

The Use of Fitbit Technology Among Rural Obese Adolescents

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Abstract

Mobile health technology can lead to effective behavior changes in adults, however, there is little data on the impact of this technology in teenagers or in rural areas. This study assessed qualitative and quantitative aspects of FitBit use among rural obese teens. Teens living in rural areas with a body mass index greater than 95% for age were included. Subjects completed a health assessment, received standardized counseling, were provided a FitBit, and were assessed at 3 and 6 months. 24 of 34 subjects completed the study. 46% lost weight during the 3-month intervention, 46% gained weight, and 8% did not change. There was a statistically significant decrease in FitBit usage over time. The use of social networking with FitBit had no impact on weight or daily step counts. While most subjects reported satisfaction with FitBit, quantitative data did not significantly improve, and the excitement of this technology was short-lived.

Keywords: Adolescent Health; Fitbit; mHealth Technology; Obesity; Rural Health

Introduction

Obesity is now a global pandemic and a leading cause of death worldwide [1]. Regular physical activity is critical in preventing functional morbidity including cardiovascular disease, however only a quarter of adolescents meet the recommended minimum 1-hour of daily moderate or higher intensity physical activity [2]. Lack of physical activity can be compounded in rural areas, where adolescents may have less access to gyms, community centers, and parks. Physical activity may be inherently different among rural adolescents compared to those in urban areas [3], and in a recent meta-analysis, all but one study suggested that residence in rural areas was associated with higher prevalence or increased odds of obesity compared to urban areas [4].

The use of mobile health (mHealth) technology has grown in recent years, with the expansion of smartphone applications (apps) and wearable activity trackers like Fitbits [5]. These devices have the advantage of real time tracking, reminders for physical activity and goal setting. Several studies have demonstrated that the

use of mHealth technology can lead to effective behavior changes to increase physical activity [6-11]. In a recent systematic review, most studies evaluating the efficacy of wearable activity trackers were performed in middle age adults over the age of 30, with only a few studies on young adults age 18-30 years [12]. One study evaluating 30 adolescents using an mHealth app, wearable activity tracker and Facebook group did find that participation among adolescents was rated as enjoyable, but only qualitative data was collected [13]. Another study evaluated the use of FitBits in older obese adults in a rural area. No quantitative data was collected, but Fitbit satisfaction and feasibility were again demonstrated [14].

There is clearly a paucity of literature concerning the effectiveness of wearable activity trackers in adolescents, specifically those in rural areas that may be at highest risk for obesity and physical inactivity. The goal of this study was therefore to assess qualitative and quantitative data among a group of rural obese adolescents using a wearable activity tracker. We describe a prospective study using FitBits in rural obese adolescents for three months, with post intervention follow up at six months. FitBits allow for tracking of steps, but also social networking with peers. This study evaluates whether the use of FitBit technology in rural

areas is successful in promoting increased physical activity measured by participants' step counts, and whether social networking impacts physical activity in a positive manner.

Materials and Methods

This is a prospective study assessing the impact of FitBit technology on physical activity among adolescents in a rural area. Subjects were identified by an initial chart review using diagnosis codes for "Obesity" or "weight Gain." Female subjects were obtained from both the pediatric & adolescent gynecology clinic and general pediatric clinic at an academic center. Male subjects were obtained from the general pediatric clinic only. The adolescent gynecology clinic patients were included as weight related menstrual complaints are a common referral to the academic center, and it broadened the patients available to participate in the study.

Inclusion criteria were body mass index greater than 95th percentile for age, age 13-18 years, residence in a rural county based on rural codes, home internet access, parent or guardian willing to be present for study consent and procedures, and no restrictions by a health care provider for physical activity. Rural codes were based on United States census urban/rural codes. Subjects meeting all inclusion criteria were called by the research team and invited to participate in the study. Subjects that agreed to participate were scheduled for an initial visit with a parent or legal guardian present. A total convenience sample of 40 subjects were recruited, with equal number of males and females (n=20).

At the initial visit, child assent for subjects age 13-17 years and informed consent for subjects age 18 was obtained. Parental consent was obtained for subjects age 13-17 years. Baseline demographics included age, gender, and ethnicity. Initial anthropometric data included height, weight, body mass index, blood pressure, and pulse. Subjects completed a short survey including a seven-day recall of dietary intake, daily physical activity, screen time, and sports participation. The survey also included the Rosenberg self-esteem questionnaire to assess self-image and quality of life. Laboratory studies at the initial visit included a lipid profile, glucose and insulin level.

All subjects received standardized diet and exercise counseling from a pediatrician (JKG) on the research team in concordance with the American Academy of Pediatrics guidelines for diet and exercise in adolescence. The subjects were then being provided a FitBit Charge and instructed on use of the technology. Each participant was given a standard goal of 10,000 steps per day. They were instructed on all aspects of FitBit use including that of social networking with peers if desired. They were also invited to join a private, invitation-only FitBit group created for the study to interact with other participants. This group was optional, and no messages or reminders were sent out by the research team using this platform.

At three months following the intervention the subjects then had a follow up visit. Height, weight, body mass index, blood pressure, and pulse were again measured, along with repeat laboratory studies. Participant's daily step counts were collected by downloading data from their FitBit to the study database. Percentage of days wearing the FitBit, and number of days that the goal of 10,000 steps was reached was recorded. Whether or not they joined the private group or whether they used the option of social networking with peers was also recorded by survey. Subjects again completed a survey including seven-day recall of diet, exercise, screen time and sports activity. The survey also included the Rosenberg self-esteem questionnaire and an assessment of satisfaction with FitBit technology using Likert scale questions. Each subject was given a \$25 gift card incentive for attending the three-month follow up visit, and was allowed to keep the FitBit at the conclusion of the study.

At six months following the subject's initial visit, each subject was contacted by phone and asked about FitBit device use. Frequency of use and social networking was assessed along with FitBit satisfaction. Comparison was made among males and females regarding differences in physical activity and differences in social networking. Any changes in body weight, BMI, blood pressure, pulse and laboratory values before and after Fitbit were compared. Approval was obtained from the Institutional Review Board prior to study commencement.

Results

At the intake visit, 34 adolescents were enrolled with 18 females and 16 males. The average age was 15 (range of 13-18) and the average BMI at enrollment was 36.3 kg/m²(SD 8.1) with a range of 26-63.8. All patients were Caucasian. On average, subjects reported exercise at least 2.5 days out of the week. Only 7 (20.5%) helped plan what groceries were purchased in their household but 23 (67.6%) participated in picking items at the grocery store. 18 subjects (52.9%) reported eating school lunches, and the remaining 16 (47%) packed their lunch for school. Twelve subjects (35.2%) participated in an organized sport, with only 4 (11.7%) participating in two sports teams. All subjects reported using social media of some sort (Facebook, Twitter, Instagram, or Snapchat), with 29 (85.3%) with daily use, and 5 (14.7%) subjects reporting weekly use.

Twenty-four of the adolescents (70.6%) (9 males and 15 females) attended the follow up visit at three months. Table 1 demonstrates intake and follow up anthropometric data and laboratory results. There was no overall difference in weight or BMI at follow up. Eleven subjects lost weight (46%), 11 subjects gained weight (46%), and 2 subjects remained the same weight (8%). There were no differences in gender groups among those who lost or gained weight. There was a significant change in pulse rate among those at follow up compared to intake (92.6 vs 79.4, p=.003). There were

also no significant changes in glucose, lipid levels, or insulin levels at intake compared to follow up, except for HDL levels. Among those who lost weight, insulin levels did decrease at follow up (73.5 vs 52.5, $p=0.245$) and among those gaining weight, insulin levels increased at follow up (47.6 vs 92.1, $p=0.199$), but was not significant. Subjects who lost weight had a greater increase in HDL levels at follow up compared to those who gained weight (+7.9 vs +5.4, $p=0.367$) yet this did not reach statistical significance.

	Intake Visit	3 months Follow up	p value
Weight (pounds)	237.9 (SD 53.3)	240.8 (SD 57.4)	0.129
BMI (kg/m²)	37.3	37.4	0.642
SBP	118.5 (SD 10.3)	122 (SD 13.5)	0.179
DBP	77.7 (SD 8.1)	75.7 (SD 7.2)	0.24
Pulse	92.1 (SD 16.4)	79.4 (SD 13.0)	0.003
Glucose	93.6 (SD 47.4)	97.1 (SD 59.8)	0.382
Cholesterol	165.3 (SD 29.6)	172.9 (SD 34.6)	0.797
Triglycerides	153.2 (SD 76.5)	149.5 (SD 60)	0.807
HDL	47.2 (SD 14.8)	53.4 (SD 20.3)	0.008
LDL	90.1 (SD 22.5)	89.7 (SD 26.2)	0.94
VLDL	28.1 (SD 8.6)	29.8 (SD 11.9)	0.474
Insulin	59.6 (SD 51.9)	52.5 (SD 72.6)	0.64

Table 1: Comparison of anthropometric and laboratory data among subjects completing 3-month intervention (n=24).

Self-esteem scores among subjects did not change from intake to 3-month follow up (19.9 vs 19.8, $p=.992$). There were no significant changes in seven-day diet recall in regard to fruit, vegetable, and soda intake. Number of days per week that subjects reported exercise outside of normal activity also did not change from intake to follow up (2.3 days vs 2.2 days, $p=0.916$).

Use of the FitBit device declined over the study period. Figure 1 demonstrates the average daily steps taken by subjects which declined from month 1, 6462 steps, to months 2 and 3 (5113 and 5101 steps, respectively).

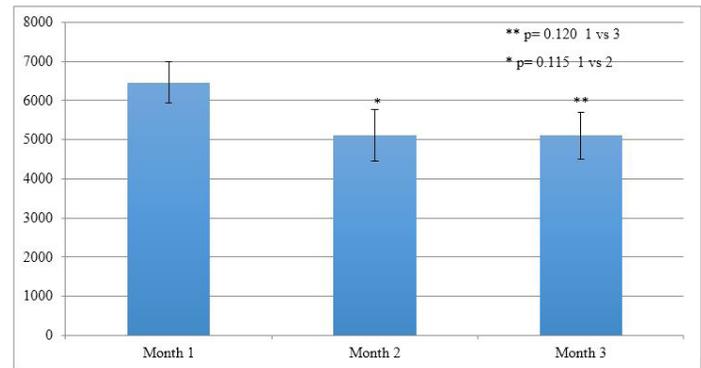


Figure 1: Average daily steps taken during each month of the intervention. (n=24).

The average number of days of use declined as well, as noted in figure 2, with subjects using the FitBit an average of 26 days during month 1, to 21 days in month 2 and 19 days in month 3. Only two subjects (8.3%) reached the goal of 10,000 steps per day for at least half of the days per month for months 1 & 2. Only one subject (4.1%) accomplished this goal for month 3. When comparing those subjects who lost weight at follow up to those subjects who gained weight, there was a difference in the average number of steps each month, although it did not reach significance. Those subjects who lost weight had higher daily step counts each month compared to those who gained weight for month 1 (6957 vs 5957, $p=0.808$), month 2 (5209 vs 4773, $p=0.339$), and month 3 (5614 vs 4466, $p=0.282$). There was no difference between those who lost or gained weight regarding the number of days the FitBit was used each month.

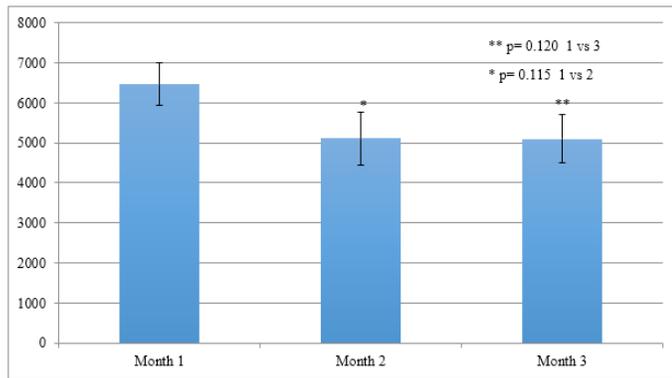


Figure 2: Average daily steps taken during each month of the intervention. (n=24).

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Ten of the 24 subjects networked with other friends using their FitBit. Among these, 5 (50%) found networking helpful, 4 (40%) found it “Somewhat Helpful” and 1(10%) found it “Not Helpful”. Table 2 demonstrates the effect of social networking on number of days of FitBit use and daily step counts. While the group who participated in social networking on average used the FitBit more days and averaged higher step counts each month, this did not reach statistical significance.

	+Social Network (n=10)	No Social Network (n=14)	p value
Mean Days of FitBit Use			
Month 1	27.5	24.8	0.37
Month 2	22.5	19.7	0.593
Month 3	22.2	16.8	0.277
Mean Daily Step Count			
Month 1	6730.8	6270.8	0.679
Month 2	5437.3	4881.9	0.69

Month 3	5610.1	4743.5	0.496
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Table 2: Affect of social networking on days of FitBit use and daily steps.

All 24 subjects completed the assessment of satisfaction and feasibility. Twenty-one (87.5%) of subjects reported that the FitBit was “Very Easy” to use on Likert scale evaluation. Ten (41.6%) reported that it motivated them “A Lot” to be more active, while 8 (33.3%) reported that it motivated them “some”, 2 (8.3%) reported it motivated them “Little” and 4 (16.6%) reported that FitBit did not motivate them at all. Eighteen (75%) reported that they were “Very Likely” to continue to use their FitBit, and 17 (70.8%) reported that they were “Very Likely” to recommend using a FitBit to a friend. Problems such as forgetting to put on the FitBit, not charging the FitBit, FitBit malfunction, and the FitBit being uncomfortable were reported by small percentages of subjects (12.5%, 12.5%, 0%, 4.2%, respectively). Twenty-three subjects reported that using the FitBit made them realize they were not as active as they should be.

Thirteen subjects (54.2%) responded to the six-month phone survey. Of these responses, 10 subjects reported having a FitBit still “Motivated me a lot.” Twelve out of 13 subjects reported they were “Very Likely” to continue using their FitBit, however, only 6 subjects reported daily FitBit use over the previous three months. Only four subjects continued to use the FitBit to network with other users. All 13 subjects reported they would be “Very Likely” to recommend it to a friend.

Discussion

This study prospectively evaluated the use of FitBits among rural obese adolescents, which is an innovative approach that has not specifically been studied among this population type. While satisfaction rates with FitBit use were high, the excitement of FitBit use waned over the study period, as daily step counts and days of use decreased each month. While not significant, this study also showed that those who lost weight did average more steps compared to those who gained weight. This study correlates with others that found similar high satisfaction rates among FitBit users [11,14]. It was expected that satisfaction with use would be promising in achieving changes in health status, however, minimal changes were found in quantitative outcomes associated with FitBit use.

Study limitations include the small sample size, short duration of the intervention, and a lack of comparison group. This was a pilot feasibility study which contributed to the small sample size. Surveys including self-reported behaviors of diet and exercise also may introduce a social desirability bias. However, subjects reported low exercise and fruit/vegetable intake, which correlated to low step counts and no significant change in laboratory studies. Three months is a relatively short period of time to notice significant changes in weight and in laboratory studies. Given the declining use of FitBit over the study period, extending the follow up beyond

three months likely would not have yielded different results. It is known that higher attrition rates in mHealth technology studies are found with intervention periods of 6 months or longer [12]. Despite the quick follow up, in three months 46% of subjects did lose weight and a significant change was seen in HDL levels and resting pulse. Insulin results also trended towards improvement among those subjects experiencing weight loss.

This population may have other barriers that were not elucidated in data collection. While this is the first study to evaluate FitBit use among rural obese adolescents, rural barriers such as geographic location, walkability of surrounding areas, and home restrictions were not assessed. Social networking may have a positive influence along with mHealth technology tracking. In our study, those subjects who participated in social networking on average used the FitBit more days and had higher mean step counts, yet this was not statistically different from the group that did not use social networking, likely due to small sample size. All subjects reported using some form of social media, with the majority using it daily. An adolescent's behavior along with familial and social environments must be considered in efforts to treat obesity. It is known that social ties are associated with weight status, as one study showed that adolescent friendships tended to cluster on the basis of weight [4]. Similarities are also seen among peers' choice of foods and type of physical activities [5]. Social networking with health trackers such as FitBits allows subjects to interact with a variety of peers in an anonymous and nonthreatening fashion, and capitalizing on these relationships may enhance effectiveness of these health interventions.

Personal feedback or group challenges were not incorporated into this study during the intervention. One study that used FitBits along with social media found that encouraging subjects with "1-day challenges" using Twitter was successful in increasing daily step counts [11]. Another FitBit study found that giving participants "Badges" for fitness accomplishments through Facebook was ranked highly among participants, although no quantitative data was obtained [13]. It is known that with any fitness regimen, the first six months are critical for subjects to develop behaviors that result in long term benefit [15]. While there is great potential for mHealth technology trackers to assist with healthy behavioral change, our study demonstrated that these devices alone are not sufficient, especially among a population with other significant barriers to exercise. This study does demonstrate that satisfaction rates are high among rural obese adolescents using FitBits, and that success with weight loss can be achieved in this population. Future study is needed to assess optimal use of FitBits to promote sustained behavior. This could include studying the use of ongoing feedback or rewards, ongoing assessment of barriers to use, or incorporating social networking resources among users.

Author Contributions

All authors conceptualized the study and contributed to the study design and methods. JLY, JKG, and HAC contributed to acquisition of study data at intake and three months follow up. KMS contributed to acquisition of six-month data. JLY and HAC drafted the manuscript and JKG and KMS critically reviewed and approved the final manuscript. All authors give final approval of the manuscript and agree to be accountable for all aspects of work ensuring integrity and accuracy.

Declaration of Conflicting Interests

The authors declare that there is no conflict of interest with respect to the research, authorship and publication of this manuscript.

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