Digital Activity Tracker-Based Behavioral Characteristics Associated with Comorbid Mental Health Illness Symptoms Among Individuals With Diabetes

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Introduction

Behavior and lifestyle habits play an important role in defining long-term health outcomes of an individual. This is especially true for an individual burdened by a chronic condition, whose behaviors may directly impact the management of the condition. The recent rise in popularity of digital health devices, activity trackers and apps has created the opportunity to quantify behavioral patterns with the ultimate goal of identifying those that are associated with specific health outcomes. In this study, we consider a population of patients with digital activity trackers who self-reported as diabetic. Research has shown that individuals with type 1 or type 2 diabetes have a higher risk of developing mental health illnesses (MHI) such as depression and anxiety than individuals without diabetes[1]. However, many individuals with diabetes experience undiagnosed MHIs due to inadequate screening or diagnosis. The goal of this study is to understand whether there are significant digital activity tracker-based behavioral characteristics that can help identify individuals with MHI symptoms in a population of individuals with diabetes. Early identification of MHI comorbidities may enable interventions to prevent poor diabetes management and progression of MHI.

Methods

Members of an online health community that use activity trackers and apps were invited to participate in a survey that included self-reports of diagnoses and symptoms, ratings of perceived overall health status, physical health, and mental health, and characteristics such as age and gender. We used the members' activity information recorded from activity trackers and apps over the past 12 months to compute per-individual daily features that indicate the tracking rate, consistency, and intensity of step counts and sleep duration. When comparing digital activity tracker-based behavioral characteristics between individuals with diabetes and individuals with diabetes and MHI, we conducted nonparametric tests and t-tests, and examined the false discovery rate.

Results

A total of 1,330 members reported a diagnosis of diabetes, and 336 (25.3%) of those individuals reported having MHI symptoms in the last year. Of those who reported MHI symptoms, 259 (77.1%) reported having anxiety symptoms and 237 (70.5%) reported having depression symptoms. Among individuals diagnosed with diabetes, those with self-reported symptoms of a MHI walk on average 1,469 steps per day less than individuals without MHI symptoms (p<0.001). Those who reported MHI symptoms had significantly lower frequency of tracking steps than individuals without symptoms (p<0.001). These individuals also had significantly less frequent days with high activity (more than 10,000 steps/day) and more frequent days with low activity (fewer than 500 steps/day) compared to individuals with no reported MHI symptoms (p<0.01). Despite similar mean sleep lengths between both groups, individuals experiencing MHI symptoms slept for longer durations (more than 9 hours/day) significantly more frequently than individuals without symptoms (p<0.01).

Conclusion

Our preliminary results indicate that digital activity tracker data can help identify behavioral traits associated with self-reported symptoms of MHI in a population of individuals with self-reported diabetes. Traditionally, clinicians use self-reported data to screen and measure the progression of MHI. Digital activity tracker-based behavioral data may enrich and supplement this self-reported data, and can potentially help detect MHI and track MHI symptoms. Further research should focus on detecting behavioral markers of onset of and progression of MHI symptoms in individuals with diabetes as soon as they begin to develop.

References

1. Ducat L, Philipson LH, Anderson BJ. The mental health comorbidities of diabetes. JAMA. 2014;312:691-2.