a national health insurance (NHI) coverage for polysomnography (PSG) and PAP was introduced in Korea. Specifically, patients who meet the specific criteria in terms of the apnea-hypopnea index (AHI), as well as comorbidities related to sleep apnea, have their PAP rental fee reimbursed by the NHI. Previously, the PAP rental fee was approximately 330,000 won ($292) a month; however, with insurance coverage, it has dropped to between 15,200 ($13) and 25,200 won ($21). According to the insurance policy, the PAP prescription can be extended only when a patient shows good compliance (≥ 21 days of device usage for a minimum of 4 hours per night for 30 consecutive days) during the first 90 days. Since
the prescription is available for up to 6 months, patients with OSA are required to visit the hospital and meet a doctor at least once every 6 months to maintain the reimbursement.

Between 2006 and 2018, the PAP compliance in Korea ranged from 20% to 60%, which indicated a 'non-adherent' level [11-14]. With the introduction of the NHI for PAP therapy, reduction of costs for PAP devices, as well as the increased need for regular hospital visits, PAP compliance in Korea is expected to increase.

This study aimed to evaluate the effect of the NHI for PAP therapy on PAP compliance in Korea. This offers a good opportunity to discuss whether the current NHI policy is adequately supporting patients with OSA with PAP therapy.

Materials and Methods

We retrospectively reviewed the medical records of adult patients (≥ 18-years-old) diagnosed with OSA who had started PAP treatment for ≥ 1 month at the Asan Medical Center between January 2011 and September 2019. OSA was diagnosed using a full-night attended in-laboratory PSG. The PSG settings included continuous recording of the electroencephalogram, electrooculogram, electromyogram of the mentalis and anterior tibialis, electrocardiogram, thoracic-abdominal motion, oronasal thermistor, nasal pressure transducer, oxygen saturation and body position. The results of all data were analyzed by a trained technician using a high resolution monitor and were confirmed by a physician who is belong to sleep laboratory. The diagnosis of OSA was confirmed
if the AHI ≥ 5 in a patient with one or more symptoms of OSA (snoring, sleep apnea, daytime sleepiness, nonrestorative sleep, fatigue, or insomnia) or with comorbidities such as hypertension, type 2 diabetes mellitus, stroke, congestive heart failure, atrial fibrillation, coronary artery disease, mood disorder, or cognitive dysfunction. Patients with an AHI ≥ 15 were also diagnosed OSA regardless of the presence of associated symptoms or comorbidities. We excluded patients with a history of sleep surgery or previous PAP usage. Consequently, 246 patients were included and classified into the pre-insurance (PI) group (patients who started PAP at their own expense before July 2018) and the NHI group (patients who were offered PAP reimbursement by the NHI service). All patients in the PI group purchased the PAP devices from their out-of-pocket expenses from the start of PAP therapy. Patients in both PI and NHI groups could choose which company’s model to use at their own discretion, among ResMed, Philips, and Fisher & Paykel. The mode of device was selected as per the following process: If the in-laboratory manual PAP titration was successfully performed, both the fixed-pressure continuous PAP (CPAP) mode and the APAP mode were offered based on the titration results for more than ten consecutive days each, during the first month. The mode that achieved better compliance was selected for long-term prescription. If the compliance result was similar, the mode was chosen by the patients. If manual titration failed or was delayed, the APAP wide range was prescribed from the beginning and the pressure level was gradually adjusted based on the 90th or 95th percentile pressure recorded on the usage report. Given the rapid increase in the number of patients with sleep apnea from July 2018, there was a delay in the waiting time for the in-laboratory PAP titration. Furthermore, there was a time limitation for PAP
therapy as the therapy needed to be started within 1 year of the PSG in order for the costs to be covered by the NHI. Therefore, we occasionally prescribed APAP without titration in the NHI group. We evaluated baseline data, including demographic characteristics, comorbidities, Epworth sleepiness scores [15], titration results, PSG measurements, and mode of the device determined at the first month (CPAP or APAP). Data regarding usage, including 90th or 95th percentile pressure, residual AHI, and usage hours were obtained from the device at 1, 3, and 9 months after starting the PAP therapy. This study defined PAP compliance as A (percentage of used days over the monitoring days), B (percentage of days used for ≥ 4 night hours over the monitoring days), and C (average hours of daily usage). Between-group comparisons of compliance were performed at three follow-up time points (1, 3, and 9 months). Since the pressure changed several times during the first month, we could not determine the reliable average usage time. Statistical analyses were performed using STATA 14.0 (Stata Corporation, College Station, TX, USA). Between-group differences in categorical and continuous variables were performed using the Chi-square test and a two-sample independent t-test, respectively. A multivariate logistic regression analysis with stepwise selection of covariates was used to identify factors independently associated with compliance B, as the compliance B indicates the standard definition of PAP adherence. Confounding factors were adjusted using multivariate linear regression analysis for between-group comparison of the compliance. This study was approved by the Asan Medical Center Institutional Review Board (IRB No. 2020-0007).
Results

This study included 246 patients with OSA (146 and 100 patients in the PI and NHI groups, respectively). There were no significant between-group differences in all baseline characteristics except in the PAP titration rate (proportion of patients who underwent in-laboratory titration over the total patients in each group) (Table 1). Table 2 shows differences between the adherent group (compliance B ≥ 70) and the non-adherent group (compliance B < 70 or lost to follow-up). Patients in the adherent group were significantly older (p=0.003) and had a significantly higher proportion of those using the APAP mode and NHI than those in the non-adherent group at both 3 and 9 months (all P < 0.001). There were significantly more patients with hypertension in the adherent group at 3 months, but no significant difference was found at 9 months. The proportion of patients who underwent overnight in-laboratory manual titration was significantly higher in the non-adherent group at both 3 and 9 months. Univariate analysis showed that PAP compliance (compliance B) for the first 3 months was associated with age, hypertension, PAP titration, APAP mode, and NHI. Subsequent multivariate analysis showed that APAP mode (P = 0.009) and NHI (P < 0.001) were the significant factors for compliance B (Table 3). Regarding the next 6 months, when the compliance was evaluated at the 9 months' follow-up point, univariate and multivariate analysis showed that sex (P = 0.029), APAP mode (P = 0.005), and NHI (P = 0.015) were independent predictors of compliance B (Table 3). Table 4 shows the compliance of both groups analyzed with adjustment for confounding factors. At all three time points, the NIH group showed higher compliance than the PI group. For compliance A, the NHI group showed a significantly
higher compliance at 3 months \( (P = 0.002) \). Further, there was a significant between-group difference in compliance B at 1 month \( (P = 0.004) \) and 3 months \( (P < 0.001) \), but not at 9 months. For compliance C, the 3-month compliance was significantly higher in the NHI group \( (P < 0.001) \); however, there was no between-group difference at 9 months. The proportion of follow-up and adherent patients is shown in Figure 1. Both groups showed a progressively decreasing number of follow-up patients, but the number of patients lost to follow-up in the NHI group (18%) was lower than that in the PI group (34%). The proportion of adherent patients was obtained by the proportion of those with a compliance B level of \( \geq 70 \). At 9 months, the adherence rate in the NHI group dropped to 47%, which was more than double that in the PI group (22%).

**Discussion**

With the implementation of NHI on PSG and PAP therapy, there has been a significant increase in public awareness of sleep apnea disease. According to the data from the Korean National Health Insurance Service, the number of patients undergoing PSG has almost tripled from 2,600 in July 2018 to 6,205 in May 2019. The reduction of the personal economic burden by insurance coverage has led to more patients opting for PAP therapy. However, with the increase in demand by patients with sleep apnea, the financial burden of NHI has increased. Therefore, there is a need to determine whether and how the NHI has significantly affected PAP therapy. Our findings indicate that the NHI has positively influenced the PAP use pattern. At 3 months, the NHI group showed significantly higher compliance A and B than the PI group. This indicates that the NHI group used
the PAP device more often and efficiently than the PI group. However, there was no significant
between-group difference in all compliance terms (A, B, and C) at 9 months. The fact that the
current insurance policy requires good compliance performance only for the first 90 days to
maintain the reimbursement on PAP therapy might explain the difference between the 3- and 9-
month results. Therefore, the insurance policy itself, in addition to the cost reduction benefit,
appears to increase PAP compliance during the first 3 months. The Centers for Medicare and
Medicaid Services (CMS) of the United States of America, which have provided reimbursement for
PAP since 2008, also evaluates the compliance for the first 3 months in anticipation of long-term
PAP usage and benefits. However, it has been argued that the CMS criteria for early compliance
can limit the benefit of PAP therapy in patients who might become adherent after 3 months.
According to a study by Naik et al., of the 23 initially non-adherent (using CMS criteria)
participants, 7 participants (30.4%) became adherent during the remainder of the year, which
indicates that the PAP nonadherence during the first 3 months was predictive for further
nonadherence in only 69.6% cases [16].
Notably, we found that the NHI group maintained a good compliance level of 70% at 9 months,
which corresponds to a good compliance level. This level is higher than that reported by previous
Korean studies as well as the PI group in this study [11-14]. There was no significant between-
group difference in compliance B at 9 months (P = 0.085); however, this study had a small sample
size and larger sample sizes might yield significant findings. Moreover, since initial PAP use has
been shown to predict PAP compliance for up to 1 year [17-18], the high compliance during the
first 3 months could have led to increased compliance for the subsequent ≥ 6 months. Consistent
with our findings, a long-term prospective study by Billings et al. reported a higher initial
adherence with the CMS policy than with the clinic-only policy. Specifically, the CMS policy had an
11% higher adherence rate than the control group after 5 years [19].

Another notable finding is the decrease and increase in the proportion of patients lost to follow
up and maintaining good compliance, respectively, after NHI implementation. The insurance policy
dictates that patients must visit the outpatient clinic within every six months to renew the PAP
prescription. This regular follow-up allows doctors to encourage patients to discuss their difficulties
with using PAP, improve the patients’ willingness to use the device through repeated education,
and to control the PAP pressure to precisely match the patients’ condition [20-21].

In addition to NHI, APAP mode was shown to be a significant predictor of compliance by
multivariate analysis. As more patients in the NHI group used the APAP mode to adjust the
pressure instead of conducting a titration, the NHI group showed an increase in the proportion of
patients who continued to use APAP mode. The efficacy, acceptance, and compliance of APAP
compared with those of CPAP remain unclear; however, several studies have indicated that patients
tend to prefer the APAP mode [22-23]. As reported by Winfried et al., we assume that the pressure
flexibility allowed by the APAP mode provides comfort to the patients, which increases acceptance
and compliance [24].

According to previous studies on comorbidities and long-term compliance, hypertension is not an
important predictor of long-term compliance, however, recently, Rafael et al. reported that
hypertension is closely related to the prediction of compliance at 1-3 months [25-27]. Our study confirmed these findings by between-group comparison and multivariate analysis. The effect of in-laboratory manual titration is controversial, with some studies showing reduced PAP use without titration [28], while others reported no difference in the titration rate between the compliant and non-compliant groups [29]. Unlike previous reports, the titration rate was slightly lower in the adherent group in this study. This finding could reflect the fact that the proportion of patients without titration in the NHI group was higher than that in the PI group, not meaning that titration itself had a negative effect on compliance. This was confirmed by our results, which showed that titration was not a significant predictor of PAP compliance when controlling for other factors such as NHI and the PAP mode.

This study has several limitations. First, the short follow-up period could not yield a large sample size and long-term compliance results. Specifically, the study period (data collection) was < 2 years after NHI implementation on PAP; therefore, a 9-month follow-up period was the longest period that could be studied. Second, we did not collect socioeconomic data, including income level, employment status, and education, which could affect compliance [30]. Third, since this study was only conducted in a tertiary center, our findings could be affected by referral bias and the retrospective design of this study implies a risk of selection bias. Finally, the generalizability of the results is also limited, since the findings may apply only to Korea.

Nevertheless, this is the first study to investigate the influence of NHI on PAP therapy in Korea. There is a need for future prospective multicenter studies to verify the long-term efficacy of NHI
Conclusions

The NHI policy is beneficial to patients with sleep apnea on PAP therapy by enhancing efficient device use and regular follow-ups. The 90-day initial compliance-testing period could affect both early and long-term compliance. Modification of the NHI policy could further affect PAP compliance. This study could be a useful reference for future studies on the adequacy of the revised NHI policy in Korea, as well as to other countries considering implementation of NHI on PAP therapy.

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**Figure legends**

Figure 1. Proportions of follow-up and adherent patients at 1, 3, and 9 months.
Table 1. Baseline characteristics (n = 246)

| Factor                | PI group (n = 146) | NHI group (n = 100) | P-value |
|-----------------------|--------------------|---------------------|---------|
| Age (years)           | 50.20 ± 11.04      | 52.50 ± 12.12       | 0.124   |
| Sex                   | 0.379              |                     |         |
| Male                  | 121 (82.9)         | 87 (87.0)           |         |
| Female                | 25 (17.1)          | 13 (13.0)           |         |
| BMI (kg/m²)           | 27.10 ± 4.18       | 26.41 ± 3.09        | 0.161   |
| Comorbidity           | 0.135              |                     |         |
| HTN                   | 58 (39.7)          | 29 (29.0)           | 0.084   |
| DM                    | 16 (11.0)          | 11 (11.0)           | 0.992   |
| Smoking               | 37 (25.3)          | 17 (17.0)           | 0.120   |
| CVD                   | 14 (9.6)           | 9 (9.0)             | 0.876   |
| Stroke                | 1 (0.7)            | 2 (2.0)             | 0.568   |
| NSD                   | 41 (28.1)          | 39 (39.0)           | 0.073   |
| ESS                   | 9.43 ± 5.14        | 8.97 ± 4.74         | 0.526   |
| PSG measurements      | 0.135              |                     |         |
| AHI (/hour)           | 44.02 ± 21.68      | 45.12 ± 20.39       | 0.690   |
| RDI (/hour)           | 46.99 ± 20.12      | 46.98 ± 19.62       | 0.997   |
| TAI (/hour)           | 40.25 ± 18.50      | 40.52 ± 17.78       | 0.910   |
| PLMI (/hour)          | 4.74 ± 10.80       | 3.49 ± 12.82        | 0.418   |
| TST (minutes)         | 328.40 ± 47.63     | 328.59 ± 42.53      | 0.975   |
| ODI (/hour)           | 38.43 ± 23.19      | 39.49 ± 21.94       | 0.724   |
| Titration             | 141 (96.6)         | 73 (73.0)           | <0.001  |
| Mode                  | 0.135              |                     |         |
| CPAP                  | 74 (50.7)          | 41 (41.0)           |         |
**Table 1**

| APAP   | 72 (49.3) | 59 (59.0) |

* Data presented as n (%) or mean ± sd.

PI, pre-insurance; NHI, national health insurance; BMI, body mass index; HTN, hypertension; DM, diabetic mellitus; CVD, cardiovascular disease; NSD, nasal septal deviation; ESS, Epworth Sleepiness Scores; PSG, polysomnography; AHI, apnea-hypopnea index; RDI, respiratory distress index; TAI, total arousal index; PLMI, periodic limb movement index; TST, total sleep time; ODI, oxygen desaturation index; CPAP, continuous positive airway pressure; APAP, auto-adjusting positive airway pressure.
Table 2. Comparisons of adherent and non-adherent groups at 3 and 9 months

| Factor          | 3 months         | 9 months         | P-value  | 3 months         | 9 months         | P-value  |
|-----------------|------------------|------------------|----------|------------------|------------------|----------|
|                 | Adherent (n=110) | Non-adherent (n=136) | P-value | Adherent (n=99)  | Non-adherent (n=147) | P-value  |
| Age (years)     | 53.57 ± 11.24    | 49.16 ± 11.41    | 0.003    | 53.74 ± 10.80    | 49.38 ± 11.70    | 0.003    |
| Sex             |                  |                  | 0.480    |                  |                  | 0.057    |
| Male            | 95               | 113              |          | 89 (89.9)        | 119 (81.0)       |          |
| Female          | 15               | 23               |          | 10 (10.1)        | 28 (19.0)        |          |
| BMI (kg/m²)     | 27.61 ± 3.58     | 26.98 ± 3.94     | 0.446    |                  |                  | 0.307    |
| Comorbidity     |                  |                  |          |                  |                  |          |
| HTN             | 48 (43.6)        | 39 (28.7)        | 0.015    | 40 (40.4)        | 47 (32.0)        | 0.175    |
| DM              | 15 (13.6)        | 12 (8.8)         | 0.230    | 11 (11.1)        | 16 (10.9)        | 0.956    |
| Smoking         | 25 (22.7)        | 29 (21.3)        | 0.791    | 23 (23.2)        | 31 (21.1)        | 0.69     |
| CVD             | 11 (10)          | 12 (8.8)         | 0.753    | 5 (5.1)          | 18 (12.2)        | 0.057    |
| Stroke          | 2 (1.8)          | 1 (0.7)          | 0.442    | 1 (1.0)          | 2 (1.4)          | 0.806    |
| NSD             | 36 (32.7)        | 44 (32.4)        | 0.982    | 35 (35.4)        | 45 (30.6)        | 0.458    |
| ESS             | 9.43 ± 5.14      | 8.97 ± 4.74      | 0.370    | 8.56 ± 4.29      | 9.69 ± 5.34      | 0.114    |
| PSG measurements |                  |                  |          |                  |                  |          |
| AHI (hours)     | 45.73 ± 21.03    | 45.43 ± 21.22    | 0.399    | 46.51 ± 21.95    | 43.08 ± 20.51    | 0.213    |
| RDI (hours)     | 47.42 ± 20.27    | 46.62 ± 19.61    | 0.755    | 47.86 ± 21.53    | 46.39 ± 18.73    | 0.572    |
| TAI (hours)     | 39.32 ± 18.27    | 41.22 ± 18.09    | 0.422    | 40.12 ± 19.15    | 40.53 ± 17.51    | 0.863    |
| PLMI (hours)    | 4.04 ± 12.93     | 4.35 ± 10.57     | 0.838    | 3.48 ± 10.83     | 4.72 ± 12.26     | 0.423    |
| TST (minutes)   | 329.26 ± 45.64   | 327.83 ± 45.52   | 0.807    | 326.19 ± 39.80   | 330.05 ± 49.09   | 0.52     |
| ODI (/hours)  | 40.31 ± 22.74 | 22.74 ± 22.54 | 0.378 | 40.81 ± 23.09 | 37.54 ± 22.28 | 0.275 |
|-------------|----------------|----------------|--------|----------------|----------------|--------|
| Titration   | 90 (81.8)      | 124 (91.2)     | 0.036  | 80 (80.8)      | 134 (91.2)     | 0.018  |
| Mode        |                |                | < 0.001|                |                | < 0.001|
| CPAP        | 35 (31.8)      | 80 (58.8)      | 29 (29.3)| 86 (58.5)      |                | < 0.001|
| APAP        | 75 (68.2)      | 56 (41.2)      | 70 (70.7)| 61 (41.5)      |                |        |
| NHI         | 62 (56.4)      | 38 (27.9)      | < 0.001| 56 (56.6)      | 44 (29.9)      | < 0.001|

* Data presented as n (%) or mean ± sd.

BMI, body mass index; HTN, hypertension; DM, diabetic mellitus; CVD, cardiovascular disease; NSD, nasal septal deviation; ESS, Epworth Sleepiness Scores; PSG, polysomnography; AHI, apnea-hypopnea index; RDI, respiratory distress index; TAI, total arousal index; PLMI, periodic limb movement index; TST, total sleep time; ODI, oxygen desaturation index; CPAP, continuous positive airway pressure; APAP, auto-adjusting positive airway pressure; NHI, national health insurance.
Table 3. Predictors of PAP compliance based on compliance B at 3 and 9 months

| Predictor    | 3 months |                      | 9 months |                      |
|--------------|----------|----------------------|----------|----------------------|
|              | Univariate analysis | Multivariate analysis | Univariate analysis | Multivariate analysis |
|              | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value |
| Age          | 1.03 (1.01-1.06) | 0.007 | 1.03 (0.99-1.06) | 0.052 | 1.02 (0.99-1.05) | 0.108 |
| Sex          |          |        |          |        |          |        |          |        |
| Male         | 1.30 (0.62-2.73) | 0.495 |          |        | 2.65 (1.14-6.20) | 0.024 | 2.74 (1.11-6.75) | 0.029 |
| Female       | Reference |        | Reference |        |          |        |          |        |
| BMI          | 0.98 (0.91-1.06) | 0.623 |          |        | 0.94 (0.86-1.03) | 0.190 |
| Comorbidity  |          |        |          |        |          |        |          |        |
| HTN          | 1.79 (1.02-3.14) | 0.042 | 1.97 (1.05-3.69) | 0.035 | 1.11 (0.60-2.07) | 0.732 |
| DM           | 1.52 (0.65-3.54) | 0.337 |          |        | 1.20 (0.44-3.25) | 0.725 |
| Smoking      | 1.06 (0.56-2.02) | 0.856 |          |        | 1.10 (0.53-2.26) | 0.802 |
| CVD          | 0.87 (0.37-2.07) | 0.753 |          |        | 0.34 (0.11-1.04) | 0.059 | 0.30 (0.09-1.01) | 0.051 |
| Stroke       | 1.94 (0.17-21.77) | 0.589 |          |        | 0.74 (0.05-12.11) | 0.836 |
| NSD          | 1.03 (0.58-1.82) | 0.919 |          |        | 1.21 (0.64-2.30) | 0.556 |
| ESS          | 0.98 (0.92-1.04) | 0.516 |          |        | 0.94 (0.88-1.01) | 0.094 |
| PSG measures |          |        |          |        |          |        |          |        |
| AHI          | 1.01 (0.99-1.02) | 0.419 |          |        | 1.01 (0.99-1.03) | 0.187 |
| RDI          | 1.00 (0.99-1.02) | 0.750 |          |        | 1.01 (0.99-1.02) | 0.472 |
| TAI          | 0.99 (0.98-1.01) | 0.586 |          |        | 1.00 (0.98-1.02) | 0.937 |
| PLMI         | 0.99 (0.97-1.02) | 0.784 |          |        | 0.99 (0.96-1.02) | 0.392 |
| TST          | 1.00 (0.99-1.01) | 0.840 |          |        | 0.99 (0.99-1.01) | 0.798 |
|                | CPAP      | Reference | APAP      | Reference | Mean pressure | Reference | Residual AHI | Reference | Insurance | Reference | PI         | Reference | NHI        | Reference |
|----------------|-----------|-----------|-----------|-----------|---------------|-----------|--------------|-----------|-----------|-----------|------------|-----------|------------|-----------|
| **ODI**        | 1.00 (0.99-1.02) | 0.434     | 1.01 (0.99-1.02) | 0.222     |                |           |              |           |           |           |            |           |            |           |
| **Titration**  | 0.32 (0.13-0.79) | 0.013     | 0.65 (0.23-1.80) | 0.406     | 0.24 (0.08-0.74) | 0.013     | 0.49 (0.13-1.81) | 0.281     |           |           |            |           |            |           |
| **Mode**       |           |           |           |           |                |           |              |           |           |           |            |           |            |           |
| CPAP           | Reference | Reference | Reference | Reference | Reference       | Reference |              |           |           |           |            |           |            |           |
| APAP           | 2.14 (1.23-3.73) | 0.007     | 2.26 (1.22-4.17) | 0.009     | 2.69 (1.43-5.04) | 0.002     | 2.71 (1.35-5.43) | 0.005     |           |           |            |           |            |           |
| **Mean pressure** |           |   0.99 (0.87-1.12) | 0.840     | 0.94 (0.81-1.08) | 0.375     |           |               |           |           |           |            |           |            |           |
| **Residual AHI** |           | 1.01 (0.89-1.13) | 0.931     | 1.02 (0.87-1.21) | 0.780     |           |               |           |           |           |            |           |            |           |
| **Insurance**  |           |           |           |           |                |           |              |           |           |           |            |           |            |           |
| PI             | Reference | Reference | Reference | Reference | Reference       | Reference | Reference     | Reference | Reference | Reference | Reference | Reference | Reference |
| NHI            | 2.99 (1.71-5.23) | <0.001    | 3.12 (1.66-5.85) | <0.001    | 2.55 (1.37-4.77) | 0.003     | 2.39 (1.18-4.81) | 0.015     |           |           |            |           |            |           |

BMI, body mass index; HTN, hypertension; DM, diabetic mellitus; CVD, cardiovascular disease; NSD, nasal septal deviation; ESS, Epworth Sleepiness Scores; PSG, polysomnography; AHI, apnea-hypopnea index; RDI, respiratory distress index; TAI, total arousal index; PLMI, periodic limb movement index; TST, total sleep time; ODI, oxygen desaturation index; CPAP, continuous positive airway pressure; APAP, auto-adjusting positive airway pressure; PI, pre-insurance; NHI, national health insurance.
Table 4. Between-group comparison of compliance at 1 month, 3 months, and 9 months

|                  | 1 month          | 3 months        | 9 months        |
|------------------|------------------|-----------------|-----------------|
|                  | PI group (n=146) | NHI group (n=100) | p-value | PI group (n=116) | NHI group (n=95) | p-value | PI group (n=96) | NHI group (n=82) | p-value |
| Compliance A \(^a\) (%) | 90.03 ± 1.18     | 90.42 ± 1.99    | 0.870          | 80.36 ± 1.54     | 88.13 ± 1.77     | 0.002    | 83.09 ± 2.13     | 81.89 ± 2.27     | 0.702   |
| Compliance B \(^b\) (%) | 65.99 ± 2.06     | 78.22 ± 3.55    | 0.004          | 58.17 ± 2.23     | 74.88 ± 2.56     | <0.001   | 63.85 ± 2.58     | 70.39 ± 2.75     | 0.085   |
| Compliance C \(^c\) (h) | 4.20 ± 0.14      | 5.05 ± 0.17     | <0.001         | 4.52 ± 0.17      | 4.77 ± 0.18      | 0.323    |

PI, pre-insurance; NHI, national health insurance.

\(^a\) Percentage of days used.

\(^b\) Percentage of days used for at least 4 hours of the night.

\(^c\) Average daily usage hours.
Figure 1. Proportions of follow-up and adherent patients at 1, 3, and 9 months

† Number of follow-up patients out of total number of group patients
* Number of adherent patients out of total number of group patients