**Unobtrusive Sensing Technology Detects Distinct Longitudinal Sleep Patterns in Individuals with and without Amyloid Pathology** Yu-Hung Cheng, Jennifer Marcoe, Nora Mattek, Wan-Tai M. Au-Yeung, Lisa Silbert, Zachary Beattie, Hiroko H. Dodge, Jeffrey A. Kaye, Chao-Yi Wu. *Gerontechnology* 25(s)

**Purpose** Sleep disturbances have been implicated in the aging process and in neurodegenerative diseases, yet detecting these subtle changes in the real world, particularly with early Alzheimer's disease pathology, remains challenging. Unobtrusive, continuous sleep monitoring may afford a more effective method for identifying early disease-related changes. This study examines changes in core sleep architecture over 2 years among older adults with and without amyloid PET-defined pathology. **Method** Sleep data was collected as part of the DETECT-AD (Digital Evaluations and Technologies Enabling Clinical Translation for Alzheimer's Disease) study (ClinicalTrials.gov, NCT05385913) (Kaye et al., 2023). Electronic bed mats (Emfit QS; Vaajakoski, Finland) were placed under the mattresses in 98 real-world homes consisting of 98 participants (mean±SD age:77.73±6.83; 66% female) living in the greater Portland area, Oregon, USA. Participants were classified as amyloid positive (Aβ+; n=48) or amyloid negative (Aβ-; n=50) status based on Aβ Florbetapir PET imaging and an established cutpoint. Daily recordings of sleep features were aggregated into weekly means. Linear mixed-effects models were used with time (study week), group (Aβ+/ Aβ- status), and time-by-group interaction included as fixed-effects variables. Dependent variables were the percentage of deep sleep (duration in deep sleep/total sleep duration), percentage of light sleep (duration in light sleep/ total sleep duration), and percentage of REM sleep (duration in REM sleep/total sleep duration). All models included random intercepts for subject and were adjusted for baseline age, sex, education, APOE status, and clinical dementia rating (CDR) global score. **Results and discussion** The current cohort contributed an average follow-up of 52.8 weeks (total observations 5,173 weeks, or 36,211 days). Among the 98 participants, 72.4% were cognitively unimpaired (CDR=0) and 27.6% were classified as MCI (CDR=0.5; 18% in Aβ- group; 37.5% in Aβ+ group). There were no baseline (first-week) differences between the Aβ+/Aβ- groups for the three sleep features (deep sleep [p=0.89], light sleep [p=0.36], REM [p=0.58]). A significant group*time interaction was observed for the percentage of deep sleep (beta= $-6.9\times10^{-5}$; p= 0.003; **Figure 1a**), suggesting that those with Aβ+ exhibited a steeper decline in deep sleep proportion over time compared with the Aβ- group. Participants with Aβ+ also showed an increased light sleep proportion over time compared with the Aβ- group (beta=$5.9\times10^{-5}$; p=0.006; **Figure 1b**). There was no group difference in slopes for REM sleep (p=0.72). This shift in sleep stage distribution suggests that a progressive loss of restorative deep sleep may be replaced by less stable sleep stages among those with early AD pathology, highlighting the potential of continuously and unobtrusively collected digital sleep metrics to support early risk stratification and longitudinal monitoring of AD-related changes.

**References**

Kaye, J. A., Marcoe, J., Mar, A. B., Hanna, E. J., Pierce, A., Silbert, L. C., ... & Beattie, Z. T. (2023). DETECT-AD (Digital Evaluations and Technologies Enabling Clinical Translation for Alzheimer's Disease): A simulated anti-amyloid clinical trial using digital biomarkers as primary outcome measures. *Alzheimer's & Dementia*, *19*, e071888.

**Keywords**: Linear Mixed-Effects Model, Deep Sleep Ratio, Light Sleep Ratio, Sleep Structural Disintegration, AD Progression

**Main affiliation and country of first author:** Department of Biostatistics, School of Public Health, Boston University, USA, Email: yhcheng@bu.edu

**Acknowledgement:** The project is funded by NIA (R56AG074321; P30AG066518; K01AG088184)

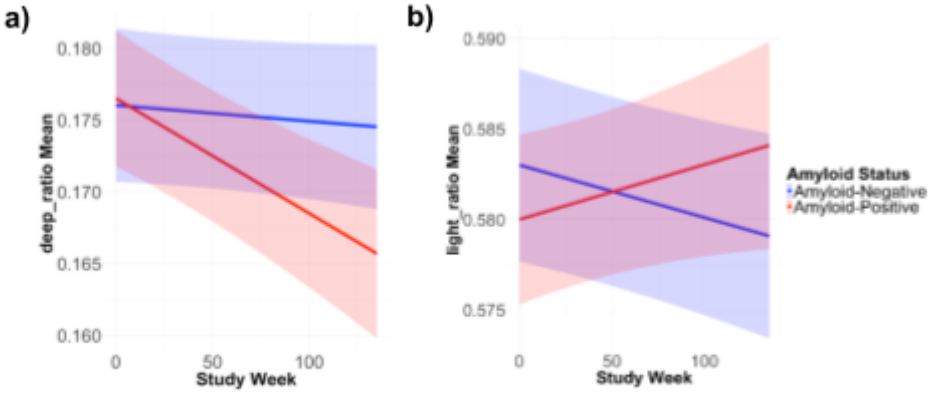


**Figure 1**. a) Least squares estimate of percentage of deep sleep, adjusted for covariates. b) Least squares estimate of percentage of light sleep, adjusted for covariates