Background: Brain Age

Diagnostic biomarkers for brain aging are lacking. Our lab previously developed a machine learning model that predicts an estimate of chronological age (CA) from sleep EEG. This estimate is called brain age (BA). The difference between BA and CA is the brain age index (BAI). BAI may serve as a brain health biomarker.

Methods

We used doubly robust estimation to adjust for potential confounders (age, sex, race, tobacco use disorder, alcoholism), in order to estimate the effect of HIV on BAI.

For each subject, the model predicts their BAI had they been diagnosed with HIV or not. We compared the group averages of these potential outcomes. This difference in average BAI was 3.17 years (p = 0.02, CI = [0.40, 5.51]).

We also performed mediation analysis to estimate the contributions of mediation and interaction to the total effect of HIV on BAI. Our causal diagram with two mediators is shown as an example.

Results: Effect of HIV and Mediators on BAI

We found that mediation and interaction (CIE + IntMed) accounted for 30% of the total effect on average. The average controlled direct effect was 2.42 and significant.

Results: BA Features

Delta power (slow waves) in N2 sleep are reduced relative to alpha and theta in HIV+ subjects.

Conclusion

Our retrospective analysis provides new evidence that people with HIV experience accentuated aging, and that this process is reflected in the EEG of sleep. In particular, the reduction in slow waves during non-REM sleep that we observed in HIV is implicated in cognitive decline and dementia risk. We also found that multiple mediators account for increased brain age in HIV. An interventional study may be warranted to test whether treating these mediators would mitigate brain aging in HIV.

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