Night to night variability of Pulse Wave Amplitude Drops index

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Declaration of competing interest

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To The Editors,

Solelhac et al. [1] showed that Pulse Wave Amplitude Drops index (PWADi), defined as the number of drops in the pulse oximetry-based photo-plethysmography (PPG) signal per hour of sleep, reflecting modulation of digital perfusion during sleep [2], is an interesting biomarker of Cardiovascular (CV) Risk in Obstructive Sleep Apnea (OSA). However, PWADi must be consistent and reliable across different nights to be used as a predictor of cardiovascular risk from a single sleep study.

To assess the reliability of PWADi and its associated features (descending and ascending slopes, mean duration, and mean area under the curve (AUC) of PWADs), 18 participants (14 males) underwent two consecutive polysomnographies. PPG signal was recorded using a Nonin pulse oximeter and was analyzed using a validated automated algorithm [3] to extract PWADi and its specific features. Repeatability was evaluated using the Intraclass Correlation Coefficient (ICC (A,1)) [4,5].

The sample median age was 66.5 years (IQR: 55.2–72.0), median BMI 25.5 kg/m2 (IQR: 24.3–28.0), and median AHI 18.56/h (IQR: 11.1–23.4). Mean PWADi on the first and second nights were 44.98/h (SD: 26.94) and 45.05/h (SD: 26.39), respectively, with a mean difference of −0.08/h (SD: 8.64). ICC [95% CI] was 0.95 [0.87–0.98], indicating excellent repeatability. For comparison,

ICC of AHI across nights was only 0.81 [0.57–0.92]. In the sub-group of AHI≥15/h (N = 12), the mean difference in PWADi between consecutive nights was 0.26/h (SD: 8.26) with an ICC of 0.95 [0.85–0.99]. The correlation between AHI and PWAD indices was −0.1426 but not significant (p-value 0.412), suggesting that they reflect different physiological aspects of OSA.

The mean duration, AUC, descending and ascending slopes also demonstrated good to moderate repeatability with ICC of 0.87 [0.69–0.95], 0.75 [0.44–0.90], 0.72 [0.40–0.88], and 0.72 [0.40–0.88], respectively.

In conclusion, these results reinforce the potential clinical use of PWADi as a CV risk marker, given that it can be reliably assessed with single-night polysomnography, regardless of the AHI. Additional features, in particular drops' mean duration and AUC also seem to be consistent over two nights and should be further investigated to determine whether they can add to the predictive value of PWADi. Combining PWADi with AHI and other OSA indices could provide a more comprehensive assessment of long-term cardiovascular risk.

References

[1] G. Solelhac, M. Sánchez-de-la-Torre, M. Blanchard, M. Berger, C. Hirotsu, T. Imler, et al. Pulse wave amplitude drops index: a biomarker of cardiovascular risk in Obstructive sleep Apnea. Am J Respir Crit Care Med, 207 (12) (2023 Jun 15), pp. 1620-1632

[2] L. Grote, D. Zou, H. Kraiczi, J. Hedner. Finger plethysmography—a method for monitoring finger blood flow during sleep disordered breathing. Respir Physiol Neurobiol, 136 (2) (2003 Jul 16), pp. 141-152

[3] M. Betta, G. Handjaras, E. Ricciardi, P. Pietrini, J. Haba-Rubio, F. Siclari, et al. Quantifying peripheral sympathetic activations during sleep by means of an automatic method for pulse wave amplitude drop detection. Sleep Med, 69 (2020 May), pp. 220-232

[4] S. Qin, L. Nelson, L. McLeod, S. Eremenco, S.J. Coons. Assessing test–retest reliability of patient-reported outcome measures using intraclass correlation coefficients: recommendations for selecting and documenting the analytical formula. Qual Life Res, 28 (4) (2019 Apr 1), pp. 1029-1033

[5] T.K. Koo, M.Y. Li. A Guideline of selecting and reporting intraclass correlation coefficients for reliability research. J Chiropr Med, 15 (2) (2016 Jun), pp. 155-163