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A 6-Week Case Study on the Impact of Wearable Technology and Mobile Apps on Exercise Self-Efficacy During COVID-19 Lockdown

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ABSTRACT

One of the global risk factors for chronic disease is low levels of physical activity. Physical activity (PA) levels have dramatically decreased since March 2020, when the WHO proclaimed the COVID-19 epidemic a global pandemic, with corresponding increases in sedentary behavior. The use of smartphones and other wearable technology is expanding quickly and has the potential to affect all facets of health management. Exercise and other health outcomes have been positively correlated in previous studies. However, whether wearable technology use affects exercise self-efficacy is unclear, which may impact exercise adherence. In this study, 14 students were included to examine the impact of wearable technologies and mobile apps on exercise self-efficacy and self-rated health. Fourteen students (Mean age: 34.71 years; Range: 22-58 years) who attended online classes were instructed to 1) define a self-goal and 2) select any wearable technology to improve PA levels in 6 weeks. Before and following the six-week intervention, questionnaires were administered about self-rated health, balance efficacy, depression, vitality, and exercise self-efficacy. We performed descriptive, Chi-square, and Wilcoxon signed-rank analyses. Fourteen participants selected various wearable device to monitor their activity level. For six weeks, subjects engaged in activities they set up with wearable devices, did them 2-3 times per week and used a wearable and smartphone application to track their PA levels and health status. The findings reveal that the self-rated health scale (z=-1.903, p.05), exercise self-efficacy (z=-2.294, p.05), vitality (z=-2.28, p.05), and depression scale (z=-2.831, p.05) all underwent substantial improved. There were no significant changes observed in their BMI. A wearables device and smartphone apps improved vitality and depression, resulted in solid self-efficacy for managing PA. Understanding the underlying mechanisms of wearable technology, smartphone apps, and self-efficacy for managing health across various population groups will require further research.

Keywords: Digital Health; Wearable; Self-Efficacy; Exercise; Vitality; Depression

Abbreviations: SRH: Self-Rated Health; SEEB: Self-Efficacy Exercise Behavior; PA: Physical Activity; BMI: Body Mass Index; GDS: Geriatric Depression Scale

Introduction

The benefits of physical activity include preventing the risk of chronic disease, improving quality of life and cognition, and reducing depression. The effects of regular physical activity on depression reduction are similar to that of common depressant medications [1]. There was evidence of a considerable drop in physical activity during the Covid-10 epidemic in all age categories, regardless of gender, according to a recent systematic study [2]. During the Covid-19 shutdown, populations are prone to losing their level of physical activity and putting on weight. Physical activity is an effective non-pharmaceutical intervention for reducing menopausal symptoms, minimizing bone loss, and boosting muscle strength [3]. If a woman develops a habit of exercising during this time, it will enable her to respond without needing to use her brain. Some wearable technology and smartphone apps have recently been proposed to assist people in a sedentary lifestyle to be more active and healthier; These wearables

are sensor-enabled gadgets that track physical activity, sleep, and other fitness- and health-related states to encourage healthy behavior modification. Studies have demonstrated that these devices can help encourage and support increased physical activity [4-5].

A comprehensive study found that employing wearables to promote physical activity in adults, either by themselves or in conjunction with education or rehabilitation, has had positive outcomes [6]. Another systematic review and meta-analysis revealed that using wearables and smartphone applications increased daily step count by a moderate amount (SMD = 0.51) and daily physical activity by a small to moderate amount (SMD = 0.43, 95% CI = 0.03 to 0.82; I2 = 85%).2. The study concluded that wearable technology and smartphone apps are likely to open new potential for offering personalized interventions to boost physical activity levels [7]. Wearable activity trackers will positively impact behavioral change if users continue to use them. The issue is that many people start using the devices but quickly stop. Wearable activity trackers, for instance, have fallen short of expectations, with most users stopping their use within six months of beginning [8-9]. Self-efficacy has been defined as confidence in one's ability to plan and carry out the steps necessary to generate specific outcomes [10]. Self-efficacy is a critical factor in adopting and maintaining PA behavior and a mediator of the benefits of interventions on physical activity, as has been repeatedly demonstrated [10-12]. It is unclear whether wearable technology use affects exercise self-efficacy, which may impact exercise adherence. In addition, it is unclear that wearable device plays role in the future of physical activity-promoting efforts. Their advantages cannot be guaranteed if wearable devices are not continuously used. Therefore, the purpose of this study was to investigate the impact of wearable technologies and mobile apps on exercise self-efficacy and self-rated health.

Method

Fourteen out of twenty initial participants (Mean age: 34.71 years; Range: 22-58 years) who participated in this study were online class attendance. They were asked to

1. Set up the self-health promotion goal,
2. Choose any wearable devices and mobile Apps to enhance PA levels in six weeks,
3. Perform any mode of physical activity for six weeks, and
4. Answer pre and post-intervention surveys.

Once participants select mobile devices, guideline for activity level as daily 'very active' and 'fairly active' minutes were recommended as proper level of physical activity. We assessed individual-level socio-demographics including age, BMI, education and marital status. Self-rated health (SRH), Self-Efficacy Exercise Behavior (SEEB), and the efficacy of balance, depression, and vitality were also asked before and after six weeks of intervention. Body Mass Index (BMI), the Asian-Pacific cutoff points [13], is computed as weight in kilograms divided by the square of height in meters (kg/m^2), and it is classified into four groups: Overweight (23-24.9 kg/m^2), obese (over 25 kg/m^2), normal weight (18.5-22.9 kg/m^2), and underweight (18.5 kg/m^2).Participants answered questions before and after six weeks of intervention to evaluate their beliefs. Self-rated health (SRH) was asked "how would you rate your health in excellent, very good, fair, or poor?" The person was asked a question to find out how confident they are in maintaining balance- how confident are you if they could lift one leg and hold it for one minute without falling, with answer options like excellent, very good, fair, or poor. Self-Efficacy Exercise Behavior (SEEB) is a questionnaire with 9 questions that measures how confident are you in your ability to overcome obstacles to exercise. This response pattern has 10 points. A score of '1' means not confident at all, while a score of '10' means very confident. The Resnick's SEEB scores are made by finding the average of the responses.

A higher overall score means that a person is more confident in their ability to overcome obstacles to exercising. Depression was assessed with Geriatric Depression Scale (GDS) short form. Further, participants' vitality is measured using a part of questionnaire called the SF-36(Short Form 36 Health Survey Questionnaire). The subscale for vitality has four Likert items. On a 5-point scale, people rated how tired they felt from 1 to 5 (1 = always, 5 = never). The results were analyzed in a way that higher scores meant more tiredness.

Data Analysis

SPSS 24.0 (IBM Corp. Armonk, NY: IBM Corp.) was utilized to analyze the data. Categorical variable values are presented as absolute numbers and percentages, while continuous variable values are supplied as mean and standard deviation. We performed descriptive, Chi-square, and Wilcoxon signed-rank analyses. At the 5% ($p<.05$) level, statistical significance was considered to exist.

Results

The baseline participants' demographic characteristics are shown in Table 1. Among the 14 participants, the average age was 34.71 years (SD 15.53), and the range of participants' ages was between 22-58 years old. 71.5% (10/14) of participants were Female. The education level of participants was all over high school educated. 21.4% of participants were married, and half were previously physically active but had never utilized any wearable devices or smartphone apps in their exercise routine. None were smokers, and most participants (over 70 percent) rated their health more than fair. Based on the BMI category, most participants are in the normal weight category (50%), and 21% are in the obese category. All the participants in this study used smart phone apps or wearable devices they wore to keep track of things like how many steps they took each day, how far they walked or cycled, and their heart rate when they were resting or exercising. The pre-installed apps 'Apple Heath' and 'Galaxy Health' were used to lot on mobile devices, other examples of fitness Apps that participants utilized to track their performance include Ring Fit, G-health, Plan Fit, Fili Coach, and the Mullo app for tracking strength activity and dietary patterns.

Table 1: Demographic characteristics of participants.

Variable	Category	M(SD) or n	%
Age, yr		34.71(15.53)	
Gender	Male	4	28.5
Gender	Female	10	71.5
Education	High school	10	71.5
	Over College	4	28.5
Marital status	With spouse	3	21.4
	Without spouse	11	78.6
Previous PA habit	Yes	6	42.8
	No	8	57.2
Smoking	No	12	100
	Yes	0	0
Self-rated health g	Very bad	1	7.1
	Bad	4	28.6
	Fair	6	42.8
	Good	2	14.3
	Excellent	1	7.2
BMI	Underweight (BMI<18.5)	2	14.3
	Normal (18.5<BMI<23)	7	50.0
	Overweight (23<BMI<25)	1	7.1
	Obese (BMI>=25)	3	21.4

Note: BMI: Body Mass Index (Kg/m^2).

The changes in the variable before and after six weeks of using the wearable device and health app are shown in Table 2. Even though there was no change in weight, BMI, and subjects' self-efficacy of balance, their self-rated health slightly improved from the beginning to the sixth week. This change was small but statistically significant (z=-1. 903, p<05). There was a significant change in the efficacy of overcoming tiredness (z=-2.428, p<.05), Self-Efficacy Exercise Behavior (z=-2.294, p<.05), and Vitality (z=-2.28, p<.05). Improved depression scale was seen after six weeks of intervention (z=-2.831, p<.05). No other notable changes were observed.

Table 2: Changes of variable after 6 weeks use of wearable device and health APP.

Variable	N	PRE	POST
Weight	14	59.4±11.8	58.9±11.3
BMI	14	22.0±3.1	21.8±2.9
Efficacy of balance	14	3.8±0.9	3.9±1.1
Efficacy of overcome tiredness	14	2.4±0.7	3.1±1.0*
Self-efficacy of PA	14	27.4±7.7	33.6±37.7*
Vitality	14	9.6±2.3	7.6±2.1*
Depression	14	4.3±3.2	2.6±3.2*
* p<.05			

Note: Values are presented as Mean±SD PRE, Pre-test; POST, Post test; PA, Physical Activity; BMI, Body Mass Index.

Discussion

Wearable devices and mobile Apps have increased dramatically over the past few years. Over 2.5 billion individuals currently use smartphones, and it is estimated that by 2025, this number will increase to 5 billion. Using smartphones and wearables more often can help people with chronic conditions feel more confident in managing their health. These devices have been used in programs that aim to change one's behavior because they can assist and motivate people to reach a daily activity goal [14-15]. Our findings also showed that health and fitness apps on mobile devices and wearables could help people stick to their exercise routines better by increasing their belief in their ability to exercise. This is concordant with previous research in that self-efficacy associated with physical activity was positively related to reliably meeting aerobic physical activity guidelines [16]. This result is encouraging, given that wearable devices and apps increase exercise self-efficacy by showing prompt feedback. Further, intervention content focused on increasing self-efficacy has been shown to increase exercise habits. A cohort study focused on a chronic disease self-management program found that after seven weeks of a self-management program emphasizing self-efficacy (including problem-solving, decision-making, and confidence-building skills), participants made statistically significant improvements in their health status and health behavior [17].

There is a significant role for self-efficacy in activities contributing to the long-term health state of patients [18]. Our findings extend previous works of literature by showing positive improvements in SEEB and self-efficacy of balance and vitality. Wearable technology was linked to people's trust in their capacity to take care of their health, according to [19]. Exercise intervention with wearable technology may be beneficial in some age groups. According to Robertson, somewhat older individuals (Age range: 44-62) wore their Fitbits with greater consistency than participants who were younger (Age

range: 23-43). Given that age has been linked to hurdles to the usage of new technologies [14]. this is a bit of a surprise. Future research should examine how to use wearable gadgets and applications for optimal engagement with exercise in various age populations, given the rising percentage of physical inactivity at one age. The depression and vitality of participants in our study improved after using the wearable device and health apps. There is evidence that regular exercise positively impacts mental health, including reducing the symptom of depression [20].

Our findings support previous findings on the effects of wearable devices and health apps on depression [21]. Lee and colleagues found that real-time objective monitoring of symptoms and novel approaches for diagnosis and treatment using wearable devices lead to changes in the management of patients with depression. Wearable devices such as Fitbit and apple watch help track and monitor physical activity levels, which may help individuals stay motivated and engaged in their exercise routine. Wearable devices and health apps have the potential to detect and monitor depression as well. To ascertain their direct efficacy on depression in populations with various phases of depression, more research is required. Limitations include that our samples are small and convenient samples with a limited study duration. The group of people who have a particular favorable or unfavorable impression of wearables and applications may have been impacted by the fact that participants may have been able to decide for themselves whether they wish to participate in this study. Additionally, the participants' initial self-confidence using wearable devices and mobile apps might vary depending on their age, device, and mobile apps. Some people found them encouraging, but others thought they were annoying because they were tired and did not want to answer difficult questions. Thus, larger and more representative samples are needed to investigate more thoroughly whether the results of the present study are generalizable.

Further, given that the duration of this study was short, future research is required to confirm the relationship between physical activity-related efficacy in longitudinal patterns of adherence to recommended physical activity guidelines. We are also still determining the causality between the usage of wearable devices and exercise associated with self-efficacy. We are still unsure how these techniques affect a person's belief in their ability to exercise. It has been claimed that the gadgets we have now are not helping those who need them, like older adults who have trouble moving and people who are always sick. Although our study has several limitations, it shows that using wearable devices and mobile apps for a short period can help people exercise better, reduce tiredness, and improve depression.

Conclusion

The results shows that utilization of wearable device and Health Apps positively influenced participants' self-rated health, exercise self-efficacy, efficacy of overcome tiredness, vitality and depression. In conclusion, wearable technology in physical activity interventions has produced encouraging outcomes in raising physical activity levels. More study is required to ascertain the therapeutic effects of wearing wearables as an intervention component in various populations.

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