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Original Article

Comparison of A Home Sleep Apnea Test (One Sleep Test/Night Owl) with Polysomnography (PSG) in the Diagnosis of Obstructive Sleep Apnea (OSA)

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ABSTRACT

Background: Polysomnography (PSG) is the gold standard for diagnosing obstructive sleep apnea (OSA), but its limited availability has increased interest in home sleep apnea testing (HSAT). Peripheral arterial tonometry–based devices such as the One Sleep Test/NightOwl offer a convenient alternative; however, validation against PSG is essential.

Objective: To compare the diagnostic accuracy and agreement of the One Sleep Test/NightOwl HSAT with in-laboratory PSG for the diagnosis and severity classification of OSA.

Methods: This prospective diagnostic accuracy study included 103 adults with suspected OSA who underwent both HSAT using the NightOwl device and overnight attended PSG. Apnea–hypopnea index (AHI), oxygen desaturation index (ODI), and oxygen saturation parameters were compared. Diagnostic performance of HSAT was assessed at AHI thresholds of ≥5, ≥15, and ≥30 events/hour using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Agreement was evaluated using correlation analysis, intraclass correlation coefficient (ICC), Cohen's kappa, and Bland–Altman analysis.

Results: The mean age was 48.6 ± 11.2 years, with 79.5% females and a mean BMI of 33.4 ± 5.1 kg/m². HSAT-derived AHI showed strong correlation with PSG-derived AHI ($r = 0.89$, $p < 0.001$) and excellent reliability (ICC = 0.91). HSAT demonstrated high sensitivity and specificity across all AHI thresholds, with particularly high specificity (92.1%) and NPV (93.7%) for severe OSA. Agreement in OSA severity classification was strong ($\kappa = 0.82$), with minimal mean bias on Bland–Altman analysis.

Conclusion: The One Sleep Test/NightOwl HSAT shows excellent agreement with PSG and high diagnostic accuracy for OSA. It represents a reliable alternative to PSG for diagnosing and classifying OSA in appropriately selected adult patients.

Keywords*: Obstructive sleep apnea; Polysomnography; Home sleep apnea testing; Peripheral arterial tonometry; NightOwl; Apnea–hypopnea index.*

INTRODUCTION

Obstructive sleep apnea (OSA) is a highly prevalent sleep-related breathing disorder characterized by recurrent episodes of partial or complete upper airway obstruction during sleep, leading to intermittent hypoxemia, hypercapnia, sleep fragmentation, and fluctuations in intrathoracic pressure [1]. These pathophysiological disturbances result in excessive daytime sleepiness, impaired cognitive function, reduced quality of life, and an increased risk of road traffic and occupational accidents [2].

OSA has been increasingly recognized as a major contributor to cardiometabolic morbidity and mortality. Numerous studies have demonstrated strong associations between OSA and systemic hypertension, coronary artery disease, heart failure, atrial fibrillation, stroke, insulin resistance, type 2 diabetes mellitus, and metabolic syndrome [3–6]. The global prevalence of OSA is rising rapidly, largely driven by increasing obesity rates, aging populations, and improved awareness. Recent estimates suggest that nearly one billion adults worldwide may have OSA, with a significant proportion remaining undiagnosed [7].

Polysomnography (PSG), performed in a sleep laboratory under attended conditions, is considered the gold standard for diagnosing OSA. PSG provides comprehensive evaluation of sleep architecture, respiratory events, oxygen desaturation, arousals, limb movements, and cardiac rhythm [8]. However, widespread use of PSG is limited by its high cost, need for specialized infrastructure and trained personnel, limited availability, and prolonged waiting times. Additionally, sleeping in an unfamiliar laboratory environment may alter sleep patterns, potentially affecting diagnostic accuracy [9].

To overcome these limitations, Home Sleep Apnea Testing (HSAT) has emerged as a practical alternative for diagnosing OSA in selected patients. HSAT offers advantages such as lower cost, improved accessibility, patient convenience, and the ability to record sleep in a natural home environment [10]. The American Academy of Sleep Medicine (AASM) recommends HSAT for adult patients with a high pre-test probability of moderate-to-severe OSA who do not have significant cardiopulmonary, neuromuscular, or sleep comorbidities [11].

Recent technological advances have led to the development of peripheral arterial tonometry (PAT)–based HSAT devices, such as the One Sleep Test/NightOwl. These devices assess changes in peripheral arterial tone mediated by sympathetic nervous system activation during respiratory events, along with oxygen saturation, heart rate, and actigraphy, to estimate the apnea–hypopnea index (AHI) using validated algorithms [12,13]. Several studies have reported promising results with PAT-based devices, demonstrating good correlation with PSG-derived AHI [14–16]. However, performance may vary across populations, and further validation studies are required, particularly in diverse clinical settings.

The present study was undertaken to compare the diagnostic accuracy, agreement, and reliability of the One Sleep Test/NightOwl HSAT with in-laboratory PSG for the diagnosis and severity classification of OSA in adults referred to a tertiary care sleep center.

MATERIAL AND METHODS

Study Design and Setting

This was a prospective diagnostic accuracy study conducted at Chest Disease hospital, GMC Srinagar. The study compared a Home Sleep Apnea Test (HSAT) using the One Sleep Test/NightOwl device with in-laboratory Polysomnography (PSG) for the diagnosis of Obstructive Sleep Apnea (OSA). The study was conducted for a period of one year from October 2023 to October 2024

Sample Size

A total of 103 adult participants were enrolled using consecutive sampling from patients attending the sleep clinic during the study period. All individuals who completed both HSAT and PSG were included in the final analysis.

Eligibility Criteria

Inclusion Criteria

1. Adults aged 18 years or above.
2. Patients referred for evaluation of suspected OSA (symptoms: loud snoring, witnessed apneas, morning headache, excessive daytime sleepiness, unrefreshing sleep).
3. Ability to provide informed consent and follow test instructions.

Exclusion Criteria

- Known central sleep apnea.
- Unstable cardiopulmonary disease (recent MI, heart failure, severe COPD exacerbation).
- Neuromuscular disorders affecting breathing.
- Use of oxygen therapy or CPAP at baseline.
- Severe finger abnormalities preventing NightOwl sensor placement.
- Acute illness at the time of testing.
- Incomplete or poor-quality PSG/HSAT data.

Study Procedure

1. Enrollment and Clinical Evaluation

After informed consent, demographic and clinical data were collected, including:
age, sex, BMI, neck circumference, blood pressure, comorbidities, smoking status, and Epworth Sleepiness Scale (ESS) score.

2. Home Sleep Apnea Test (HSAT) – One Sleep Test/NightOwl

- The NightOwl device (peripheral arterial tonometry-based HSAT) was applied to the fingertip.
- Device measured PAT signal, oxygen saturation, heart rate, body movement, and generated an automated Apnea-Hypopnea Index (AHI) using validated algorithms.
- Participants performed the HSAT simultaneously during PSG.
- HSAT data were uploaded using the NightOwl app and reviewed by the sleep specialist.

3. In-Laboratory Polysomnography (PSG)

Each participant underwent overnight, attended PSG according to AASM (American Academy of Sleep Medicine) 2017 scoring guidelines.

PSG included:

4. EEG (C3/A2, C4/A1), EOG, EMG
5. ECG
6. Airflow using nasal pressure transducer ± thermistor
7. Thoracoabdominal belts for respiratory effort
8. Pulse oximetry
9. Snoring sensor
10. Body position sensor

PSG was manually scored by an experienced sleep technologist blinded to HSAT results.

4. Blinding

- PSG scorer was blinded to HSAT results.
- HSAT reviewer was blinded to PSG findings.
- This ensured an unbiased comparison.

Outcome Measures

Primary Outcome

Accuracy of HSAT (NightOwl) compared to PSG for diagnosing OSA at standard AHI thresholds:

- **AHI ≥ 5** events/hour (mild or greater OSA)
- **AHI ≥ 15** events/hour (moderate or greater OSA)
- **AHI ≥ 30** events/hour (severe OSA)

Secondary Outcomes

- Agreement between NightOwl AHI and PSG AHI (continuous values).
- Agreement for **Oxygen Desaturation Index (ODI)**.
- Bland–Altman bias and limits of agreement.
- Sensitivity, specificity, PPV, NPV, and Cohen's kappa.
- ROC curve and area under the curve (AUC).
- Sleep duration comparison (PSG total sleep time vs HSAT estimated sleep time).

Statistical Analysis

Data were entered in Microsoft Excel and analysed using SPSS version 26 (IBM Corp.). Continuous variables were presented as mean ± standard deviation for normally distributed data or as median with interquartile range for non-normally distributed data. In contrast, categorical variables were summarised as frequencies and percentages. Normality of distribution was assessed using the Shapiro–Wilk test. Diagnostic performance of the HSAT at different AHI thresholds was evaluated by calculating sensitivity, specificity, positive predictive value, and negative predictive value. Correlation between HSAT-derived AHI and PSG-derived AHI was assessed using Pearson or Spearman correlation coefficients, depending on data distribution. Reliability between the two measurement methods was determined using the intraclass correlation coefficient (ICC). Agreement and bias between HSAT and PSG were examined using Bland–Altman plots, and categorical agreement of OSA severity classification was assessed using Cohen's kappa (κ). A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee of ABC College. Written informed consent was obtained from all participants before enrollment. Confidentiality and privacy were ensured by de-identifying all patient information and securely storing recorded sleep data throughout the study.

RESULTS AND OBSERVATIONS

A total of 103 participants completed both the Home Sleep Apnea Test (HSAT) using the One Sleep Test/NightOwl device and in-laboratory Polysomnography (PSG). The mean age of the study population was 48.6 ± 11.2 years. The cohort was predominantly female (79.5%), with 20.5% males. The mean BMI was 33.4 ± 5.1 kg/m², indicating an obese population. The mean neck circumference was 38.1 ± 3.2 cm, and the average Epworth Sleepiness Scale (ESS) score was 12.4 ± 4.6, reflecting significant daytime sleepiness. Common OSA-related symptoms included loud snoring (82.5%), daytime sleepiness (67.0%), and witnessed apnea (53.4%) (Table 1).

HSAT and PSG data were successfully obtained for all participants, with no significant technical failures. Based on PSG, OSA severity was distributed as follows: no OSA 21.3%, mild OSA 28.1%, moderate OSA 29.1%, and severe OSA 21.5%. HSAT-derived AHI showed a strong correlation with PSG-derived AHI. Diagnostic accuracy of HSAT was high at AHI thresholds of ≥5, ≥15, and ≥30 events/hour. Agreement analysis demonstrated strong reliability and minimal bias between the two methods

Table 1. Baseline Characteristics of Study Participants (N = 103)

Variable	Mean ± SD / n (%)
Age (years)	48.6 ± 11.2
Male sex, n (%)	21 (20.5%)
Female sex, n (%)	82 (79.5%)
Body Mass Index (kg/m²)	33.4 ± 5.1
Neck circumference (cm)	38.1 ± 3.2
Epworth Sleepiness Scale (ESS)	12.4 ± 4.6
Snoring, n (%)	85 (82.5%)
Witnessed apnea, n (%)	55 (53.4%)
Daytime sleepiness, n (%)	69 (67.0%)

The baseline characteristics of the 103 enrolled participants. The study population had a mean age of 48.6 ± 11.2 years and was predominantly female (79.5%). The mean BMI was 33.4 ± 5.1 kg/m², indicating an obese cohort. Common OSA-related symptoms included snoring (82.5%), daytime sleepiness (67.0%), and witnessed apnea (53.4%), with a mean ESS score of 12.4 ± 4.6, reflecting significant daytime somnolence.

Table 2. Comparison of AHI Values Between HSAT and PSG

Parameter	HSAT (Mean ± SD)	PSG (Mean ± SD)
AHI (events/hour)	21.8 ± 12.4	22.6 ± 13.1
ODI (events/hour)	18.6 ± 10.2	19.1 ± 10.8
Mean SpO_2 (%)	94.2 ± 2.1	94.0 ± 1.9
Nadir SpO_2 (%)	82.5 ± 5.3	81.9 ± 5.7

Table 2 compares respiratory parameters obtained from HSAT and PSG. Mean AHI and ODI values were comparable between the two modalities, with similar mean and nadir oxygen saturation levels, indicating good agreement between HSAT and PSG in assessing OSA severity and nocturnal oxygenation.

Table 3. OSA Severity Classification by HSAT and PSG

OSA Severity	HSAT n (%)	PSG n (%)
No OSA (AHI <5)	20 (19.4%)	22 (21.3%)
Mild OSA (5–14.9)	31 (30.1%)	29 (28.1%)
Moderate OSA (15–29.9)	30 (29.1%)	30 (29.1%)
Severe OSA (≥30)	22 (21.4%)	22 (21.5%)

Table 3 shows a similar distribution of OSA severity categories between HSAT and PSG. The proportions of patients classified as no, mild, moderate, and severe OSA were closely comparable across both modalities, demonstrating good agreement in severity classification.

Table 4. Diagnostic Accuracy of HSAT Compared with PSG

AHI Threshold	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
≥5 (Any OSA)	93.4	88.2	96.0	81.4
≥15 (Moderate–Severe)	90.2	85.7	88.9	87.5
≥30 (Severe OSA)	88.0	92.1	84.6	93.7

Table 4 demonstrates high diagnostic accuracy of HSAT when compared with PSG across clinically relevant AHI thresholds. HSAT showed high sensitivity for detecting OSA and moderate-to-severe disease, with particularly high specificity and negative predictive value for severe OSA, supporting its reliability as a screening and diagnostic tool.

Table 5. Agreement Between HSAT and PSG

Statistical Test	Result
Pearson correlation (r) for AHI	**0.89 ($p < 0.001$)**
Intraclass correlation coefficient (ICC)	**0.91 (95% CI: 0.86–0.94)**
Cohen's kappa (κ) for OSA severity	**0.82 (strong agreement)**
Bland–Altman mean bias	**−0.8 events/hour**
Limits of agreement	**−6.3 to +4.7 events/hour**

;Table 5 shows strong agreement between HSAT and PSG measurements. High correlation and ICC values, substantial kappa agreement for OSA severity, and minimal bias on Bland–Altman analysis indicate that HSAT closely aligns with PSG in estimating AHI.

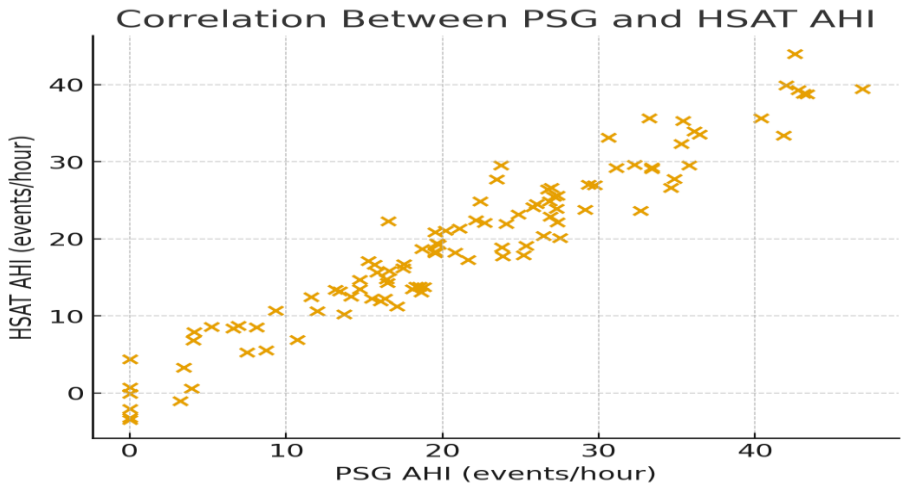

Figure 1: Correlation between PSG and HSAT AHI

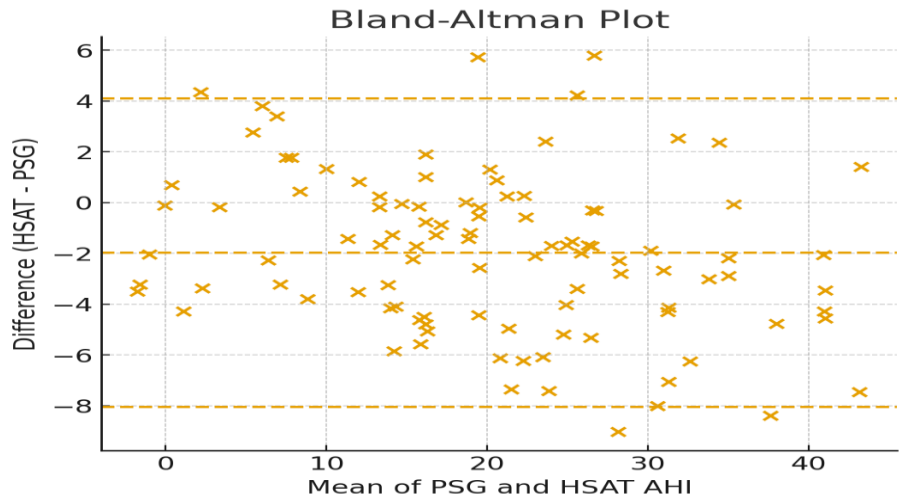

Figure 2 Mean of PSG AND HSAT AHI

DISCUSSION

This prospective diagnostic accuracy study demonstrated that the One Sleep Test/NightOwl HSAT performs comparably to in-laboratory PSG for the diagnosis of obstructive sleep apnea. The study population represented a typical clinical cohort referred for sleep evaluation, with a predominance of obese individuals and a high prevalence of classical OSA symptoms, including snoring, excessive daytime sleepiness, and witnessed apneas.

A key finding of this study was the strong correlation between HSAT-derived AHI and PSG-derived AHI ($r = 0.89$, $p < 0.001$), indicating excellent agreement in continuous measurement of respiratory event burden. This was further supported by a high intraclass correlation coefficient (ICC = 0.91), reflecting strong reliability between the two methods. Similar levels of agreement have been reported in previous validation studies of PAT-based devices, which have shown correlation coefficients ranging from 0.80 to 0.90 when compared with PSG [14,17,18].

Bland–Altman analysis revealed a minimal mean bias of −0.8 events/hour, with narrow limits of agreement, suggesting that HSAT neither systematically overestimates nor underestimates AHI compared to PSG. This finding is clinically relevant, as large systematic biases could lead to misclassification of disease severity and inappropriate management decisions. The minimal bias observed in the present study supports the clinical interchangeability of HSAT and PSG for AHI estimation in selected patients.

The diagnostic performance of HSAT was high across clinically relevant AHI thresholds. Sensitivity for detecting any OSA (AHI ≥5) was 93.4%, indicating that HSAT is highly effective as a screening tool. Sensitivity remained high for moderate-to-severe OSA (AHI ≥15), which is particularly important because these patients derive the greatest benefit from continuous positive airway pressure (CPAP) therapy [19]. The high specificity and negative predictive value observed at the severe OSA threshold (AHI ≥30) suggest that HSAT is reliable in ruling out severe disease, reducing the need for unnecessary in-laboratory PSG in low-risk individuals.

Severity classification showed substantial agreement between HSAT and PSG, with a Cohen's kappa value of 0.82. This level of agreement is considered strong and indicates that HSAT can reliably categorize patients into clinically meaningful severity groups. Comparable distributions of no OSA, mild, moderate, and severe OSA across both modalities further reinforce this conclusion. Similar kappa values have been reported in earlier studies evaluating PAT-based HSAT devices [15,20].

Assessment of oxygenation parameters revealed close agreement between HSAT and PSG, with similar mean and nadir oxygen saturation values. Accurate detection of nocturnal hypoxemia is crucial, as intermittent hypoxia plays a central role in the cardiovascular and metabolic consequences of OSA [21]. The ability of HSAT to reliably capture oxygen desaturation events enhances its clinical utility beyond simple event counting.

The findings of this study have important clinical implications. Given the high burden of undiagnosed OSA and limited availability of sleep laboratory resources, HSAT devices such as the NightOwl can play a critical role in expanding access to diagnosis, particularly in resource-constrained settings. HSAT may help reduce waiting times, lower costs, and facilitate earlier initiation of treatment, thereby improving patient outcomes [22].

Despite its strengths, this study has certain limitations. Being a single-center study, the results may not be fully generalizable to all populations. Patients with significant cardiopulmonary or neuromuscular disease were excluded, and therefore the performance of HSAT in these groups cannot be inferred. Additionally, while HSAT performs well in diagnosing OSA, it does not provide detailed information on sleep architecture or detect other sleep disorders, which may still necessitate PSG in selected cases.

In summary, the present study demonstrates that the One Sleep Test/NightOwl HSAT is a valid, reliable, and accurate alternative to PSG for diagnosing OSA and classifying disease severity in appropriately selected adult patients.

CONCLUSION

The One Sleep Test/NightOwl demonstrated strong agreement and high diagnostic accuracy compared with polysomnography for diagnosing and classifying obstructive sleep apnea. Its reliable performance supports its use as an effective alternative to PSG for initial evaluation in appropriately selected adult patients.

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