Activity Trackers Show That Inconsistent Sleep Patterns are Associated with Severe Forms of Anxiety and Depression

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Purpose: Behavioral data inferred from activity trackers (e.g., sleep patterns) can be used to further develop the link between behavior and health outcomes. For diseases such as anxiety and depression, where symptoms expressed are highly behavioral, this link can be used to understand how to identify high-risk patients and track disease progression. In this analysis, we examined the association between health outcomes, healthcare utilization and behavioral traits for individuals with a self-reported diagnosis of anxiety or depression.

Methods: We invited members of an online health population to participate in a study for individuals with anxiety or depression. We collected self-reported data on their anxiety and/or depression history and symptoms (e.g., PHQ-9, GAD-7), healthcare utilization (number of hospitalizations, ER visits), and current medications. We calculated per-patient mean and standard deviation of daily sleep metrics using activity information passively gathered by health trackers and apps over the past three months under informed consent. For 1,102 individuals with linked activity data, we assessed the relationship between symptoms, utilization and behavioral traits, accounting for age, race and sex where appropriate.

Results: More severe forms of anxiety and depression (higher PHQ-9 and GAD-7 scores) were significantly associated with higher number of urgent care, emergency room and physician visits. More severe forms of depression (high PHQ-9 scores) were also significantly associated with inconsistent sleep patterns (i.e., standard deviation of daily sleep duration), more disordered sleep (i.e., spending a great amount of time in bed awake), and sleeping less. Compared to those not receiving treatment, individuals who were taking anxiety and/or depression related medications were more likely to sleep more, yet also have inconsistent sleep patterns, while individuals who participated in anxiety and/or depression related therapy were more likely to take frequent naps during the day. We also found that individuals who had been hospitalized for anxiety and/or depression were more likely to have inconsistent sleep patterns.

Conclusion: Our results indicate certain behavioral traits (e.g., inconsistent sleep patterns) captured by passive tracking are associated with more severe forms of anxiety and/or depression (as indicated by validated severity scales, healthcare utilization and receiving treatment). Further longitudinal research should be conducted to determine if passive tracking of behavior can predict changes in disease severity and healthcare utilization.