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Wearable-Derived Sleep Signatures as Digital Biomarkers of Cognitive Decline in Alzheimer's Disease

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Sleep undergoes substantial alterations with aging and becomes profoundly disrupted in Alzheimer's disease (AD), closely linked to cognitive decline. However, collecting objective, long-term sleep measures in large, real-world populations has remained a major barrier to understanding these mechanisms. In this study, we leveraged wearable technology to generate high-resolution sleep profiles and identify stage-specific sleep characteristics across the cognitive spectrum. We analyzed 79 consecutive days of sleep data from 299 participants in a senior cohort, encompassing individuals with healthy cognition (HC), mild cognitive impairment (MCI), and dementia. Sleep metrics, over 35 variables obtained by the wearable ring, revealed distinct group differences, with dementia patients displaying the most distinct patterns. Notably, two key sleep parameters emerged as robust markers that distinguished cognitive groups, with particular utility in differentiating HC from MCI. Additional analyses of sleep architecture and dynamics further underscored unique stage-dependent alterations. These findings demonstrate that continuous, objective sleep monitoring using wearable devices can sensitively capture cognitive stage-specific sleep signatures. The identified sleep parameters offer strong potential as non-invasive digital biomarkers for early detecting of cognitive decline, underscoring the translational utility of wearable technology in AD research and precision health.