

Spectral characteristics of quantitative EEG: associated factors and differentiation of cognitive states across the clinical continuum

P1-5008

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KEY TAKE AWAY:

- Increasing age was associated with reduced power in the α and β bands in the posterior occipital region; sex was associated with PSD parameters, with females showing higher power than males in the α , β and δ bands, primarily distributed in the central and occipital regions. Cardiometabolic risk factors (e.g., diabetes, stroke, and coronary heart disease) were associated with a widespread increase in low-frequency (δ , θ) activity.
- In older adults with low cognitive performance, PSD characteristics manifest as widespread whole-brain increases in the low-frequency bands (δ , θ); PSD in low-frequency bands, especially θ , showed good-to-excellent performance in distinguishing different cognitive states. This suggests that the generalized enhanced low-frequency activity is the core electrophysiological feature in AD progression.

INTRODUCTION

Resting-state EEG power spectral density (PSD) serves as a non-invasive biomarker of cortical neural oscillatory activity. Characterizing cardiometabolic and cognitive profiles of PSD may facilitate the understanding of the electrophysiological patterns that underly cognitive disorders in older adults.

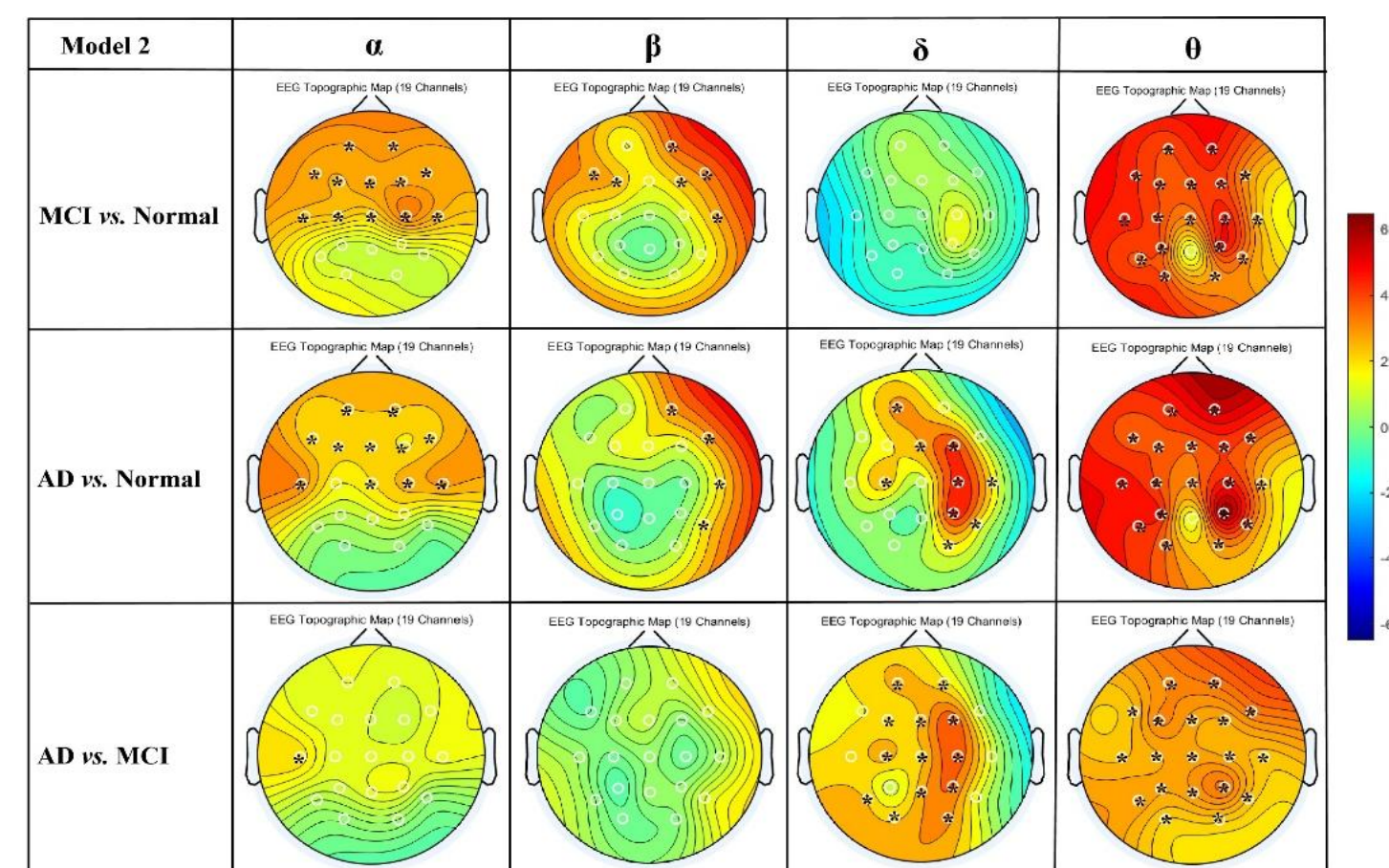
METHODS

We obtained PSD of four frequency bands: delta (0.5-4 Hz), theta (4-8 Hz), alpha (8-12 Hz), and beta (12-30 Hz). We examined the associations of PSD parameters with demographics and chronic cardiometabolic conditions (hypertension, diabetes, hyperlipidemia, stroke, and coronary heart disease). We used ROC curves to assess the capacity of PSD features in differentiating cognitive states.

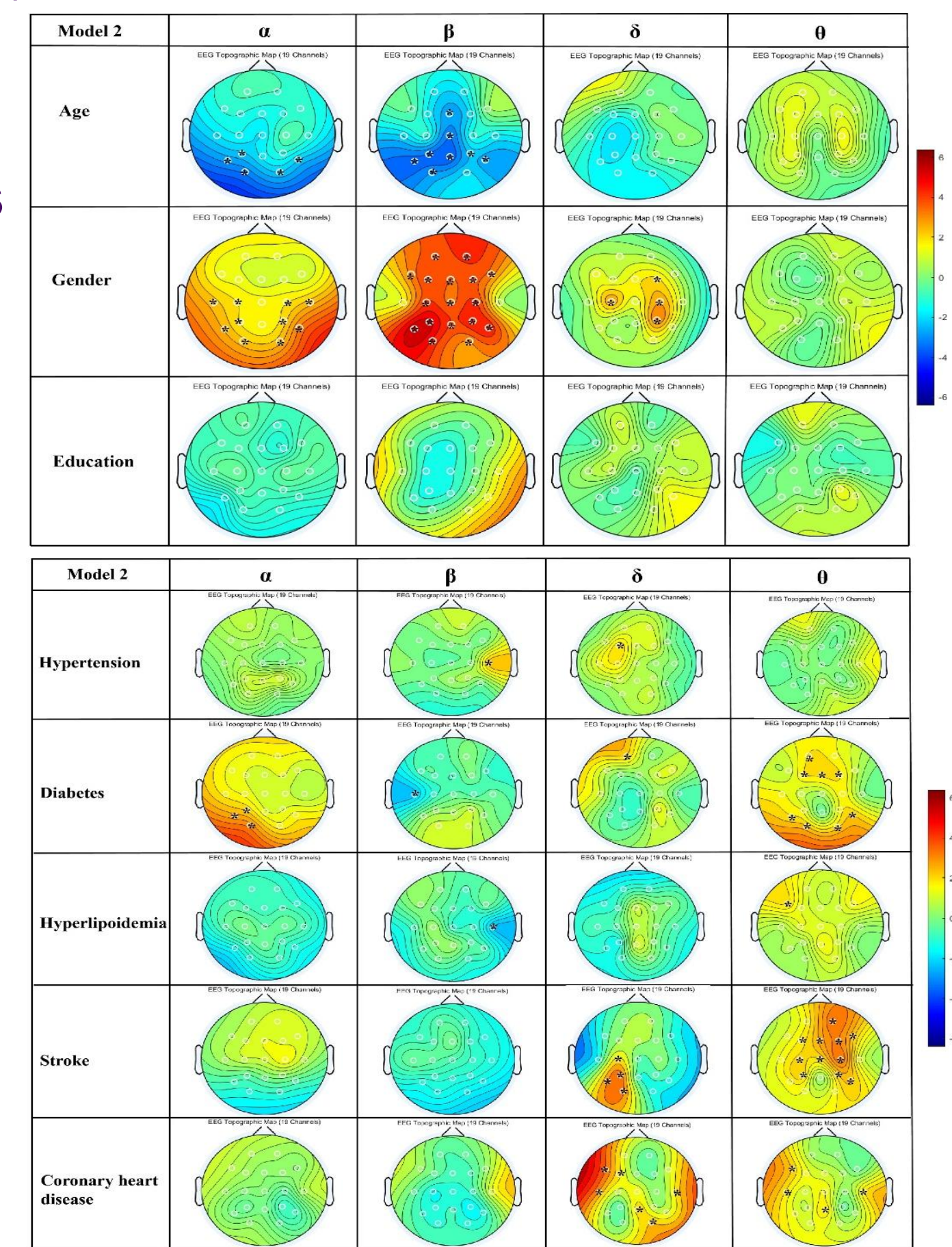
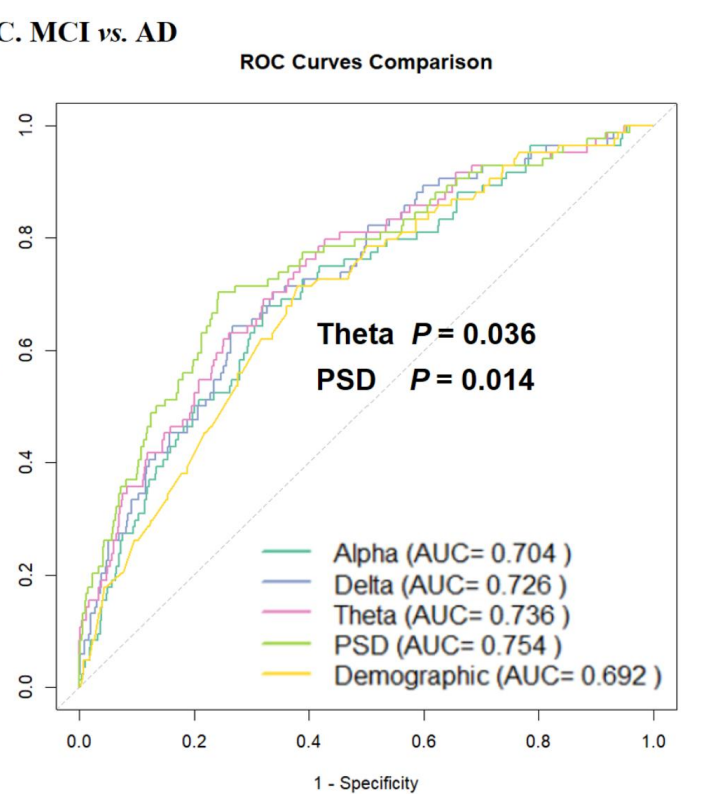
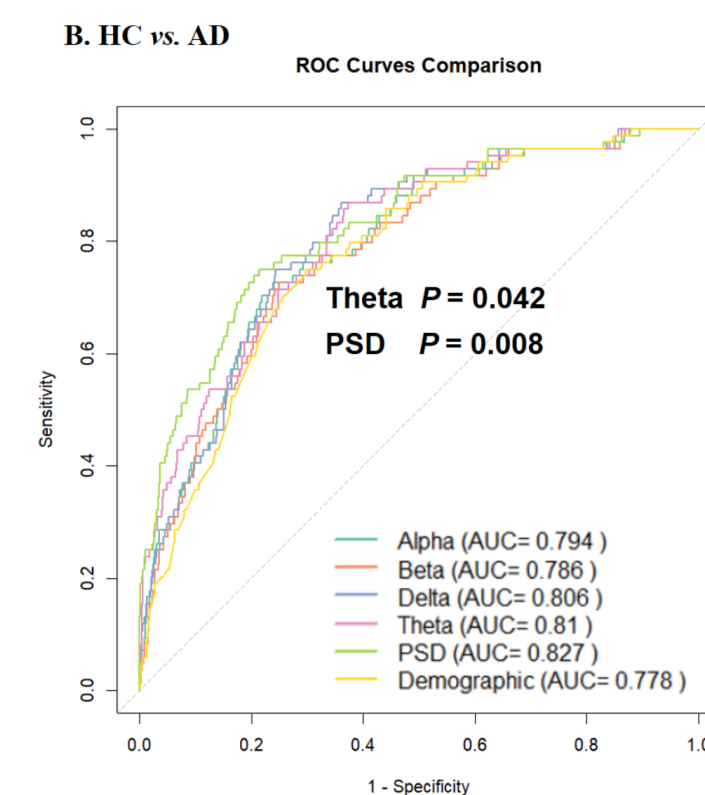
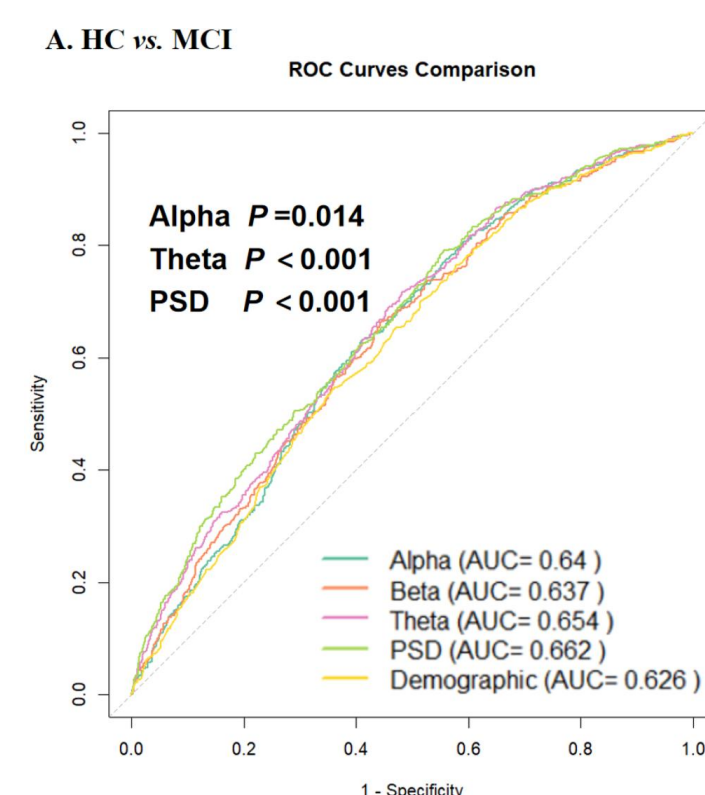
RESULTS

Older age was significantly associated with reduced power in the alpha and beta bands over posterior-occipital regions ($P_{FDR}<0.05$). Women showed increased power in the alpha, beta, and delta bands than men, mainly in the central and occipital regions. Diabetes, stroke, and CHD were significantly correlated with widespread increases in low-frequency band (delta/theta) activity ($P_{FDR}<0.05$).

PSD characteristics manifest as whole-brain increases in the low-frequency bands (delta & theta) in older adults with low cognitive function.



PSD of the theta and delta bands showed good-to-excellent performance in distinguishing between cognitive stages, with AUC of the theta band for distinguishing clinical AD from normal cognition and from MCI being 0.810 and 0.736, respectively. The model utilizing all PSD features achieved the highest diagnostic performance, with an AUC of 0.827 for distinguishing AD from normal cognition.



CONCLUSIONS

The PSD parameters derived from the quantitative EEG, especially those from the theta band, are associated with cardiometabolic disorders and may be a potential biomarker for AD and MCI in rural-dwelling older adults.

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