

How AHI Came to be the Standard Diagnostic Measure

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Publish date: July 15, 2025

The AHI and OSA are deeply intertwined, but questions have been asked about AHI as a metric of OSA diagnosis and classification from the beginning.

The AHI and OSA grew up together, but the time may have come for them to part ways. The more we learn about OSA, the more we understand its complex nature and potentially severe consequences for patients and impact on research, diagnosis and treatment. But how did AHI gain such an important role in the first place?

The identification of sleep apnea syndromes

Although the association between morbid obesity, hypersomnolence and respiratory failure was first fully described in 1956,¹ it wasn't until 1976 that Guilleminault, Tilkian and Dement introduced the concept of 'sleep apnea syndromes' and identified them as drivers of disease in their own right.²

Their research, based on laboratory findings, provided formal evidence that respiratory problems during sleep could account for previously unexplained medical conditions. It defined an apnea as a cessation of airflow lasting at least ten seconds and argued that sleep apnea syndrome should be diagnosed in patients suffering at least 30 apneas during the night of sleep.²

A new disease, a new index

So far, so good. But in 1978, with no obvious rationale, Guilleminault and Dement proposed a new metric, the apnea index (AI), which measured the number of apneic

events a patient suffered per hour of sleep. Formal comparative analyses of the merits of an hourly index versus a night-long total were not carried out due to a lack of data.³

The cut-off value for diagnosing sleep apnea—at least five events per hour—was derived from a limited cohort of patients and control subjects. The research underpinning the index has never been adequately reproduced or validated. At the same time that a clinically important condition had been discovered, the key way of understanding and quantifying it was taking a wrong turn.⁴

“From the outset, researcher worried that a simple measure of frequency might obscure the varied clinical picture of sleep apnea syndrome.”

Early concerns about a one-dimensional metric

Concerns about the AHI were raised from the outset. Researchers worried that a simple measure of frequency might obscure the varied clinical picture of sleep apnea syndrome. They noted it was an

inadequate metric to represent a heterogeneous collection of respiratory disturbances and symptoms. They also indicated it did not capture important differences between men and women or between younger and older people in apneic events, desaturation and symptoms. They argued the cut-off score of five events per hour was arbitrary, implied a high risk of false-positive diagnoses and did not reliably predict clinically relevant disease.⁴

Nevertheless, for lack of an alternative, the AI became a shared standard, morphing into the AHI as the importance of hypopneas became recognized. Still the criticisms did not go away. In the 1990s, for example, researchers noted the weak correlation between AHI score and relevant clinical symptoms, the lack of a clear 'dose-response' relationship between AHI and clinical consequences of OSA, and methodological issues around the recording and scoring of hypopneas.⁴

“The realities of the US health insurance industry may be one factor that prevented efforts to advance OSA diagnosis and assessment.”

| Surface change instead of real change

In light of these criticisms and with the aim of developing a standardized approach to OSA research, efforts were made to refine and formalize OSA diagnosis and assessment. Results were mixed.

For example, $AHI \geq 30$ was classified as severe disease due to research showing that an increased risk of systemic hypertension at this level. The cut-off for 'moderate' disease—an $AHI \geq 15$ —however, was just a convenient mid-point between 5 and 30. The importance of hypopnea was recognized and they were integrated into the index, but scoring systems and severity thresholds were not adjusted accordingly.⁴

Competing definitions of hypopneas were allowed even though ~20% of patients diagnosed under one definition would be OSA-free under another.⁵

The first Manual for the Scoring of Sleep and Associated Events, published by the American Academy of Sleep Medicine (AASM) in 2007, even insisted that digital filters be used to ensure that the results of new, digital PSG testing would be consistent with existing paper-based analogue tests.⁶

While the intention to reduce inaccuracy and improve research quality was good and gave the appearance of increasingly refined and standardized guidelines, the reality was undermined by circular definitions, a reliance on consensus rather than evidence, and the need to keep one eye on the realities of the US health insurance industry.

| Calling time on AHI

Over the years, the AHI has become the benchmark for diagnosing and assessing sleep disordered breathing and has even been codified in laws and regulations as a way to assess fitness for driving, medical reimbursements and more. But fundamental weaknesses, identified from the outset and exacerbated by later decisions, remain.

AHI fails to express relevant clinical features of OSA and does not necessarily reflect clinically relevant disease. It does not capture the heterogeneity of sleep disordered breathing or the true severity of disease. It doesn't identify the risk or potential magnitude of systemic effects on patients' bodies or the benefits those patients might receive from treatment. It risks over-diagnosing some populations, like the elderly, and under-diagnosing others who could benefit from treatment.^{7,8,9} It suffers from methodological issues regarding the recording, scoring and classification of events and fails to make effective use of extensive data collected during sleep trials.¹⁰ While AHI is an effective way to measure the frequency of apneic episodes, it is not adequate as a metric to diagnose OSA, measure its severity or assess treatment efficacy.

Other diagnostic tools exist and more are in the pipeline. A better, more complete, more considered approach to diagnosing and quantifying OSA is both possible and necessary, for the sake of clinicians, researchers and patients alike.

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