Ecological momentary analysis of high-frequency cognitive testing and its relationship to fatigue and sleep across neurodegenerative and inflammatory disorders.

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SUBMISSION DETAILS

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Methodological Issue Being Addressed Do high-frequency cognitive tasks, done within a naturalistic environment, track fluctuations in transdiagnostic symptoms like fatigue and sleepiness?

Introduction Cognitive performance, fatigue and sleep-quality vary within and between individuals over time. Given the prevalence of fatigue and sleep disturbances across diseases, the IDEA-FAST consortium is investigating objective digital biomarkers that can be assessed through high-frequency tests in a home environment. Here, we compare methods for best estimating whether fluctuations in cognitive performance can provide objective digital biomarkers for self-reported sleep and fatigue.

Methods The IDEA-FAST feasibility study includes data from 22 patients with Huntington's and Parkinson’s disease (neurodegenerative disease, NDD) and 65 patients with primary Sjogren's syndrome, rheumatoid arthritis and systemic lupus erythematosus (immune-mediated inflammatory diseases, IMID), and 37 healthy participants. A psychomotor vigilance test (PVT) for alertness and attention and a digit substitution test (DST) of global cognition were administered daily via smartphone app. Participants did two repetitions of the tests per day for five days, over four weeks and self-reported fatigue and sleep using validated scales. We used daily aggregated means for performance in the cognitive tests and related this to PROs for sleep and fatigue using correlation, mediation and mixed effect linear models. Mean square successive difference (MSSD) and autocorrelation estimated whether temporal instability and temporal dependency of performance was related to fatigue and sleep.

Results Average daily PVT reaction time showed a significant correlation with baseline sleepiness, $r(57)=0.36$, $p<0.01$, and quality of sleep, $r(57)=0.41$, $p<0.01$ in the IMID group. DST reaction time and physical fatigue were also significantly correlated, $r(16)=0.70$, $p<0.01$, in NDD patients. Mediation analysis showed that the relationship between sleep and PVT performance was not mediated by fatigue, and the relationship between DST and fatigue was not mediated by sleep quality.

In mixed effect linear models, daily self-reported sleep and fatigue, corrected for age, with group (NDD, IMID, HC) as a random effect, showed daily mean reaction time in the PVT to be a significant predictor of daily sleep quality ($F(1,31)=6.30$, $p<0.05$), but not overall daily fatigue ($F(1,9.88)=0.1$, $p=0.76$).

Autocorrelation and MSSD were used to index temporal dependency and temporal instability of daily cognitive performance and fatigue and sleep measures. In correlations, corrected for age, temporal dependency in overall fatigue was strongly correlated with temporal dependency in reaction time in DST ($r=0.51$, $P<0.001$). Temporal stability in PVT reaction time was associated with temporal dependency in sleep quality ($r=-0.27$, $p<0.001$).

Conclusion High-frequency cognitive testing has potential as an objective digital biomarker for fatigue and sleep. We show sensitivity across disease groups (NDD and IMID), and independent effects across self-reported measure of sleep and fatigue at both baseline, and collected daily. Importantly, measures indexing relative stability and large variations in self-reported sleep and fatigue correlate with fluctuations in cognitive performance.

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Keywords

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Guidelines I have read and understand the Poster Guidelines

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