

Population-based mapping decodes dynamic spatiotemporal EEG microstates across the Alzheimer’s disease continuum in older adults

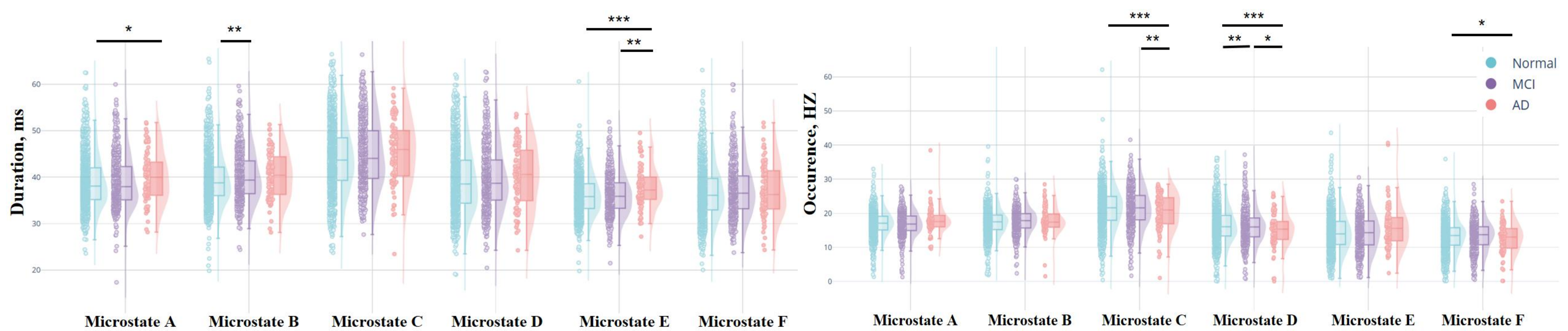
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KEY TAKE AWAY:

- As cognitive function declines, microstates exhibit a significant “slowing” trend that was prolonged duration, reduced occurrence and more active transions;
- EEG in MCI is characterized by dynamic changes in microstates A (auditory network) and D (attention network), whereas EEG in AD is marked by severe disruption in microstates C (default mode network/DMN), D, and E (part of the DMN); Furthermore, the temporal parameters of microstates C and D were associated with global cognition and cognitive domains such as memory and language.
- Microstate characteristics of EEG perform in distinguishing AD from non-dementia (including normal cognition and MCI).

INTRODUCTION	RESULTS	REFERENCES
Resting-state EEG microstates capture millisecond-scale brain network dynamics, offering a potentially promising tool for early detection of Alzheimer's disease (AD). However, the evolutionary patterns of microstates across the AD cognitive continuum have yet to be characterized in the general older population.	Of the 2059 participants, 554 were defined with MCI and 84 with AD. Across the cognitive continuum, EEG microstate parameters exhibited significantly increased duration, reduced occurrence, and active transition matrix ($P<0.05$). Specifically, MCI was associated with dynamic alterations in microstates A and D, whereas AD was related to pronounced disruption in networks C and D (reduced transitions and increased C/E duration) ($P_{FDR}<0.05$).  Duration, ms Occurrence, HZ Microstate A Microstate B Microstate C Microstate D Microstate E Microstate F	Smailovic U, Koenig T, Laukka EJ, et al. EEG time signature in Alzheimer’s disease: Functional brain networks falling apart. <i>NeuroImage: Clinical</i>. 2019;24. Khanna A, Pascual-Leone A, Michel CM, Farzan F. Microstates in resting-state EEG: current status and future directions. <i>Neurosci Biobehavioral Rev</i>. 2015;49:105-113. Babiloni C, et al. Measures of resting state EEG rhythms for clinical trials in Alzheimer's disease: Recommendations of an expert panel[J]. <i>Alzheimers Dement</i>, 2021, 17(9): 1528-1553.
METHODS	CONCLUSIONS	CONTACT
We identified six types of EEG microstate (A-F) and quantified their temporal dynamic parameters (e.g., occurrence, duration, and transitions). We used linear and logistic models to examine associations of microstate parameters with cognitive outcomes. We used ROC curves to assess the capacity of microstate measures in differentiating between cognitive states.	The brain network functional disintegrations across the AD cognitive continuum are characterized by progressive loss of dynamic flexibility in saliency and default mode network (Class C) and attention network (Class D), accompanied by underlying compensatory adaptations. EEG microstate dynamics in older people may act as non-invasive biomarkers for defining cognitive phenotypes across the clinical continuum.	Name: Yan Wang Shandong Provincial Hospital, Shandong First Medical University Email: wwwangyan0904@163.com 

Lower z-scores in memory and verbal fluency were associated with the prolonged duration of all microstate measures and decreased occurrences and transitions of microstates C and D ($P_{FDR}<0.05$). These spatio-temporal microstate dynamics achieved an AUC of 0.833 and 0.745 in distinguishing AD from normal cognition and MCI, respectively.

