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Exploring Digital Biomarkers for Depression Using Mobile Technology

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Introduction & Background

With the advent of ubiquitous sensors and mobile technologies, wearables and smartphones offer a cost-effective means for monitoring mental health conditions, particularly depression. These devices enable the continuous collection of behavioral data, providing novel insights into the daily manifestations of depressive symptoms.

Objectives & Approach

The present study summarizes findings from our five recent investigations that explored the relationships between depression severity and digital biomarkers captured by wearables and smartphones. These studies analyzed data from RADAR-MDD, a multinational mobile health program, involving 623 participants and tracked for up to two years. Participants' depression severity was measured biweekly using the PHQ-8 questionnaire conducted via smartphones. Concurrently, participants' Fitbit and smartphone data were also collected. Given the longitudinal nature and repeated measurements for each participant, multilevel modeling techniques were employed to analyze the data.

Relevance to Digital Footprints

Our approach involved extracting features from passive data that reflect various aspects of daily behavior—such as sleep quality, social interaction, physical activity, and walking patterns—akin to digital footprints.

Results

We found several significant links between depression severity and various behavioral biomarkers: elevated depression levels were associated with diminished sleep quality (assessed through Fitbit metrics), reduced sociability (approximated by Bluetooth), decreased levels of physical activity (quantified by step counts and GPS data), a slower cadence of daily walking (captured by smartphone accelerometers), and disturbances in circadian rhythms (analyzed across various data streams).

Conclusions & Implications

Leveraging digital biomarkers for assessing and continuously monitoring depression introduces a new paradigm in early detection and development of customized intervention strategies. Findings from these studies not only enhance our comprehension of depression in real-world settings but also underscore the potential of mobile technologies in the prevention and management of mental health issues.

