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**Passive Monitoring of Physical Activity Using a Fitbit Charge 3 in Individuals at Risk for
Depression**

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Abstract

Purpose: The purpose of this study was to measure the effectiveness of using an activity tracker, Fitbit Charge 3, on depression scores and physical activity scores in individuals at risk for depression.

Design: This was a pilot project that passively monitored step count activity using a Fitbit Charge 3 over an 8-week intervention period in individuals who were at risk for depression. Individuals were screened for depression risk using the patient health questionnaire-2 (PHQ-2).

Methods: Individuals were recruited from a convenient sample. Selection criteria was limited to adults ages 18-69 with a score >1 on the patient health questionnaire-2 (PHQ-2) indicating risk for depression and who owned or had access to a smartphone. Upon enrollment, individuals completed the patient health questionnaire-9 (PHQ-9), the international physical activity questionnaire (IPAQ) and were issued a Fitbit Charge 3. Individuals were asked to wear their Fitbit Charge 3 for 8 weeks. Step count data was automatically uploaded into the individual's electronic health record (EHR) every 24hrs via Bluetooth integration with the Fitbit Charge 3. At the end of the 8 weeks, individuals completed the PHQ-9 and IPAQ. Step count data was downloaded from the EHR at the end of the intervention.

Results: Individuals with lower PHQ-9 scores had higher IPAQ scores and higher step counts. These individuals indicated they would continue to use the Fitbit post study. In most individuals, PHQ-9 scores decreased from baseline while IPAQ scores increased. Overall step count peaked at week 5, then decreased but stayed above baseline.

Conclusions: Physical activity is an important component for mental and physical wellbeing. Using commercially available devices can provide clinicians an important tool in encouraging patients to engage with improving their overall health.

Keywords: physical activity, Fitbit, depression, passive monitoring

Introduction

In their January 2020 fact sheet, The World Health Organization (WHO) lists depression as a leading cause of disability with over 264 million people affected worldwide.¹ Depression negatively impacts the health of many people by limiting their ability to be physically active. This limitation in physical activity can lead to other behavioral and physical issues resulting in an overall poor quality of life.

Being physically active can be a useful coping mechanism and provide some people with the same benefits as medication therapy.² People who are physically active report having an improved mood, better sleep patterns and a more positive state of mind.² Using an activity tracker to monitor physical activity may be helpful by providing immediate feedback to the individual and their care team. Activity trackers and wearable technology can be prescribed and may be a cheaper alternative to medication.³

Individuals with behavioral health issues have a decreased life expectancy because of the associated health risks common in people with a sedentary lifestyle⁴. Adults with depression tend to be less active which puts them at risk for other medical issues such as obesity, cardiovascular disease and risk for suicide⁵. For older adults, depression can be a chronic, debilitating disease and adding antidepressant medications to their current medication regime may put them at higher risk for falls and other medical issues due to medication interactions⁶. Physical activity is one of the indicators evaluated when reviewing an individual's treatment plan for depression⁷ because depression can act as a barrier to participating in physical activity leading to an overall poor quality of life⁸.

For some individuals, physical activity may be a useful coping mechanism⁹. Participating in some type of physical activity at least twice a week may decrease symptoms of depression and help maintain physical and psychosocial health³. Available depression screening tools provide a measurement of a person's depression severity at a single point in time. Most of the tools are self-

reporting and rely on the person to answer the questions honestly and accurately. Digital technology provides a way to capture individual specific data over time with less reliance on self-reporting.

Activity trackers provide individual's and clinicians with a tool for tracking and monitoring physical activity that can be easier to implement than self-reporting tools or mobile apps.

Existing research on using activity trackers in individuals with behavioral health issues is limited. There is some indication that monitoring physical activity can provide objective information early allowing for quicker intervention^{7,8} and others cite that activity trackers offer an easy innovative way to engage individuals in improving their physical activity⁴. Some individuals with behavioral health issues indicated that wearing an activity tracker provided motivation to increase their physical activity⁵.

The objective of this project was to measure the effectiveness of using an activity tracker, Fitbit Charge 3, on depression scores and physical activity scores in individuals at risk for depression.

Methods

This was a pilot project that passively monitored step count activity using a Fitbit Charge 3 over an 8-week intervention period in individuals who were at risk for depression. IRB approval was obtained. The patient health questionnaire-2 (PHQ-2) was given as part of the routine screening for individuals in this family health care practice located in the Northeast. The PHQ-2 questionnaires were reviewed at time of visit to identify those at risk for depression. Adults 18 or older were conveniently selected based on a positive screening of the PHQ-2 that is routinely collected as part of the assessment data in the clinic.

Sample and Setting

Eight individuals from a family health care practice with a positive patient health PHQ-2 agreed to participate. The family medicine practice services individuals from infants to seniors and is part of a larger health care organization. Individuals were also required to own or have access to a smart phone,

so they could download applications that authorized step count data sharing between the Fitbit Charge 3 and the individuals electronic health record (EHR). The mean age of individuals was 45 years old with a range of 18 years old to 65 years old. There were four men and four women.

Procedure

Once informed consent was obtained, each individual completed two baseline questionnaires; the patient health questionnaire-9 (PHQ-9)¹⁰ and the international physical activity questionnaire (IPAQ)¹¹. The PHQ-9 is a 9-item self-reporting depression scale with severity scoring ranging between 0 and 27. Scores are grouped into five categories: 0-4 no evidence of depression, 5-9 mild depression, 10-14 moderate depression and 20 or > indicates severe depression. The IPAQ is a 7-item self-reporting tool that estimates an individual's physical activity over the previous seven days. IPAQ scores are grouped into three categories: low, moderate or high. The higher the score the more active the individual.

The PHQ-9 provided a baseline depression score and the IPAQ assessed activity level for the previous seven days. Individuals were issued a Fitbit Charge 3 at no cost and instructed on how to download and authorize the needed applications. The applications provided a secure link for data sharing between the Fitbit Charge 3 and the EHR. Individuals were asked to wear the Fitbit Charge 3 continuously during the intervention period. Data was automatically uploaded from the Fitbit Charge 3 to the EHR via existing Bluetooth integration every 24 hours at midnight. At the end of the 8-week intervention period, step count data was downloaded from the EHR, data sharing was deactivated, and individuals received a post intervention PHQ-9 and IPAQ questionnaire to complete using Qualtrics.

Results

A total of eight individuals provided complete data points. Comparing PHQ-9 and IPAQ scores, individuals who reported low PHQ-9 scores at baseline reported higher activity on their IPAQ. The same group reported improved PHQ-9 scores at the end of the intervention. Individuals with higher

PHQ-9 scores at baseline were not as engaged with the Fitbit Charge 3 and had minimal change in activity from baseline to the end of the intervention. Table 1 describes the mean changes.

Post intervention activity scores showed a 24% positive percent change from baseline. Overall, 63% of individuals reported an increase in overall physical activity from baseline. Figure 1 depicts how step count activity in all individuals peaked at week 5 then decreased but remained above baseline.

Discussion

Step count data was automatically uploaded daily from the Fitbit app into the EHR during the eight-week intervention period. Upon enrollment, 62% of individuals started sending step count data to their EHR on day one. Average step count gradually increased from baseline, peaking at week five then gradually decreased but remained above baseline. Over 50% of the individuals reported an increase in step count from baseline. One individual had intermittent data and one individual stopped transmitting after week four. Wearing the activity tracker was motivational for some, but not all the individuals found a benefit wearing the activity tracker. This is consistent in the literature as initially the newness of a device provides the initial motivation but this wanes over time as the individual does not perceive any benefit to the continued use of wearing the activity tracker¹².

Overall, there was a 22% positive percent change in step count from week 1 to week 8 with some individuals seeing a 92% increase in step count from the beginning to the end of the intervention period. Individuals who reported lower baseline PHQ-9 scores of mild to no depression increased their physical activity from baseline and reported they were more likely to continue wearing the Fitbit Charge 3 at the end of the study period. Similar studies have shown that individuals are interested in sharing their personal data with their clinician using commercially available technology¹³. In this study, the care team was able to access step count data in the individuals EHR and discuss their physical activity during visits. For these individuals, their motivation is based on knowing someone from their care team is viewing their data⁵.

Individuals reporting higher baseline IPAQ scores also reported feeling more motivated to move. One individual in an open-ended response, reported being eager to increase step count record from the previous day. Some individuals enjoy being able to use trackers to set activity goals and then monitor their activity patterns over time to create better habits¹⁴. Individuals who reported lower levels of depression and higher activity levels were taking at least one prescribed medication for treating their depression. Conversely, individuals who scored moderately depressed on the PHQ-9 had low IPAQ scores indicating limited physical activity prior to the intervention. Individuals who scored moderately depressed indicated they were not taking any prescribed medications to treat their depression. Physical activity levels are a good indication on how individuals are responding to treatment and medication use can help stabilize depression symptoms⁷. Passively monitoring physical activity in individuals who are at risk for depression was seen to have benefit in individuals who were active prior to the intervention and being treated for their depression symptoms.

Conclusions

In individuals who reported low depression scores, the activity tracker was a beneficial tool to keep them engaged in being more active. They reported being interested in setting goals and being more active in general. Individuals with higher depression scores wore the activity tracker but reported they were not interested in engaging with the tracker. Improving physical activity is challenging in all populations. Individuals with higher depression scores may need a combination of treatment options such as medication, coaching, and social support to improve their depression symptoms¹⁵. The activity tracker can be easily integrated into most treatment plans and provide actionable data to the individual and the care team. The trackers used in this project were integrated into the EHR and data was uploaded nightly at midnight. This data was available to all members of the care team for evaluation and easily accessible within the patient's EHR.

Physical activity is one of the indicators evaluated when reviewing an individual's treatment plan for depression ⁷. Activity trackers provide individuals and clinicians with a tool for tracking and monitoring physical activity that can be easier to implement than self-reporting tools or mobile apps. Increased physical activity has many positive benefits on a person's physical and emotional health and activity trackers are an easy to use technology that are becoming more accessible to many people.¹⁶ Using commercially available devices can provide clinicians with real time data to make timely decisions and encourage individuals to engage in improving their overall health.

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Table 1: Mean change PHQ-9 and IPAQ scores

Pre-intervention PHQ-9	Post-intervention PHQ-9	Pre-intervention IPAQ	Post-intervention IPAQ
M= 10.5	M= 5.25	M= 3,029	M= 4,001

M=mean

Figure 1: Average weekly step count