EDITORIAL

# Thumbs Up

## Sleep EEG Predicts Long-Term Health

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*Neurology: Clinical Practice* 2024;14:e200247. doi:10.1212/CPJ.0000000000200247

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In "Assessing Risk of Health Outcomes from Brain Activity in Sleep: A Retrospective Cohort Study,"[1] Sun et al. use sleep EEG to predict the 10-year odds ratio of poor outcomes, including ischemic stroke, intracranial hemorrhage, mild cognitive impairment, dementia, atrial fibrillation, myocardial infarction, type 2 diabetes, hypertension, bipolar disorder, depression, and mortality. Among 86 derived sleep "features," analyzed after manual sleep staging, the most predictive was the delta-to-alpha band power ratio. The predictive model was superior to the predictive value of AHI or other EEG and respiratory values. The model was developed using a large single-institution clinical cohort; it was then validated using a separate large cohort of Sleep Heart Health Study participants who had at least 2.5 hours of 2-channel sleep EEG. For the 8673 patients in the development cohort, the average age was 51 years and 49% were male; for the 5650 patients in the validation cohort, the average age was 63 years and 48% were male. Both cohorts used binary sex designations (male/female). Racial/ethnic groups other than non-Hispanic White were represented in low numbers. Hazard ratios for poor health outcomes were adjusted for covariates including age, sex, body mass index, and use of certain psychoactive medications, but not for general medical conditions. Poor sleepers, having a score above the 75% percentile, had a hazard ratio of 3.8 compared with average sleepers in the middle 2 quartiles while average sleepers had a hazard ratio of 3.5 compared with good sleepers, who had a score lower than the 25% percentile. The authors intend to develop this tool to help us better understand the relationships among sleep, treatment, and health, but even now it may help us motivate our patients to modify risk factors of brain disorders.

This model takes sleep EEG data in a standard format (European Data Format, or EDF) as the only input, and it delivers a verdict of high, intermediate, or low risk of serious cardiovascular, medical, neurologic, and psychiatric disease over the next 10 years, whether the end point is primary or secondary. By contrast, clinical algorithms to compute cardiovascular (CV) risk[2] take current and prior health data as inputs, and most deliver a percentage risk of a major CV event within 10 years. Sleep EEG offers a more intuitive view of future risks—high, intermediate, or low—for a larger range of unwanted outcomes.

This is the first publication of this model, and the authors intend to develop it further, but already we may use it to compute and communicate dementia and stroke risk to bring home the importance of behavior modifications. Potentially modifiable risk factors of dementia include diabetes, smoking, hypertension, lack of exercise, and low educational level; the presence of multiple factors indicates a hazard ratio of 3–4, each single factor conferring a lower risk.[3] Sun et al. present hazard ratios for dementia in eTable 8a: for male and female patients, respectively, the hazard ratio is 6.1–6.2 for poor vs average sleep and 2.5–2.4 for average vs good sleep. The high predictive value for dementia, particularly among those with poor sleep, may be as prognostic as any single risk factor other than apolipoprotein ε4 status.

Hazard ratios for stroke are also presented in eTable 8A: for male and female patients, the hazard ratio is 3.4 (both sexes) for poor vs average sleep and 9.9–10.3 for average vs good

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Funding information and disclosures are provided at the end of the article. Full disclosure form information provided by the authors is available with the full text of this article at Neurology.org/cp.

sleep. For intracerebral hemorrhage, male and female patients, respectively, had a hazard ratio of 7.9–7.8 for poor vs average sleep and 5.2 (both sexes) for average vs good sleep. It seems that the brain is yielding stroke warnings that do not depend on the vascular disease usual suspects.

This model could help neurologists find a greater role within preventive care, whereas now, we usually participate in recovery and rehabilitation for people after a stroke or at a relatively late stage of cognitive loss. As we coach patients toward better brain health, people who have a personal risk prediction based on their own brain characteristics may better grasp the need for change. When we order a sleep EEG or PSG, we can now submit patient data for risk modelling, to help target our discussions at follow-up. Can we say, "Your own brain is telling us that you need to exercise!"

Patients may trust their familiar wearables more than they trust their doctor, many do not want to share their data with their doctors, and many trust a computer formula more than they trust the science we espouse.[4] While CV risk calculators have the look and feel of a medical procedure, this predictive service may have the much cooler look and feel of a MAGIC 8-BALL™ wedded to a smart phone. We can envision a near future when patients may be empowered to at least partly forecast their own health by uploading data from 2.5 hours of a single-channel wearable sleep EEG, with automated sleep staging. Then we would not be chiding patients about their behavior; rather, we will be helping them toward their own goals.

## Study Funding

The author reports no targeted funding.

## Disclosure

The author reports no relevant disclosures. Full disclosure form information provided by the authors is available with the full text of this article at Neurology.org/cp.

## Publication History

Received by *Neurology: Clinical Practice* September 29, 2023. Accepted in final form November 7, 2023.

## References

1. Sun H, Adra N, Ayub MA, et al. Assessing risk of health outcomes from brain activity in sleep: a retrospective cohort study. *Neurol Clin Pract*. 2023;14(1):e200225. doi: 10.1212/CPJ.0000000000200225.
2. Wilson PWF. Cardiovascular disease risk assessment for primary prevention: risk calculators. Accessed October 13, 2023. uptodate.com/contents/cardiovascular-disease-risk-assessment-for-primary-prevention-risk-calculators?search=cardiovascular%20disease%20risk&source=search_result&selectedTitle=2~150&usage_type=default&display_rank=2
3. Larson EB. Risk factors for cognitive decline and dementia. Accessed October 13, 2023. uptodate.com/contents/risk-factors-for-cognitive-decline-and-dementia?search=dementia%20risk%20factors&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1
4. Ahn H, Park E. Determinants of consumer acceptance of mobile healthcare devices: an application of the concepts of technology acceptance and coolness. *Telemat Inform*. 2022;70:101810. doi:10.1016/j.tele.2022.101810. sciencedirect.com/science/article/pii/S0736585322000430

**How to cite this article**: RaphaelsonM.. Thumbs up: sleep EEG predicts long-term health. *Neurol Clin Pract*. 2024;14(1):e200247. doi: 10.1212/CPJ.0000000000200247.