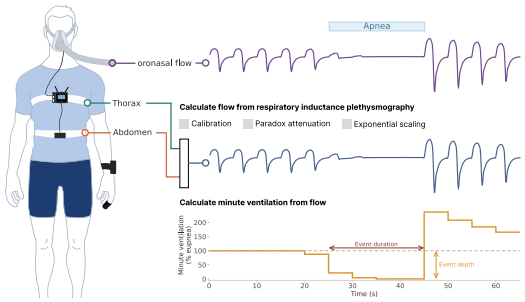
Research spotlight/Review

Quantifying Ventilation in Obstructive Sleep Apnea with RIP

Finnsson, E., Arnardóttir, E., Montazeri, K., et al. (2026). Respiratory inductance plethysmography to quantify changes in ventilation in obstructive sleep apnea. IEEE Transactions on Biomedical Engineering, 73(5), 1943–1952. https://doi.org/10.1109/TBME.2025.3618403

Study findings suggest RIP correction improved measurement across breaths, events, and patient-level metrics.



Small-breaths

12.21% → 1.51% eupnea

Overestimation bias

Respiratory event depth

9% → 1% eupnea

Mean bias

Improved agreement with gold-standard PSG:

Patient-level event depth

ICC 0.57→ 0.77

Bias reduced from

~9% → ~4% eupnea

Ventilatory burden (VB)

ICC 0.80→ 0.91

Bias reduced from

~275 → ~116% eupnea min/hr

Purpose:

This study asked whether respiratory inductance plethysmography (RIP) could do more than track respiratory movement. Could calibrated thoracic and abdominal RIP signals quantify changes in ventilation and support development of advanced OSA severity metrics?

The goal was to address a practical limitation of airflow measurement during sleep: nasal pressure can be affected by oral breathing, while RIP provides an independent signal derived from thoracoabdominal movement. The study compared RIP-derived ventilation with gold-standard oronasal pneumotachography across **495,631 individual breaths** from 89 adults with OSA.

Method

- **Participants:** 89 adults with OSA in a multicenter observational cohort.
- **Reference method:** Quantitative oronasal pneumotachography via a sealed mask during in-lab PSG.
- **RIP method:** Simultaneous thoracic and abdominal Nox RIP signals processed with a three-step calibration and correction algorithm.
- **Analysis:** Agreement assessed at the breath level, respiratory-event depth level, and patient-specific level for average event depth and ventilatory burden.

Conclusion

With appropriate calibration and correction, dual RIP signals can provide estimates of ventilation normalized to eupneic levels during sleep, supporting advanced ventilation-based measures of OSA severity

The corrected RIP signal reduced systematic bias at both breath and event levels and showed strong agreement with pneumotach-derived patient-level measures. The authors note that this approach may be particularly useful when nasal airflow is absent or compromised.

Key takeaway

Dual-belt RIP can provide more than an effort signal. When paired with appropriate calibration and processing, it can support continuous ventilation measurement and physiologically meaningful metrics such as event depth and ventilatory burden, helping clinicians look beyond event counts alone.

Study context: The study population was predominantly male (76%) and White (76%); the authors note that additional validation in women and non-White groups would be useful. Results apply to the studied RIP configuration and processing approach and are not necessarily generalizable to heavily filtered RIP or non-RIP respiratory movement signals. This is a Nox-sponsored study, and the authors are Nox employees.

For educational and sales-enablement use. Clinical decisions should be based on full clinical evaluation, device labeling, and established guidelines.

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