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The Influence of Activity Trackers on Physical Activity, Cardiorespiratory Endurance, Body Composition, and Exercise Motivation

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A THESIS

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Table of Contents

List of Tables

List of Figures

Abstract

The purpose of this research was to examine the influence of activity trackers on physical activity (PA), cardiorespiratory endurance (CRE), body fat percentage (BF%), and exercise motivation. With wearable technology being named as the number one fitness trend for 2016 and 2017 (Thompson, 2015, 2016), activity trackers may be an effective tool to increase physical activity, increase CRE, decrease BF%, and improve exercise motivation. Forty-eight healthy volunteer participants ages 18-72 who did not achieve more than 3000 metabolic equivalent of task (MET) minutes per week of physical activity (PA) were recruited to participate in a 12-week walking intervention. Participants were given the International Physical Activity Questionnaire (IPAQ), exercise motivation inventory (EMI-2) survey, tested for anthropometric measures, and tested for CRE at baseline and final testing. Participants were divided into an activity tracker group and a control group. Analyses revealed no significant differences between the treatment and control groups for PA, CRE, BF%, or motivation from baseline to final testing. There were significant improvements in PA measured by the IPAQ for both groups from baseline to final testing, $F_{(2, 64)} = 17.374$, $p = .000$; however, step counts did not improve for either group from baseline to final testing. There were significant improvements in CRE for both groups from baseline to final testing, $F_{(1, 29)} = 13.016$, $p = .001$. Analyses revealed that the walking program may have been effective for improving PA and CRE, but that activity trackers did not provide any additional benefits. The conclusion is that activity trackers alone may not be an effective tool for the improvement of PA, CRE, BF%, or motivation.

CHAPTER ONE: Introduction

Obesity worldwide has become an area of major concern. Since 1980, obesity has more than doubled (World Health Organization [WHO], 2015). Obesity has been associated with diseases such as type 2 diabetes, cardiovascular disease (CVD), cancer, and depression (Ross, Blair, Lannoy, Despres, & Lavie, 2014). An entire industry has been created for the purpose of getting people to reduce their weight. Strategies used to reduce weight are often unsuccessful and do not follow recommendations, such as a healthy diet and increased PA, given by health organizations (Kakinami, Gauvin, Barnett, & Paradis, 2014). Healthy behaviors including a healthy diet, increased PA, and decreased sedentary behavior have been found to be effective for obesity management (Ross et al., 2014). Warren et al. (2010) found that high levels of PA were associated with reduced risk of CVD death in men aged 20 - 89 years. Losing weight may be an acceptable method for reducing health risk factors; however, some research suggests that health professionals may be focusing on the wrong outcomes for obesity management (Ross et al., 2014). Ross et al. (2014) argues that cardiorespiratory endurance and reduced sedentary behavior should be the focus for improved health risk factors rather than body mass index (BMI). Sedentary behavior has been associated with risk of disease and obesity (Chomistek et al., 2013; Saleh et al., 2015; Warren et al., 2009); PA has been shown to reduce these risks (Warren et al., 2010). Reducing sedentary behavior may be just as important as increasing PA in efforts to reduce CVD risk factors (Brordulin et al., 2015; Chomistek et al., 2013; Epstein et al., 2005; Saleh et al., 2015; Warren et al., 2010). Findings from multiple studies reveal that excessive amounts of sedentary activities may contribute to CVD risk even in conjunction with moderate exercise (Chomistek et al., 2013; Saleh et al., 2015; Warren et al., 2009). Additionally, studies show cardiovascular fitness may be a more important measure of health than body mass index

(BMI; Ross et al., 2014; Barry et al., 2014; Farrell, Fitzgerald, McAuley, & Barlow, 2010). Managing disease risk by motivating increased PA and decreasing sedentary behavior may be a more effective approach than managing weight loss alone (Barry et al., 2014). Additionally, Ross et al. (2014) reported that individuals who are fit at any BMI category are at less risk of CVD than their unfit counterparts.

The American College of Sports Medicine named wearable technology as the number one fitness trend for 2016 and 2017 (Thompson, 2015, 2016). Wearable technology may provide motivation for individuals to increase PA and decrease sedentary activities. Research has shown that accelerometers are effective for increasing PA (Rowe-Roberts et al., 2014; O'Brien et al., 2015; Cadmus-Bertram et al., 2015). In a population of older adults, Thomas et al. (2012) found that PA and mean number of steps increased when participants used activity trackers and had a partner during exercise. Rowe-Roberts et al. (2014) completed a study of 212 employees and concluded that the use of activity trackers can improve PA levels, lead to reduced diabetes risk factors, and that the devices can be effective with high risk individuals. O'Brien et al. (2015) found that in older community dwelling populations, aged ≥ 60 years old, devices were well accepted and that there was an initial improvement in step counts from baseline. Of postmenopausal women studied, mean age 58.6 years, an activity tracker was well accepted and associated with increased PA after a 16-week intervention (Cadmus-Bertram et al., 2015). Researchers concluded that direct-to-consumer technology can be leveraged to improve PA interventions when combined with behavior change theories (Cadmus-Bertram et al., 2015). The age of participants in the included studies included a wide range of ages; however, the majority of participants were older populations. Thompson et al. (2014) concluded that their results may have been due to the inclusion of much older population than other studies measuring the influence of activity trackers. Future research should include a wide range of populations, but more studies should include populations aged 18 - 60 years.

The purpose of the research was to determine if activity tracker use increased PA and physical fitness more than education alone in a population of sedentary adults aged 18-72 years participating in a 12-week walking program. There are few studies that examine whether fitness trackers improve the fitness and PA levels of their users. This study can help determine if fitness trackers can provide effective motivation for PA and improved fitness as a result.

Hypotheses

The primary hypothesis of this study was that activity tracker users increased PA levels more than education alone. The secondary hypothesis was that with increased PA levels, users of activity trackers improved their cardiorespiratory endurance (CRE) and body fat percentage (BF) more than those who receive education alone.

Operational Definitions

1. Activity tracker – a wearable technology device worn on the wrist or hip that tracks the number of steps taken using an accelerometer and caloric expenditure using user data and number of steps taken per epoch.
2. Accelerometer – an instrument for detecting acceleration or vibrations (Merriam-Webster, 2015).
3. Body Fat Percentage – the percentage of an individual's weight that is made up of fatty tissue.
4. Cardiorespiratory Endurance – the ability to perform exercise at moderate-high intensity for prolonged periods (Heyward & Gibson, 2014).

5. Cardiorespiratory Fitness – VO_{2max}, a measure of CRE, within fitness classifications as defined by Cooper Institute for Aerobics Research (2005).
6. Epoch – a fixed point of time.
7. Metabolic equivalent units (METs) – energy cost of sitting quietly or oxygen uptake of 3.5 $mL \cdot kg^{-1} \cdot min^{-1}$ (Pate, O'Neill, & Lobelo, 2008).
8. Physical Activity – voluntary movement of the body with an energy expenditure ≥ 3.0 METs.
9. Sedentary Behavior – activity characterized by an energy expenditure of ≤ 1.5 METs (Pate et al., 2008).

Delimitations

1. Activity tracker used for the study will be the Garmin Vivofit which displays the number of steps taken, estimated calories burned, a daily step goal, a clock, and a date.
2. Activity tracker used will be provided by the primary investigator. Regular checks for number of steps taken will ensure the device is working properly and recording data.
3. Sample population will be selected from the faculty and staff of the University of Central Oklahoma. Participants will have free access to a walking track in the University Wellness Center in addition to campus sidewalks and trails throughout the 12-week study.

Limitations

1. Participant's adherence to wearing a PA tracker during the 12-week intervention cannot be controlled, other than regular reminders to wear and use the activity trackers during data collection (Harrison, Marshall, Berthouze, & Bird, 2014).

2. Data collection will occur during the fall and spring semesters in central Oklahoma. Participant PA levels may be affected by outdoor weather conditions such as outdoor temperature > 90°F or < 32°F with or without freezing precipitation.
3. A 12-week intervention may not be of sufficient length to determine a habitual change. Additionally, 12 weeks may not be a sufficient length of time to determine if users will continue use of an activity tracker for the measurement of PA levels.

Summary

Activity trackers may not provide users with motivation to increase PA levels. This research study examined the effect of activity trackers during a 12-week interventional walking program. The hypothesis is that participants with activity trackers increased their level of exercise motivation and PA more than those who had education alone. This hypothesis is formulated on research that shows PA levels increase with the use of activity trackers. The secondary hypothesis is that with increased PA levels over the 12-week program, participants with activity trackers improved CRE and reduced BF more than those with education alone. Findings from this research can help fitness professionals decide if activity trackers can be an effective motivational tool for clients who need to improve their PA levels and overall fitness.

CHAPTER TWO: Review of Literature

Introduction

The purpose of this review is to examine strategies to manage obesity and CVD risk factors. Studies examining the effects of sedentary behavior on CRE and obesity were evaluated. Studies have shown that sedentary behavior may be a significant contributor to health risk factors such as CVD (Brordulin, Karki, Laatikainen, Peltonen, & Luoto, 2015; Chomistek et al., 2013; Epstein, Roemmich, Pauluch, & Raynor, 2005; Saleh et al., 2015; Warren et al., 2010). Reducing sedentary behavior with increased PA may help improve CRE and reduce risk all-cause mortality (Brordulin et al., 2015; Chomistek et al., 2013; Epstein et al., 2005; Saleh et al, 2015; Warren et al., 2010) even at a higher BMI (Barry et al., 2014). This review examines the use of electronics and technology to motivate, increase, and track PA. Specifically, studies that used activity trackers in the tracking and motivation of PA were evaluated.

Methods

Data Sources and Search Strategies

The University of Central Oklahoma Library database was searched for articles to include in this review. Search terms included (1) cardiovascular disease and physical activity, (2) cardiovascular disease and obesity, (3) sedentary behavior, and (3) weight loss strategies were used for articles on obesity, obesity management, and weight loss strategies. Search terms such as (1) pedometer, (2) activity tracker, (3) Fitbit™, and (4) accelerometer were used for articles that included tracking devices. Bibliographies of retrieved articles were searched for relevant articles.

Study Selection

Studies on obesity management, sedentary behavior, and weight loss strategies were considered for inclusion if they were in the English-language and evaluated the effects of obesity, sedentary behavior, and effective and ineffective weight loss strategies respectively. Articles of any length with any number of participants were considered for inclusion if they used a pedometer or activity tracker for monitoring or motivation of PA, and did not block collected information from participants. Studies of all design types were considered, but were excluded if collected activity information was blocked from the participants.

Results

Changing the Measure of Success in Obesity Management

Recommendations to manage obesity in adults include increasing PA by 200 to 300 min/week and reducing energy intake by 500 to 750kcal/day (Jensen et al., 2013). Of 2,523 obese adults who attempted weight loss in the past year, researchers found successful weight loss strategies included eating less, exercising more, eating less fat, and switching to lower-calorie foods; while, liquid diets, nonprescription diet pills, and popular diets were not associated with significant weight loss (Nicklas, Huskey, Davis, & Wee, 2012). Researchers have concluded that public health efforts should focus on proven methods of weight loss (Nicklas et al., 2012); however, one plan may not be acceptable to all individuals. Ross et al. (2015) discussed that obese adults may not be able to maintain recommended PA requirements and dietary changes. Researchers recommended an alternate approach that incorporates smaller changes in PA and small changes in diet to start the process of change (Ross et al., 2015). Adoption of healthy behaviors, rather than weight loss, should be the focus in obesity management (Ross et al., 2015). The Obesity Cycle shows that the steps in the cycle include: (1) Public desire for weight loss; (2) Prescription of weight loss program (exercise and diet); (3) Obesogenic environment;

(4) Individual experiences minimal weight loss compared to expectations; (5) Individual becomes frustrated, experiences sporadic adherence to exercise and diet; (6) Individual regains weight; (7) Individual discontinues exercise and diet; (8) The individual becomes more obese (Ross et al., 2015). Khan et al. (2009) suggested increased access to PA facilities and measures for obesity prevention and concluded with a list of strategies involving increased nutrition education and recommendations that can be tailored to a community.

Outcomes for obesity management could be alternatively measured by fat distribution and cardiorepiratory fitness. Hunter et al. (1997) found PA may be related to CVD, but only as it relates to intra-abdominal fat accumulation. Findings from a study of 137 individuals with a BMI range of 19.5 kg/m^2 – 40.6 kg/m^2 and body fat percentage (BF%) of 6.1% - 40.6% found that PA may be important in shifting fat away from central deposits. The authors concluded that neither chronic low intensity, nor high intensity activity will affect maximal oxygen uptake, but that those activities may affect central fat distribution and CVD risk (Hunter et al., 1997). Barry et al. found that the association of CVD and BMI on risk of death may be related to CRE and not higher BMI classifications. A meta-analysis by Barry et al. (2014) concluded that fit individuals who were overweight or obese were not necessarily at a higher risk of death, and unfit individuals had twice the risk of death when compared to their fit counterparts. The conclusion was that health professionals might consider a focus on CVF rather than weight loss in mortality reduction (Barry et al., 2014). An evaluation of 11,355 obese and overweight females revealed similar results, in that higher CVF was associated with lower risk of death in overweight and obese individuals over 35 years (Farrell, Fitzgerald, McAuley, & Barlow, 2010). Hazard ratios (HR) for CRE unfit females were significantly higher than those for CRE fit females, and fit-overweight and fit-obese had similar HR to normal weight fit females. HR were incrementally higher for females in higher WC categories with unfit being significantly higher than fit women with normal WC (Farrell et al., 2010). Being fit may be a more important outcome than being at a normal weight.

Sedentary Behavior and Disease Risk

Sedentary behavior has been found to be a major contributor to CVD risk factors (Brordulin et al., 2015; Chomistek et al., 2013; Epstein et al., 2005; Saleh et al., 2015; Warren et al., 2010). Reasons include the types of food consumed during sedentary activities, and the lack of daily energy expenditure (Epstein et al., 2005). After adjusting and monitoring sedentary behavior and dietary intake, Epstein et al. (2005) found significant increases in sedentary activities after participants were instructed to increase such behavior; however, there were no significant changes when participants were instructed to decrease sedentary activities. The authors found that decreasing sedentary behavior by ~100 min×d^{-1} reduced energy intake by >450 kcal×d^{-}, and decreasing sedentary behavior reduced fat intake by nearly 300 kcal×d^{-1}. The data revealed reductions in energy intakes and increases in energy expenditures resulted in a negative energy balance of ~576 kcal and that these findings may be important in understanding how a change in sedentary behaviors influence energy intake and balance (Epstein et al., 2005). Saleh et al. (2015) similarly found decreased sedentary behavior had a positive effect on body weight, BMI, waist circumference (WC), triglycerides, and blood pressure after three months; however, participants received education on healthy eating habits, which may have had an effect on reductions in weight and other risk factors.

Decreasing total time of daily sedentary behavior has been shown to reduce CVD risk factors (Brordulin et al., 2015; Chomistek et al., 2013; Epstein et al., 2005; Saleh et al., 2015; Warren et al., 2010). Brordulin et al. (2015) found that weekday sitting time was significantly associated with fatal and nonfatal CVD in adults aged 25-74 years. The data revealed participants with increased sedentary behavior were more likely to be diagnosed with CVD. Of the 4,516 males that were included in the study, 183 diagnoses of fatal and nonfatal CVD events were identified. Those sitting at least 4 hours per day were more likely to be diagnosed with CVD, and participants newly diagnosed with CVD were more physically inactive during leisure time (Brordulin et al., 2015). Saleh et al. (2015) found that increasing physical activity (PA) may not be enough to decrease CVD risk if the individuals are spending the rest of their time in sedentary pursuits. Sitting time has been associated with a 2% higher risk of CVD for every hour per day of sitting (Chomistek et al., 2013). Women reporting ≥10 $h \times day^{-1}$ sitting time, who were physically inactive, were at 63% greater risk for CVD when compared to highly active women reporting less than 5 $h \times day^{-1}$ sitting time (Chomistek et al., 2013). Warren et al. (2010) found that among 7,744 males, those reporting >32 $h \times week^{-1}$ of sedentary behavior were at a 37% greater risk of CVD mortality compared to those reporting <11 $h \times week^{-1}$.

In addition to reducing sedentary behavior, PA should be increased for optimal health (Warren et al., 2010). Regardless of time spent in sedentary behavior, being older, having normal weight, having normal blood pressure, and being physically active was associated with a lower risk of CVD (Warren et al., 2010). Chomistek et al. (2013) found that increased sitting time and decreased PA was positively associated with coronary heart disease (CHD) and stroke. In 71,018 postmenopausal women (aged 50-79 years) research has shown that each metabolic equivalent (MET) of PA was associated with a 1% lower risk of CVD (Chomistek et al., 2013).

Exercise Motivation

Information on recommended amounts of PA alone may not be providing effective motivation for populations to change their behaviors. Powers, Sanus, Grubber, Olsen, Oddone, and Bosworth (2011) found that personalized risk communications were no more effective than standard risk factor education. Patients in the standard education group (n=65) received printed information from the American Heart Association. Patients in the personalized education group (n=68) received personalized information about their risk of stroke and coronary heart disease (CHD) as well we information on how lifestyle changes can reduce these risks. From baseline to 3-months there were no significant differences in medication, exercise, or smoking cessation (Powers et al., 2011). Conversely, Courneya & Hellsten (2001) found that participants who were led to believe colon cancer risk could be reduced with increased PA were more motivated to increase PA than those who believed that PA was ineffective at reducing their risk.

Ball, Bice, and Parry (2014) found that individuals who exercise or engage in recreational physical activity do so for more extrinsic motivations. Conversely, individuals who participated in sport physical activity did so for more intrinsic motivation (Ball et al., 2014). Ball et al. (2014) found that extrinsic motivation encouraged less physical activity than intrinsic motivation (Ball et al., 2014). Further, individuals who participated in sport physical activity did so for affiliation, social recognition, and competition (Ball et al., 2014). Activity trackers may provide similar motivations as sport physical activity with rewards and achievements for achieving increasing levels of physical activity. Fritz, Huang, Murphy, & Zimmerman (2014) found that the feedback and social aspects of activity trackers had positive effects on motivation.

Monitoring and Motivating Physical Activity with Technology

According to the Centers for Disease Control and Prevention (CDC) 21% of adults meet the 2008 Physical Activity Guidelines (CDC, 2015). The CDC Physical Activity Guidelines for adults includes 150 minutes of moderate-intensity aerobic activity each week and two or more days of resistance training working all major muscle groups (CDC, 2015). Motivating and encouraging individuals to participate in PA can be difficult. Self-efficacy alone may not motivate individuals to increase PA (Olahnder et al., 2013). Researchers found that social media encouraged college students to enroll in 4 – 7 more fitness classes when compared to the control group, who only received promotional media (Zhang, Brackbill, Yang, & Centola, 2015). Social influence significantly increased the likelihood of enrollment in PA classes, and moderate PA was increased by an average of 1.6 days more than the control group (Zhang et al., 2015).

Wearable technology allows users the convenience of portability while providing reminders, rewards, and motivation for physical activity. Fritz et al. (2014) found that users who had been using tracking devices for long term saw initial value in the devices which initiated a change in habits. Numerical feedback was seen as a driving factor for moving more throughout the day, and reward systems built into the software were motivators for added movement. The social aspect of the devices can be seen as a motivator; however, it was found that the users needed to find others that had similar goals (Fritz et al., 2014). Many studies focus on groups of individuals who are co-located in office settings or communities of older adults. This social environment may have an effect on the results in that the social setting provides motivation with or without electronic activity trackers (O'Brien, Troutman-Jordan, Hathaway, Armstrong, & Moon, 2012; Patel, Schofield, Kolt, & Keogh, 2013; Rowe-Roberts, Cercos, & Mueller, 2014; Thomas et al., 2012; Thompson, Kuhle, Koepp, McCrady-Spitzer, & Levine, 2014).

Physical Activity Trackers and Increased Physical Activity

Physical activity trackers have been shown to improve PA levels (Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015; Caulfield, Kaljo, & Donnelly, 2014; O'Brien et al., 2012; Rowe-Roberts et al., 2014; Thomas et al., 2012). Among 34 community dwelling older adults, mean steps per day increased over 12 weeks when a wrist worn Nike Fuelband™ was used to track PA levels (O'Brien et al., 2012). Functionality, measured by the timed up and go, was improved and WC decreased; however, most health outcomes were not improved. The authors concluded that the devices were well accepted and mastery of device use was easily attained (O'Brien et al., 2012). Cadmus-Bertram et al. (2015) found that among 51 overweight, postmenopausal females, the activity tracker group increased moderate to vigorous physical activity (MVPA) by 38 minutes per week and steps per day increased by 789 steps. Conversely, a standard pedometer group did not significantly increase MVPA. Ninety-six percent of the participants found the Fitbit to be helpful for increasing physical activity compared to 32% who found the pedometer to be helpful (Cadmus-Bertram et al., 2015). A 2007 meta-analysis revealed that pedometer users, mean age 49 years, increased their physical activity by 26.9% from baseline (Bravata et al., 2007). Rowe-Roberts et al. (2014) found that participants with a higher health risk were motivated to increase activity and had the highest average steps per day. In a study of 10 Chronic Obstructive Pulmonary Disorder (COPD) patients, the Fitbit One was found to significantly increase mean number of steps from baseline to 6 weeks (Caulfield et al., 2014). Alternatively, some studies have shown that physical activity levels are not improved with activity tracking devices (Patel, Schofield, Kolt, & Keogh, 2013; Thompson, Kuhle, Hoepp, McCrady-Spitzer, & Levine, 2014). Thompson et al. (2014) found no significant improvements in total PA or health outcomes in a year-long study of 49 older adults wearing a Fitbit pedometer. Results may have been limited by the mean age of the population tested (79.5 ± 9 years), and the influence of the Go4Life intervention program (Thompson et al., 2014). Similar findings showed that pedometer use in a PA program did not increase motivation or relieve perceived barriers in low-active older adults (≥ 65 years; Patel et al., 2013).

Not all potential users of activity trackers are willing or able to accept the devices. In a study of 24 Australian truck drivers, 34 invitations for participation were sent and 31 accepted. Of the 31 that accepted the study invitation, 7 returned their trackers unopened for reasons that included technological barriers. Only 19 of the participants used the full capabilities of the device and the application installed on their cellular phones (Gilson et al., 2014). Five of 34 participants in a study of the acceptability of activity trackers among older adults dropped out of the study because they did not want to wear the device every day (O'Brien et al., 2012). Cadmus-Bertram et al. (2015) found that some users had technical issues with their devices, preventing them from effectively using them. In addition to the ability to accept and use devices, results have shown that adherence for long term use may be limited (O'Brien et al., 2012). O'Brien et al. (2012) found that among study participants, mean steps increased from week 1 to 6, and began to decrease from week 7 to 11 over 12-weeks. This suggests that in longer studies, adherence may continue to decrease over time. In a study of long term use of activity trackers, Fritz et al. (2014) found that initial excitement of devices promotes use, but over time the excitement diminishes. Users reported continued use of their devices, but it was more of a daily routine rather than PA monitoring (Fritz et al., 2014).

Some limitations of activity tracking devices become a limitation for users of the devices (Fritz et al., 2014; Rowe-Roberts et al., 2014). Survey participants from a 2014 study reported that they would avoid activities the devices could not measure, like swimming or bicycling (Fritz et al., 2014). The participants in those cases felt they were not getting credit for activities that could not be monitored by the devices. Additionally, rewards systems built into the device websites would be a source of motivation, even if the rewards were based on false movements. Vibrations that add steps or added floors while driving a car are examples (Fritz et al., 2014).

Participants from a 2014 study expressed a desire to be motivated by something different than step counts, like playing games that encourage physical activity (Rowe-Roberts et al., 2014). Fritz et al. (2014) concluded that developers may want to focus on the changing goals of long term users.

Discussion

The majority of articles reviewed suggest that successful strategies for obesity management include increased PA, reduced sedentary behavior, and eating a healthy diet (Barry et al., 2014; Brordulin et al., 2015; Chomistek et al., 2013; Epstein et al., 2005; Farrell et al., 2010; Hunter et al., 1997; Nicklas et al., 2012; Khan et al., 2009; Saleh et al., 2015; Warren et al., 2010). Managing weight and having a healthy diet may be important; however, to reduce risk factors a shift to other outcomes may be warranted (Barry et al., 2014; Farrell et al., 2010; Hunter et al., 1997; Ross et al., 2015). CVD risk factors at any BMI are reduced when an individual has higher CRE fitness levels (Barry et al., 2014; Farrell et al., 2010). Requiring a change in PA levels in addition to diet on a consistent basis long term can be overwhelming (Ross et al., 2015). Motivating an individual to make changes to CVF rather than other combined factors, such as diet and exercise, may be easier and more effective for reducing health risk factors (Ross et al., 2015). To achieve this, the use of technology can be an effective strategy to motivate and track PA (Bravata et al., 2007; Cadmus-Bertram et al., 2015; Caulfied et al., 2014; Fritz et al., 2014; Gilson et al., 2014; O'Brien et al., 2012; Rowe-Roberts et al., 2014; Thomas et al., 2012; Zhang et al., 2015). Alternatively, technological problems may exist that become barriers for the use of technology (Gilson et al., 2014). Some research suggests that technology was not effective at increasing PA indicating that not all populations are willing to use or accept activity trackers (Gilson et al., 2014; Patel et al., 2013; Thompson et al., 2014). Social media applications were effective for some populations (Zhang et al., 2015), but not effective in some situations for others (Fritz et al., 2014; Thomas et al., 2012).

In studies with the successful application of technology, PA levels were increased in most (Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015; Caulfield, Kaljo, & Donnelly, 2014; O'Brien et al., 2012; Rowe-Roberts et al., 2014; Thomas et al., 2012), and health outcomes were improved in some (O'Brien et al., 2012; Rowe-Roberts et al., 2014). Limitations of study length may be a reason why health outcomes were not improved in more studies. The average study length of studies in this review was ≤ 1 year which may not be sufficient time to see results in health outcomes for the tested populations (Caulfield et al., 2014). Adherence of activity tracker use may begin to fall in short periods of time (6-12 weeks; O'Brien et al., 2012) and further research should include longer time periods (≥ 12 weeks) to determine if activity trackers will be an effective tool in obesity management. A study on the use of activity trackers did not find significant changes in the number of steps taken per day with an effect size of 0.3; however, the researchers did find significance in waist circumference after 12 weeks (ES = 0.3; O'Brien et al., 2015). The effect sizes are small in all variables evaluated in the O'Brien et al. (2015) study; although, the limitations of the study may have had an effect on the results. O'Brien et al. (2015) evaluated 29 participants, mean age of 73.5 (SD = 9.4), community dwelling older adults for 12-weeks. The age of the participants and the environment may have been limitations on the results. The researchers did find that data indicated activity trackers may be an effective method for recording physical activity in older adults (O'Brien et al., 2015). It is concluded that activity trackers may be an effective tool in the management of obesity, increased physical activity, and decreased sedentary behavior.

CHAPTER THREE: Methodology

Introduction

Few studies evaluate health outcomes using activity trackers. Further, many studies include participants that are aged 65 years and older who are living in communities for aging adults. The hypothesis of this research is that the use of activity trackers among adults aged 18-72 years on a 12-week walking program will motivate individuals to increase PA levels more than education alone. Additionally, with increased PA levels, it is hypothesized that users of activity trackers will improve CRE and BF more than those who receive education alone (α = .05). This study was reviewed and approved by the University of Central Oklahoma Institutional Review Board (Appendix A).

Participants

For this research, thirty-four healthy volunteer participants ages 18-72 who did not achieve the highest levels of physical activity as scored by the IPAQ were recruited to participate in a 12-week study. In a 12-week study of the influence of activity trackers on physical activity, O'Brien et al. (2015) found no significant increase in steps from baseline, $t(1.62) = 22$, $p = .11$, $d = 0.28$, among 34 older adults aged ≥ 60 years; however, there was a significant improvement in waist circumference, $t(28) = 2.82$, $p = 0.009$, $d = 0.3$. The estimated number of participants to reach significance in number of steps is approximately 180 individuals based on calculations to reach a power of 0.80 ($\alpha = .05$, $d = .28$). For this study, forty-six participants were recruited due to limitations in resources.

Participants were recruited from the faculty and staff of the University of Central Oklahoma campus in Edmond, Oklahoma. Advertisements for the study were sent through University communication email (Appendix B), and fliers (Appendix C) were distributed throughout campus facilities. Participants contacted the primary researcher by telephone or email to arrange an informative initial meeting to determine eligibility. Criteria for inclusion was that the participant did not complete more than 3000 metabolic equivalent of task (MET) minutes per week of physical activity as measured by the IPAQ (Appendix D) and that the participant was healthy enough to participate in exercise as measured by the physical activity readiness questionnaire plus (PAR-Q+; Appendix E). Participants were excluded if they (1) were under the age of 18 or over age 72; (2) had medical conditions that would prohibit them from participating in a walking for fitness program; (3) were unable to wear a fitness tracking device on the wrist regularly for any reason; (4) were scored by the IPAQ as completing more than 3000 MET minutes per week of physical activity.

Instruments

Prior to being considered for inclusion into the study, participants completed the PAR-Q+ and the IPAQ. At the beginning of the study all participants completed the Exercise Motivations Inventory (EMI-2; Appendix F), anthropometric measurement testing, and were tested for their current level of CRE using the Rockport walking test.

Physical activity readiness questionnaire plus. Bredin, Gledhill, Jamnik, and Warburton (2013) found the PAR-Q+ to be a safe and effective tool to use for risk stratification. The original PAR-Q resulted in more false positives and generated unnecessary physician referrals (Bredin et al., 2013). Bredin et al. (2013) concluded that the PAR-Q+ allows individuals, previously screened out of physical activity, back into physical activity. The PAR-Q+ is a 4-page questionnaire with seven initial questions on general health. Answering yes to any of the initial seven questions resulted in a second section of questions with up to 36 additional questions that helped determine the level of risk for exercise. Answering yes to follow-up questions resulted in a referral to a physician. Answering no to the 7 initial questions or no to the follow-up questions cleared the individual for an exercise program.

International physical activity questionnaire. Craig et al. (2003) found the IPAQ to be a valid and reliable instrument for the measurement of self-reported physical activity. Further, the short form was recommended for national monitoring and the long form for more detailed measurement (Craig et al., 2003). The IPAQ long form was used for this study which consisted of 27 questions about the participant's amount of physical activity over the past seven days. The questionnaire was self-administered, but was completed during a meeting with a researcher.

Exercise Motivations Inventory. Markland and Hardy (1993) found the Exercise Motivations Inventory (EMI) to be a valid and reliable method to test individual's motivation for exercise. Markland and Hardy (1993) also found that men and women, as well as those who participate in exercise and those who don't, can be measured using the EMI. The EMI-2 test consisted of 51 questions across 14 subscales of motivation. Scores were calculated by totaling the Likert scale responses for each domain.

Rockport 1-mile walk test. Kline et al. (1987) found the Rockport 1-mile walk test to be a valid assessment for VO_{2max} estimation in a study of 169 participants. At the beginning of the test participants were instructed to walk 1.0 mi as quickly as possible on the UCO Wellness Center track. At the end of the test, participant heart rate was measured by counting pulse for 15 sec and their time to complete 1.0 mi was recorded. The results were used to estimate VO_{2max} using the equation VO_{2max} = 132.853 – 0.0769 (BW, lb) – 0.3877 (age, years) + 6.315 (gender; males = 1, females = 0) – 3.2649 (time, min) – 0.1565 (HR, bpm).

Anthropometric measurement testing. Anthropometric data such as height, weight, waist circumference, and hip circumference was evaluated. Height and weight was measured using a stadiometer with shoes removed for measurement. Waist and hip circumferences were measured using the Anthropometric Standardization Reference Manual (ASRM) norms for measurement of the waist at the narrowest portion of the torso, and hip measurement at the maximum extension of the buttocks using a research grade measurement tape (Callaway et al., 1988). Waist to hip ratio norms were established using the ASRM recommendations for measurement (Heyward & Gibson, 2014).

Percent body fat. Percent body fat was tested using the Omron Healthcare Inc. model HBF-306BL body fat analyzer, which uses bioelectric impedance analysis (BIA) to measure body fat percentage. Heyward and Gibson (2014) discussed that the BIA method can be affected by numerous factors including client factors, instrumentation, and the equation used by the device. Talma et al. (2013) found that BIA is a practical method for measuring body fat percentage in adolescents, but the validity and measurement errors are unsatisfactory. When comparing skinfold and BIA, Aandstad et al. (2014) found that none of the methods studied were superior to the others due to different results across participants and equations used.

Procedures

Participants were given an informed consent (Appendix G), a PAR-Q+, and the IPAQ before being considered for inclusion for the research. Participants who did not agree to the informed consent were thanked for their time and dismissed. Participants who required a physician's referral as determined by the PAR-Q+ were thanked for their time and dismissed. Participants who completed more than 3000 MET minutes per week of physical activity were thanked and dismissed. Participants who agreed to the informed consent, met the PAR-Q+ standards for physical activity, and did not complete more than 3000 MET minutes per week of physical activity were selected for inclusion in the study. Selected participants completed the

EMI-2 questionnaire before beginning anthropometric and fitness testing. Participant's age and sex was recorded and they were tested in the laboratory for height and weight using a stadiometer, waist and hip circumference (WC) using a tape measure, and body fat percentage using an Omron HBF-306BL body fat analyzer. Participants completed the Rockport 1-mile walking test by walking 12 laps on an indoor track at the University of Central Oklahoma Wellness Center. Total approximate time for a participant to complete the informed consent, PAR-Q+, IPAQ, EMI-2, anthropometric, and fitness testing was 45 minutes. All data were recorded for each participant (Appendix H) and stored in a locked file cabinet. Participants who met inclusionary criteria and completed baseline measurements were randomly assigned to an activity tracker group (n = 24) or a control group (n = 24). Both groups were asked to set up a cellular smartphone application that tracked activity and instructed to avoid viewing this application for the duration of the study. The smartphone application was included on the device from the manufacturer. The fitness tracker group was given a tracker to be worn for the duration of the study. The fitness tracker was a Garmin Vivofit® wrist mounted activity tracker which displayed the number of daily steps taken, daily caloric expenditure, a clock, the date, and a daily step goal that could modified by the user. Participants from both groups were given a printed physical activity education that included ACSM recommended physical activity guidelines and a walking program (Appendix I). The walking program was designed for sedentary individuals starting an exercise program for cardiorespiratory fitness and weight management. Both groups were monitored throughout the study for updates on their progress by collecting step data from the activity tracker group every two to three weeks and step data from participant's cell phones every two to three weeks. The IPAQ was completed by both groups at 6-weeks and 12-weeks. Step count data collected every two weeks during the intervention was a 10 to 15-minute meeting where step data history was reviewed and recorded. At the halfway point (6 weeks), participants were asked to complete the IPAQ to assess physical activity level changes from baseline. The IPAQ testing took approximately 20 minutes and was completed at a location convenient to the participant. Assessment of the IPAQ, EMI-2, height, weight, BF, WC, and CRE was repeated at the end of the 12-week intervention in the UCO Wellness Center. IPAQ, EMI-2, and testing completion at the conclusion of the study took no longer than 45 minutes.

Design and Analysis

The proposed research was a true experimental pretest-posttest randomized groups design. The activity tracker group and control group was randomly formed and each group was tested before and after the 12-week intervention to evaluate changes in CRE and body fat percentage. A repeated measures ANOVA was used to analyze interaction and main effects for each dependent variable ($\alpha = .05$). The between subjects independent variable was group (treatment or control). The within subjects independent variable was time (pre, mid, and post). Dependent variables were self-reported physical activity, EMI-2 score, CRE, and BF. The null hypothesis for the primary hypothesis was that use of an activity tracker would not improve physical activity levels and exercise motivation more than education alone in the activity tracker group. The null hypothesis for the secondary hypothesis was that users of activity trackers would not see improved CRE or body fat percentage more than those with education alone.

CHAPTER FOUR: Results

The aim of this study was to examine the effect of activity trackers during a 12-week interventional walking program. The treatment group was provided with a 12-week walking program and a Garmin Vivofit® activity tracker. The control group was provided only with a 12-week walking program.

Participants were recruited from the University of Central Oklahoma faculty and staff, of which there were 61 respondents. Fifteen respondents were dropped from the study after the initial meeting with an IPAQ score above the maximum acceptable activity level of 3000 metabolic equivalent of task (MET) minutes per week. Forty-six participants were invited to complete the study. Of the total accepted respondents two participants were dropped for ceased communication with the researchers, three dropped with scheduling conflicts, one dropped for a family illness, and one voluntarily dropped with a musculoskeletal injury. Thirty-nine participants began the study and completed baseline testing. Throughout the study two participants dropped with musculoskeletal injuries, two dropped for family emergencies, and one ceased communications with the researchers. Thirty-four participants, 29 female and 5 male, completed the intervention. The mean age of participants was 42.91 years (*SD* = 13.92 years, Range = 20 – 65 years, skewness = -0.04, kurtosis = -1.41).

Anthropometric measurements including weight, height, waist circumference (WC), and hip circumference (HC) were taken at baseline and final testing. Waist to hip ratio (WHR) was calculated from WC and HC and BMI was calculated from height and weight. Mean baseline measurements for all participants were height = 65.51 in (*SD* = 3.54 in), weight = 180.61 lbs (*SD* = 41.63 lbs), WC = 102.33cm (*SD* = 13.10 cm), HC = 111.52 cm (*SD* = 10.59 cm), WHR = .91 (*SD* = .05), and BMI = 29.45 kg/m^2 (*SD* = 5.14 kg/m^2). All anthropometric measures were normally distributed with the exception of WHR which was positively skewed (skewness = 1.16) and leptokurtic (kurtosis = 1.39). Final measurements for all participants were weight = 181.91 lbs (SD = 42.67 lbs), WC = 101.54 cm (SD = 14.54 cm), HC = 110.52 cm (SD = 10.33 cm), WHR = .91 (SD = .07), and BMI = 29.70 kg/m^2 (SD = 5.26 kg/m^2). All final anthropometric measures were normally distributed with the exception of WC which was platykurtic (kurtosis = -1.06). Table 1 displays baseline and final anthropometric measurements for testing and control groups.

Physical Activity Levels

The IPAQ was completed by participants at baseline, midpoint, and final testing. The null hypothesis is that activity trackers will not change physical activity levels, as determined by the IPAQ, more than education alone ($\alpha = .05$). The mean MET score at baseline was 956.33 MET min/week (*SD* = 877.45) and 1089.82 (*SD* = 902.30) for the control and treatment groups respectively. An independent *t*-test was calculated to examine the difference in the mean baseline MET scores for the control group and treatment group. No significant difference was found between control group baseline MET scores and treatment group baseline MET scores, $t\ (32) = -.416$, $p = .680$. MET scores for the control group were not normally distributed with a skewness of 1.37 and a kurtosis of 1.22. MET scores for the treatment group were normally distributed. MET score at midpoint was 2066.25 MET min/week (*SD* = 1839.83) and 3273.64 MET min/week (*SD* = 3465.38) for the control and treatment groups respectively. Neither group scores were normally distributed with a positive skewness of 1.81 and 2.29 and kurtosis of 3.59 and 6.11 for the control and treatment groups respectively. MET scores at final testing were 3418.08 MET min/week (*SD* = 3057.30) and 3543.68 MET min/week (*SD* = 2932.73) for the control and treatment groups respectively. Final MET scores were not normally distributed with a positive skewness of 1.21 for the control group and a positive skewness and kurtosis of 1.91 and 1.44 respectively. Two outliers were identified in the initial IPAQ MET scores, one in the control and one in the treatment group, and were left in for analysis. Five outliers were identified in the midpoint IPAQ MET scores, one in the control group and four in the treatment group, and were left in for analysis. One outlier was found in the final IPAQ MET scores and left in for analysis. Outliers identified in the IPAQ MET scores were (1) one in the initial control group; (2) one in the initial treatment group; (3) one in the midpoint control group; (4) four in the midpoint treatment group; and (5) one in the final treatment group. All outliers were analyzed for errors and were deemed valid for inclusion. Mauchly's Test of Sphericity revealed that sphericity had not been violated, Mauchly's W = .950, $p = .451$. A 2 x 3 Analysis of Variance (ANOVA) with repeated measures was calculated to examine the effects of the activity tracker (control group and treatment group) and time (pre, mid, and post) on IPAQ results for physical activity in MET minutes performed per week. The interaction effect for time x group was not significant, F (2,64) = 1.072, $p = .348$. A significant main effect for time was found, F (2,64) = 17.374, $p < .000$. No significant main effect for group was found, F (1,32) = .425, $p = .519$. Post hoc t tests revealed a significant mean increase in MET minutes per week from pre to mid, t (33) = -4.112 (33), $p < .000$, and pre to post, t (33) = -5.959, $p < .000$. There was an increase from mid to post (M = 651.85, SD = 2128.81), but it was not significant ($p = .083$). Bonferroni's adjustment was applied for post hoc testing ($\alpha = .017$). Refer to Table 2 for mean differences and effect sizes for time for control and treatment groups. The null hypothesis is accepted, activity tracker use does not significantly increase physical activity more than education alone as measured by IPAQ MET scores. Figure 1 displays changes in MET minutes/week at each testing point for each group and the total sample combined. There were no significant differences between groups in total walking MET minutes, total moderate activity MET minutes, and total vigorous MET minutes. Table 8 displays results from *t*-tests along with mean differences and effect sizes.

The IPAQ also calculates a total weekly sitting score measured in minutes per week. The null hypothesis is that activity tracker use will not decrease sitting time more than education alone ($\alpha = .05$). Mean sitting score at baseline was 4275.00 min/wk (*SD* = 1131.79 min/wk, skewness = .960, kurtosis = -.283) and 3809.32 min/wk (*SD* = 1239.55 min/wk, skewness = 1.034, kurtosis = .911) for the control and treatment groups respectively. Mean sitting score at midpoint was 3763.75 min/wk (*SD* = 1167.33 min/wk, skewness = .929, kurtosis = -.637) and 2534 min/wk (*SD* = 579.45 min/wk, skewness = .554, kurtosis = -.154) for the control and treatment groups respectively. Mean sitting score at final testing was 3399.58 min/wk (*SD* = 1243.08 min/wk, skewness = 1.97, kurtosis = 4.96) and 2752.50 min/wk (*SD* = 745.96 min/wk, skewness = .719, kurtosis = .000). One outlier in the initial treatment group and one outlier in the final control group was identified and analyzed for errors. Outliers were deemed accurate and appropriate for inclusion. Mauchly's Test of Sphericity revealed that sphericity had not been violated, Mauchly's W = .844, $p = .072$. A 2 x 3 ANOVA with repeated measures was calculated to examine the use of activity trackers (control and treatment groups) on IPAQ sitting score (baseline, midpoint, final testing). The interaction effect for time x group was non-significant, F (2, 64) = 2.381, $p = .101$. A significant main effect for time was found, F (2, 64) = 17.304, $p < .000$. Post hoc *t* tests revealed a significant mean decrease from baseline to midpoint (*M* = 1005.58, *SD* = 1223.12), t (33) = 4.794, $p < .000$, and a significant decrease from baseline to final testing (*M* = 992.79, *SD* = 1000.99), t (33) = 5.783, $p < .000$. There was no significant difference from midpoint to final testing, t (33) = -.086, $p = .932$. Refer to Table 3 for mean differences and effect sizes for time for control and treatment groups. The null hypothesis that activity tracker use will decrease sitting time, as determined by the IPAQ, more than education alone is accepted. Figure 2 displays changes in sitting minutes/week at each testing point for each group and the total sample combined.

Steps for each participant were collected at four time points throughout the study. Step counts from the treatment group were collected using the Garmin Vivofit® and the Garmin Connect® cellular phone application. Step counts from the control group were collected using either the Apple Health® cellular phone application or the Samsung SHealth® cellular phone application. The null hypothesis was that activity tracker use will not increase steps over time more than education alone ($\alpha = .05$). Descriptive statistics for each group step counts during eleven weeks of the study are shown in Table 4. Figure 3 displays a line graph of weekly step counts for the treatment group, control group, and total population sample. Week one step counts were eliminated from the study due to 15 participants starting the study midweek of week one. An outlier was identified in the treatment group for week 12. The data were analyzed for errors and deemed appropriate for inclusion. Mauchly's test of sphericity was calculated and determined that sphericity had not been violated, W = .10, $p = .34$. A 2 x 11 ANOVA was calculated to compare activity tracker use (testing and control groups) with weekly step count (weeks 2 – 12). No significant effect for time x group was found, $F\ (10, 290) = .508$, $p = .88$. No significant main effect for time was found, $F\ (10, 290) = .742$, $p = .685$. A significant main effect for group was found, $F\ (1, 29) = 16.08$, $p < .000$. Post-hoc Independent *t* tests revealed significant differences in weekly step counts between the treatment group and control group. Table 6 displays results from independent *t* tests of weekly step count differences between groups. The null hypothesis that activity tracker use does not increase step counts over time more than education alone is accepted.

All participants were asked to carry their cellular phone during walking activities. Participants were asked during final data collection if they carried their phone while walking and the responses were separated into (1) never, (2) sometimes, (3) always. Of total participants in the treatment group, 5 (26.3%) reported they never carry their phone, 7 (36.8%) reported they sometimes carry their phone, and 7 (36.8%) reported they always carry their phone. Of total participants in the control group, 1 (9.1%) reported they never carry their phone, 3 (27.3%) reported they sometimes carry their phone, and 7 (63.6%) reported they always carry their phone. Figure 4 displays number of steps per week for testing and control groups as measured by cellular phone. The null hypothesis is that there is no significant difference in weekly step counts measured by cellular phone between testing and control groups (a = .05). Independent *t*-tests were calculated to analyze differences in step counts by group (testing and control). No significant differences were found in weeks 2 – 12 between testing and control groups. The null hypothesis that there is no difference in step counts measured by cellular phone between testing and control groups is accepted. Independent *t*-tests were completed to analyze the differences between steps counted by the activity tracker and steps counted by the ATA in the treatment group ($\alpha = .01$). There were significant differences in step counts on week two, four, five, six, ten, and eleven. Weeks three, seven, eight, nine, and twelve approached significance. Table 7 displays results from *t*-tests comparing activity tracker and ATA step data among the treatment group.

Cardiorespiratory Endurance

The Rockport 1-mile walk test was performed to estimate the volume of oxygen used per kilogram per minute (VO_{2max}), which is used to determine cardiorespiratory fitness levels (Heyward & Gibson, 2014). The null hypothesis was that activity tracker use will not increase

VO_{2max} more than education alone (α = .05). Mean VO_{2max} at baseline was 30.01 ml/kg/min (*SD* = 5.81 ml/kg/min) and 28.44 ml/kg^{-1}/min^{-1} (*SD* = 7.98 ml/ kg^{-1}/min^{-1}) for the control group and treatment group respectively. Mean VO_{2max} at final was 32.67 ml/kg/min (*SD* = 7.69 ml/ kg^{-1}/min^{-1}) and 30.09 ml/ kg^{-1}/min^{-1} (*SD* = 7.89 ml/ kg^{-1}/min^{-1}) for the control group and treatment group respectively. VO_{2max} at pre and post was normally distributed for control and treatment groups. Three outliers were identified as testing errors in the treatment group and were subsequently removed. A 2 x 2 Repeated Measures ANOVA was calculated to examine the effects of the activity tracker (control and treatment group) with VO_{2max} (pre and post). No significant effect for time x group was found, F (1, 29) = 0.721, p = .403. A significant main effect for time was found, F (1, 29) = 13.016, p = .001. Estimated VO_{2max} increased among the total population sample; however, there were no significant differences between groups from baseline to final testing. Mean difference and effect sizes for VO_{2max} changes are shown in Table 9. The null hypothesis that activity tracker use does not increase VO_{2max} more than education alone is accepted.

Body Composition

Body fat percentage, measured with a bioelectrical impedance analyzer, was collected at baseline and final testing. The null hypothesis is that activity tracker use will not affect a change in BF% more than education alone (α = .05). Mean BF% at baseline was 33.20 % (*SD* = 6.98%) and 36.78% (*SD* = 7.20%) for the control and treatment group respectively. Mean BF% at final testing was 33.47% (*SD* = 7.35%) and 37.03% (*SD* = 6.84%) for the control and treatment groups respectively. One outlier in the initial testing control group was identified. The outlier was analyzed for errors and deemed appropriate for inclusion. A 2 x 2 ANOVA was calculated to examine the effects of the activity tracker (control and treatment group) with BF% (pre and post). No significant effect for time x group was found, $F(1, 32) = 0.002$, $p = .96$. No significant main effect for time was found, $F(1, 32) = 1.07$, $p = .31$. No significant main effect for group was found, $F(1, 32) = 1.99$, $p = .16$. Mean difference and effect sizes for BF% changes are shown in Table 9. The null hypothesis that activity tracker use does not affect more change in BF% than education alone is accepted.

Motivation for Exercise

The EMI-2 in addition to the Locus of Causality of Exercise scale was completed by participants at baseline and final testing. The EMI-2 measures (1) stress management, (2) revitalization, (3) enjoyment, (4) challenge, (5) social recognition, (6) affiliation, (7) competition, (8) health pressures, (9) ill-health avoidance, (10) positive health, (11) weight management, (12) appearance, (13) strength and endurance, and (14) nimbleness. Revitalization, health pressures, ill-health avoidance, positive health, and nimbleness are scored on a 15-point scale. Stress management, enjoyment, challenge, social recognition, affiliation, competition, weight management, appearance, and strength and endurance are measured on a 20-point scale. The Locus of Causality is measured on an 18-point scale. Table 10 displays baseline descriptive statistics for testing and control groups in addition to independent *t*-test results measuring the differences between groups at baseline. There were no significant differences in any motivational scale or Locus of Causality for exercise between groups at baseline ($\alpha = .01$). Scores were calculated into percentage of maximum possible score and divided into 33 point subscales of (1) low (0% - 33%); (2) medium (34% - 66%); and (3) high (67% - 100%). At baseline the treatment group rated high in ill-health avoidance, positive health, weight management, strength and endurance, and nimbleness; medium in stress management, revitalization, enjoyment, challenge, affiliation, and health pressures; and low in social recognition, and competition. At baseline the control group rated motivations high in stress management, ill-health avoidance, positive health, weight management, strength and endurance, and nimbleness; medium in revitalization, enjoyment, challenge, health pressures, and appearance; and low in social recognition, affiliation, and competition. At final testing, there were no significant differences between testing and control groups in motivational scales measured by the EMI-2 ($\alpha = .01$). Table 12 displays descriptive statistics and independent *t*-test results for the EMI-2 and Locus of Causality at final testing. Effect sizes were calculated to examine the change in EMI-2 scores for each group. Refer to Table 11 for mean differences and effect sizes in motivational scales measured by the EMI-2 for testing and control groups at final testing. A dependent *t*-test was calculated to examine changes in motivations measured by the EMI-2 from week 1 – 12 ($\alpha = .01$). Analysis revealed there were no significant differences in any of 14 motivational scales from week 1 – 12 for the total population sample. Locus of Causality of Exercise at baseline were a mean 7.18 (*SD* = 3.87) and 7.00 (*SD* = 4.78) for the testing and control groups respectively. Locus of Causality of Exercise at final testing were a mean 8.14 (*SD* = 4.46) and 8.33 (*SD* = 2.83) for the testing and control group respectively. Independent *t*-tests revealed no significant difference between groups at baseline or final testing ($\alpha = .01$). A dependent *t*-test revealed no significant change from baseline to final testing for the total sample population ($\alpha = .01$). Refer to Table 13 for dependent *t*-test results and effect size calculations.

CHAPTER FIVE: DISCUSSION

Review of Results

The aim of this research was to determine if activity tracker use affected more change in physical activity levels, CRE, body composition (BF%), and motivation than education alone. PA, CRE (measured by changes to VO_{2max}), BF%, and motivation (measured by the EMI-2 survey) were examined in the treatment group and control group to discover changes over a 12-week walking intervention.

Participants were recruited from the faculty and staff population at the University of Central Oklahoma. Participants were randomly assigned to be in the treatment group or control group before baseline testing. Participants in the treatment group were given a 12-week walking intervention plan and a Garmin Vivofit® activity tracker. The Garmin Vivofit® activity tracker was set up for the individual and the Garmin Connect® cellular phone application was installed at the baseline meeting. In addition to the Garmin Connect® cellular phone application, an additional activity tracking cellular phone application provided by the cellular phone manufacturer was set up to track activity independently of the Garmin Connect® application. The control group was provided with the same 12-week walking intervention plan and an activity tracking cellular phone application (ATA) provided by the cellular phone manufacturer was set up to track activity. The control group participants were asked to avoid using or viewing information provided by the cellular phone application. The treatment group and control group were tested for height, weight, BF%, WC, HC, VO_{2max}, and were given the EMI-2 at the baseline meeting. All participants completed the IPAQ before the baseline meeting to determine eligibility for inclusion. During the 12-week intervention, physical activity data was collected at 2-3 week intervals. Physical activity data consisted of step counts from the Garmin Connect® and

ATA cellular phone applications. Participants completed the IPAQ survey at 6-weeks. At final testing the remaining physical activity data, the final IPAQ, weight, BF%, WC, HC, VO_{2max}, and final EMI-2 survey were collected from all participants.

Physical activity levels. MET minute per week scores (pre, mid, post) were tested using a repeated measures ANOVA to determine if physical activity levels, as determined by the IPAQ, changed more in the treatment group than the control group from baseline to final testing. Results indicate that testing and control groups increased MET minutes per week and decreased sitting time per week from baseline to final testing. Effect sizes were calculated for IPAQ MET minutes per week for treatment group, control group, and total population sample.

Effect sizes revealed a greater change from baseline to midpoint for the treatment group ($d = 2.42$) than the control group ($d = 1.26$); however, from baseline to final testing the effect size for the treatment group ($d = 2.71$) was similar to the control group ($d = 2.78$). Research has shown that activity tracker users may see an initial spike in increased activity followed by a levelling off or decline in activity (Fritz et al., 2014; O'Brien et al., 2012). O'Brien et al. (2012) found that users increased activity from week one to week seven, but from week seven to week 11 the number of steps levelled off. Midpoint testing in the current study was approximately at week 6, which is similar to previous study length. The initial spike, followed by a levelling off, may be explained by a loss of interest or the novelty effect of a new device. Fritz et al. (2014) reported that some long-term users, after an initial period of great interest, paid little attention to devices. Users reported wearing devices out of habit rather than continuing to gain valuable information from them (Fritz et al., 2014). The current study findings agree with prior research that activity trackers did not influence significant improvements in total PA or sitting time (Thompson et al., 2014); however, participants in both testing and control groups improved PA levels, independent of activity tracker use. Increases in treatment and control groups may have due to the walking program provided. Hospes, Bossenbroek, Hacken, Hengel, and Greef (2009) found that a 12-week fitness program was effective for increasing physical activity levels more than the usual care program among chronic obstructive pulmonary disorder (COPD) patients. Participants may have increased physical activity levels because they were participating in a research study. MacNeill, Foley, Quirk, and McCambridge (2016) discussed that research studies may have an impact on participant behavior and that subtle impacts on behavior may be a result of participants thinking about issues related to the study. The effects of the study may have also had an effect on decreased sitting time among participants. Participants were told that the goals of the program were to increase physical activity and decrease sitting time. Participants may have considered sitting time while in the study causing them to be more aware of how long they were sitting (MacNeill et al., 2016).

Step counts collected and analyzed from both groups reinforces the IPAQ results that the treatment group did not increase step counts more than the control group. It should be noted that, although the effect sizes for IPAQ MET minutes per week suggests that the treatment group changed more from baseline to midpoint testing, the step counts show little difference from week to week in either group. Table 4 shows descriptive statistics for step counts in both testing and control groups from week two to week 12. Table 5 shows *t*-test scores for each week, week 2-6, week 6-12, and week 2-12. There were no significant differences from week to week in either group from baseline to final testing; however, week two to three approached significance in both groups (p = .04). The near significant increase in step counts between week two and three may be explained by an initial increase in activity expected at the beginning of an exercise program. This would agree with previous research where participants increased physical activity levels in the early phases of a study. O'Brien et al. (2012) found an increase in step counts from week one to week seven in a 12-week study; however, in the present study the increase in step counts appears to have only occurred from week one to week three. Initial IPAQ tests were completed approximately three weeks before the study began. Subsequent IPAQ tests and step data collection did not occur until after the walking program began. This may explain the lack of a significant improvement from week one to week three. Recording IPAQ scores immediately before the beginning of the study may provide more significant results. The significant improvement in IPAQ MET scores would suggest that some improvement in step counts should have occurred. The large effect size found in the baseline to midpoint IPAQ MET scores among the treatment group may have been an effect of the activity tracker. Huang et al. (2014) discussed the immediate effects of an activity tracker on physical activity levels. Activity tracker users reported that the information displayed on the device motivated them to complete more activity throughout each day (Huang et al., 2014). The treatment group had the ability to see the amount of activity they were getting daily, which may have influenced their IPAQ MET scores from baseline to midpoint; however, the step counts collected throughout the study did not reflect an increase in activity. Prior research has found that self-reported measures may not measure physical activity accurately. Silsbury, Goldsmith, and Rushton (2017) found that the IPAQ 7-day long form had an excellent test-retest reliability, but that there was a poor correlation with an accelerometer among ten studies evaluating self-reported physical activity questionnaires. Accelerometer measurement errors can partially be attributed to activities that cannot be measured accurately, such as weight-lifting, cycling, and swimming (Lim, Wyker, Bartley, & Eisenhower, 2015). Lim et al. (2015) found substantial measurement error in self-reported physical activity data among urban populations in densely populated areas. Self-reported measurement errors can be attributed to participant response behaviors. Lim et al. (2015) found that women tended to over-report socially desirable behaviors and that physically active participants tended to underreport physical activity. Conversely, Shiroma et al. (2015) found moderate correlations between accelerometer and self-reported based measurements. The improved MET scores in the total population sample could be explained by the initial awareness of activity and increase of activity from baseline to week three (MacNeill et al., 2016). By looking at step counts independently of IPAQ MET scores, the present study appears to agree with previous research where there was no significant improvement in physical activity levels with accelerometer use (Patel et al., 2013; Thompson et al., 2014).

Step counts between testing and control groups appeared to differ significantly each week throughout the study. Table 6 shows the *t*-test results of step counts between groups. Step counts were collected from the Garmin Connect® cellular phone application for the treatment group and from an ATA for both groups. Figure 3 displays weekly step counts for both groups. When comparing ATA step counts between groups the differences are no longer significant. Figure 4 displays the weekly step counts from an ATA for testing and control groups. Table 7 displays the differences between the activity tracker and the ATA from the treatment group. There are significant differences in step counts week to week between the two devices. The differences between activity tracker step counts and cellular phone step counts may be explained by how participants carry their cellular phones during physical activity. Some participants mentioned placing the cellular phone on a treadmill when exercising, which does not register step counts. Other participants mentioned that they did not always or rarely carry their cellular phones during physical activity. To the author's knowledge, there has not been a study published that examines the differences in activity measurement between a cellular ATA and a device that is worn in a free-living environment.

Cardiorespiratory endurance. Cardiorespiratory endurance was evaluated by estimating participant's VO_{2max} using the Rockport 1-mile walk test. Analysis revealed that both groups improved their cardiorespiratory endurance from baseline to final testing. Participants using an activity tracker did not improve cardiorespiratory endurance more than education alone. Mean difference and effect sizes were examined to determine if one group changed more than the other. Mean differences and effect size calculations revealed that the control group changed more from baseline to final testing (Mean Diff = 2.66 ml O_2/ kg^{-1}/min^{-1}, *d* = .45) than the treatment group (Mean Diff = 1.98 ml O_2/ kg^{-1}/min^{-1}, *d* = .23). The control group's mean VO_{2max} at baseline was 30.01 ml O_2/ kg^{-1}/min^{-1} (SD = 5.81 ml O_2/ kg^{-1}/min^{-1}), while the treatment group was lower with a mean VO_{2max} of 26.11 ml O_2/ kg^{-1}/min^{-1} (SD = 9.56 ml O_2/ kg^{-1}/min^{-1}). The Rockport 1-mile walk test was found to be useful for estimating VO_{2max} among older and sedentary individuals (Fenstermaker, Polwman, & Looney, 1992). Kline et al. (1987) found that the Rockport to be a valid test with a minimal standard error (*SEE* = 1.1 ml O_2/ kg^{-1}/min^{-1}). Conversely, George, Fellingham, and Fisher (1998) found a standard error of up to 3.3 ml O_2/ kg^{-1}/min^{-1} among a popular of college men and women. The differences between the treatment and control groups in the present study are non-significant and might be explained by the standard error of the Rockport test.

Body composition. Percent body fat was estimated by bioelectrical impedance analysis. There were no significant changes in body fat percentage from baseline to final testing in the treatment or control group. Effect size analysis reveals testing and control groups both changed approximately the same amount over time; however, the change was not significant. Heyward and Gibson (2014) discussed that the prescription for a fat loss program should include moderate to high intensity exercise of 30-45 minutes three days per week for a minimum of eight weeks. The intensity levels of participants were not evaluated during the study, but it could be assumed that the intensity level of the walking program was not sufficient to achieve a high to moderate intensity level. Further, since there was no change in step counts from baseline to final testing, no change was expected in body composition.

Motivation for exercise. Motivation for exercise was measured using the EMI-2 survey in addition to a Locus of Causality Scale. Independent *t*-tests were used to determine differences between groups at baseline and final testing. There were no significant differences found between groups at baseline or final testing. No significant changes were found from baseline to final testing for the total sample population.

The sample population rated motivational categories that were extrinsic in nature higher than those that were intrinsic in nature. This is in agreement with Ball et al. (2014) who found that individuals perform recreational physical activities for extrinsic motivations over intrinsic motivations. Further, sporting activities were found to be driven by more intrinsic motivations (Ball et al., 2014). The present study used a walking intervention among those who were inactive or low active at baseline. There was no expectation for participants to communicate or compete with other participants in the study. Participants who may have been more intrinsically motivated may have performed less in the walking program due to the lack of competition. Extrinsic motivations were expected from the sample population due to the nature of the intervention; however, it does not appear that the activity tracker provided the type of motivation that participants needed. It was assumed that participants desired extrinsically motivated outcomes, such as weight loss and improved health, from participation. This may explain why the walking program was effective for the total population sample. Activity trackers and the associated cellular phone applications may provide more intrinsic motivations such as competition with other users. Without utilizing features that connect users to others, the intrinsic motivations provided by the activity tracking software may not have been present; however, prior research found that sharing tracker data was only motivating when there were connections with friends who had similar patterns of activity (Huang et al., 2014). Huang et al. (2014) found that sharing data with friends and family was rarely motivating over time.

The self-determination theory of motivation suggests that autonomy, competence, and connection are important factors influencing motivation (Brehm, 2014). The Locus of Causality score measured in the present study helped to determine participant's level of autonomy at baseline and final testing. The scale was scored from zero, or amotivation, to 18, or intrinsic motivation. Lower scores on the scale indicate that an individual is less autonomous than other scoring higher on the scale (Brehm, 2014). The mean at baseline for the treatment and control groups suggested that both groups were closer to amotivation than intrinsic motivation. At final testing the mean score for treatment and control groups indicated an increase in autonomy. This increase may have been due to a perceived improvement in competence for exercise. Additionally, participants may have perceived a greater connection through approval of others by participating in an exercise program. Participants in the study were not told they had to follow the exact walking program to participate. In other words, they were given their own choices for physical activity throughout the study. Sanders et al. (2016) found that children who are given greater autonomy through choice were more physically active than those who were given less autonomy. Although the activity tracker did not appear to provide added motivation for physical activity, the increase in Locus of Causality for the total sample population is encouraging for future research.

Limitations

Activity trackers did not change physical activity, cardiorespiratory endurance, body composition, or motivation more than education alone over a 12-week intervention. Limitations to this study were that the 12-week intervention occurred during the Spring 2017 academic semester at the University of Central Oklahoma. Spring break occurred around week-6 of the study which may have influenced physical activity levels of the participants. Some participants indicated a higher than sedentary level of physical activity on the IPAQ. All respondents under 3000 MET minutes per week were invited to participate in the study. Participants higher than the lowest categories of physical activity levels may not have changed as much as those at the lowest levels. Some participants had previously used activity tracking devices before the present study which may have limited the device’s influence (Huang et al., 2014). Initial IPAQ MET scores were taken at the end of the Fall 2016 academic semester which also coincides with the winter holiday season and colder temperatures. Physical activity levels during the winter months at the end of an academic semester may have been lower than typical for the total sample population.

Future Recommendations

Future research should (1) use a larger sample size; (2) limit the sample to those at the lowest levels of physical activity; (3) capture baseline activity levels before beginning the 12-week walking intervention; and (4) complete the study over a longer period to minimize the effect of the academic school year.

Conclusions

Activity trackers do not appear to increase PA levels for all users; however, further research may reveal that some individuals may be influenced more than others based on differing motivations for exercise. Prior research showed that activity trackers were effective for increasing physical activity levels; however, many of these studies were completed among community dwelling older adults where other influences, such as an activity director or program, may have affected physical activity levels more than the activity trackers (Cadmus-Bertram et al., 2015; Caulfield et al., 2014; O'Brien et al., 2012; Rowe-Roberts et al., 2014; Thomas et al., 2012). Exercise programming provided to a sedentary or lightly active population who are ready to increase physical activity may be a sufficient tool to increase physical activity levels. Further, activity tracking devices should not be used as the sole motivator for increasing physical activity levels.

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TABLES

Table 1

Descriptive Statistics and Anthropometric Measurements for Treatment and Control Groups

		Initial		Final	
TG		*M* (*SD*)	Sk / Kt	*M* (*SD*)	Sk / Kt
	Age (years)	43.68 (14.12)	-0.21 / -1.30		
	Ht (in)	65.64 (2.86)	1.50 / 3.10		
	Wt (lbs)	186.52 (36.07)	0.71 / 0.39	187.39 (51.32)	0.75 / 0.38
	BMI (kg/m^2)	30.40 (4.96)	0.05 / -0.82	30.57 (5.02)	0.10 / -0.91
	BF%	36.78 (7.20)	-0.66 / -0.42	37.03 (6.84)	-0.62 / -0.18
	WC (cm)	104.56 (12.13)	0.24 / -0.11	104.22 (13.44)	0.22 / -1.19
	HC (cm)	106.75 (10.71)	0.30 / 0.20	112.45 (9.35)	0.26 / 0.02
	WHR	0.90 (.05)	0.83 / 0.38	0.91 (.07)	0.30 / -0.25
	VO_{2max}	26.11 (9.56)	0.28 / 0.50	28.47 (8.47)	0.36 / -0.15
CG					
	Age (years)	42.00 (13.57)	0.18 / -1.46		
	Ht (in)	65.28 (4.67)	-0.03 / -1.59		
	Wt (lbs)	169.77 (50.17)	0.73 / -0.28	171.87 (51.32)	0.76 / -0.32
	BMI (kg/m^2)	27.70 (5.23)	0.81 / 0.71	28.10 (5.55)	0.80 / 0.42
	BF%	33.20 (6.98)	-0.77 / 0.44	33.47 (7.35)	-0.79 / 0.81
	WC (cm)	98.25 (14.35)	0.53 / -1.04	96.62 (15.77)	0.59 / -0.69
	HC (cm)	114.13 (9.80)	0.27 / -1.23	107 (11.51)	0.24 / -1.19
	WHR	0.91 (.07)	1.54 / 2.79	0.89 (.07)	0.82 / -0.44
	VO_{2max}	30.01 (5.81)	-0.85 / 0.18	32.67 (7.69)	-0.45 / -0.17
All					
	Age (years)	42.91(13.92)	-0.41 / -1.41		
	Ht (in)	65.51 (3.54)	0.39 / 0.14		
	Wt (lbs)	180.61 (41.63)	0.47 / -0.16	181.91 (42.67)	0.53 / -0.18
	BMI (kg/m^2)	29.45 (5.14)	0.25 / -0.73	29.70 (5.26)	0.27 / -0.78
	BF%	35.52 (7.23)	-0.58 / -0.31	35.77 (7.13)	-0.64 / -0.10
	WC (cm)	102.33 (13.10)	0.21 / -0.68	101.54 (14.54)	0.22 / -1.06
	HC (cm)	111.52 (10.59)	0.14 / -0.32	110.52 (10.33)	0.06 / -0.48
	WHR	0.91 (.05)	1.16 / 1.39	0.91 (0.07)	0.43 / -0.58
	VO_{2max}	28.57 (7.53)	0.28 / 0.58	30.81 (7.83)	0.10 / -0.44

Note: TG = Treatment group; CG = Control group; Sk = skewness; Kt = kurtosis

Table 2

Mean Differences and Effect Sizes for IPAQ MET Minutes/week

TG	Time	Mean Diff	*d*
	Pre-Mid	2183.82	2.42
	Mid-Post	270.04	0.07
	Pre-Post	2453.86	2.71
CG	Time	Mean Diff	*d*
	Pre-Mid	1109.92	1.26
	Mid-Post	1351.83	0.73
	Pre-Post	2461.75	2.80
All	Time	Mean Diff	*d*
	Pre-Mid	1804.79	2.04
	Mid-Post	651.85	0.21
	Pre-Post	2456.64	2.78

Note: Mean Diff = Mean Difference; TG = Treatment group; CG = Control group

Table 3

Mean Differences and Effect Sizes for IPAQ Sit Minutes/week

TG	Time	Mean Diff	*d*
	Pre-Mid	1275.23	1.02
	Mid-Post	-865.49	-1.49
	Pre-Post	1056.82	0.85
CG	Time	Mean Diff	*d*
	Pre-Mid	511.25	0.45
	Mid-Post	364.17	0.31
	Pre-Post	875.42	0.77
All	Time	Mean Diff	*d*
	Pre-Mid	1005.59	0.83
	Mid-Post	12.79	0.01
	Pre-Post	992.81	0.82

Note: Mean Diff = Mean Differences; TG = Treatment group; CG = Control group

Table 4

Descriptive Statistics for Treatment and Control Group Step Counts

TG	*M* (*SD*)	sk / kt	CG	*M* (*SD*)	sk / kt
Week 2	36097.18 (9919.55)	-0.31 / -0.27	Week 2	21964.00 (12015.64)	-0.83 / -0.49
Week 3	40514.71 (12413.19)	0.19 / -0.22	Week 3	24696.36 (13911.22)	0.34 / -0.59
Week 4	38988.62 (11195.81)	0.19 / .02	Week 4	21270.18 (8191.74)	-0.38 / -1.04
Week 5	35886.36 (12566.35)	0.54 / -0.40	Week 5	25255.73 (10278.50)	0.67 / -0.88
Week 6	36317.18 (15547.11)	0.29 / -0.75	Week 6	22506.00 (8812.57)	0.56 / -0.77
Week 7	39954.09 (13017.27)	0.17 / -1.12	Week 7	21366.27 (6824.37)	0.54 / -0.46
Week 8	36174.86 (13168.78)	-0.63 / 0.32	Week 8	22576.73 (13514.88)	-0.15 / -1.54
Week 9	36325.32 (11119.32)	0.22 / -0.95	Week 9	21967.64 (10992.49)	-0.41 / -1.45
Week 10	37115.09 (15024.39)	0.09 / -0.46	Week 10	23662.09 (14950.15)	1.04 / -0.39
Week 11	39119.27 (12008.78)	0.65 / -0.32	Week 11	26313.91 (13036.84)	0.68 / -0.36
Week 12	37955.00 (14467.09)	0.57 / 0.13	Week 12	23578.00 (10256.10)	-0.58 / -1.06

Note: TG = Treatment group; CG = Control group

Table 5

Weekly Step Count t-Test Scores and Effect Sizes for Treatment and Control Groups

	TG				CG			
Week	*t*	*df*	*p*	*d*	*t*	*df*	*p*	*d*
Week 2-3	-2.18	20	.04	0.43	-2.36	10	.04	0.22
Week 3-4	0.81	20	.42	0.12	1.29	10	.22	0.24
Week 4-5	0.83	20	.41	0.18	-1.79	10	.10	0.48
Week 5-6	-0.15	21	.88	0.03	1.69	10	.12	0.26
Week 6-7	-1.37	21	.18	0.23	0.81	10	.43	0.16
Week 7-8	1.58	20	.12	0.29	-0.39	10	.70	0.17
Week 8-9	-0.06	20	.95	0.01	0.35	10	.73	0.04
Week 9-10	-0.26	21	.79	0.07	-0.33	10	.74	0.15
Week 10-11	-1.05	21	.30	0.13	-0.45	10	.66	0.17
Week 11-12	0.56	21	.57	0.09	0.85	10	.41	0.20
Week 2-6	-0.06	21	.84	0.02	-0.28	10	.78	0.04
Week 6-12	-0.60	21	.55	0.10	-0.45	10	.65	0.12
Week 2-12	-0.72	21	.47	0.18	-0.63	10	.53	0.13

Note: TG = Treatment group; CG = Control group

Table 6

Independent t-Test for Step Count Differences Between Treatment and Control Groups

Week	*t* (*df*)	*p*	Mean Diff	*d*
Week 2	-3.59 (31)	.001	-14133.18	1.17
Week 3	-3.28 (30)	.003	-15818.35	1.13
Week 4	-4.62 (30)	.000	-17718.43	2.16
Week 5	-2.42 (31)	.021	-10630.63	1.03
Week 6	-2.72 (31)	.011	-13811.18	1.56
Week 7	-4.41 (31)	.000	-18587.81	2.72
Week 8	-2.75 (30)	.010	-13598.13	1.03
Week 9	-3.51 (31)	.001	-14357.68	1.30
Week 10	-2.42 (31)	.021	-13453.00	0.89
Week 11	-2.80 (31)	.009	-12805.36	0.98
Week 12	-2.93 (31)	.006	-14377.00	1.40

Table 7

Results from t-tests Comparing Step Counts from Activity Trackers and Cellular Phone Application Among Treatment Group

Week	*t* (*df*)	*p*	Mean Diff	*d*
Week 2	3.76	.007	7385.37	0.90
Week 3	2.57	.042	8827.85	0.72
Week 4	5.74	.001	8609.75	0.53
Week 5	4.59	.003	7324.37	0.48
Week 6	6.59	.000	8326.25	0.50
Week 7	2.40	.047	11477.12	0.78
Week 8	2.71	.030	10359.87	0.61
Week 9	2.59	.032	11506.33	0.91
Week 10	5.79	.000	8332.33	0.48
Week 11	5.32	.001	9952.55	0.90
Week 12	2.81	.023	7899.66	0.52

Table 8

t-test Results for IPAQ Walk, Moderate, and Vigorous Physical Activity for Treatment and Control Groups

IPAQ Category	*t(df)*	*p*	Mean Diff	*d*
IPAQ Walk Init	-0.372 (32)	.71	-57.32	0.18
IPAQ Mod Init	-1.210 (32)	.23	-258.45	0.76
IPAQ Vig Init	-0.309 (32)	.75	-33.33	0.12
IPAQ Walk Mid	-0.549 (32)	.58	-192.25	0.17
IPAQ Mod Mid	-0.902 (32)	.37	-342.42	0.44
IPAQ Vig Mid	-0.946 (32)	.35	-624.06	0.70
IPAQ Walk Fin	0.925 (32)	.36	430.11	0.23
IPAQ Mod Fin	-0.093 (32)	.92	-36.21	0.03
IPAQ Vig Fin	-1.287 (32)	.20	-794.84	0.55

Table 9

Mean Difference and Effect Sizes Pre-Post for VO_{2max} and BF%

	VO_{2max} Pre-Post		BF% Pre-Post	
	Mean Diff	*d*	Mean Diff	*d*
TG	1.98	0.23	0.25	0.03
CG	2.66	0.45	0.27	0.03
All	2.24	0.29	0.24	0.03

Note: Mean Diff = Mean difference; TG = Treatment group; CG = Control group

Table 10

Descriptive Statistics and Independent t-test Results for EMI-2 and Locus of Causality Scores at Baseline

	Group Means (SD)				
Motivation Scale	Treatment	Control	*t*	*p*	Mean Diff
SM	10.82 (4.01)	13.75 (3.91)	2.05	.04	2.93
Rev	8.55 (3.03)	9.17 (3.18)	0.561	.57	0.62
Enj	8.36 (4.40)	10.75 (5.57)	1.37	.17	2.38
Chal	9.82 (3.55)	12.83 (4.04)	2.25	.03	3.01
SR	3.95 (3.42)	5.42 (3.02)	1.23	.22	1.46
Aff	7.09 (5.03)	6.33 (5.03)	-0.41	.67	-0.75
Comp	4.91 (3.62)	5.50 (5.85)	0.36	.71	0.59
HP	5.27 (3.22)	6.67 (4.81)	1.01	.32	1.39
IHA	13.05 (2.59)	12.75 (2.49)	-0.32	.75	-0.29
PH	13.27 (1.85)	14.08 (1.24)	1.35	.18	0.81
WM	15.64 (3.54)	15.33 (5.36)	-0.19	.84	-0.3
App	11.23 (4.29)	12.67 (4.09)	0.94	.35	1.43
S&E	13.91 (4.43)	15.83 (3.09)	1.33	.19	1.92
Nimb	10.36 (3.04)	12.17 (1.89)	1.85	.07	1.8
Locus	7.18 (3.87)	7.00 (4.78)	-0.12	.90	-0.18

Note: SM = Stress management; Rev = Revitalization; Enj = Enjoyment; Chal = Challenge; SR = Social recognition; Aff = Affiliation; Comp = Competition; HP = Health pressures; IHA = Ill-health avoidance; PH = Positive health; WM = Weight management; App = Appearance; S&E = Strength and endurance; Nimb = Nimbleness; Locus = Locus of causality

Table 11

Descriptive Statistics and Independent t-test Results for EMI-2 and Locus of Causality Scores at Final Testing

Motivation Scale	Group Means (SD)		*t*	*p*	Mean Diff
	Treatment	Control			
SM	11.59 (5.60)	15.33 (3.49)	2.09	.04	3.74
Rev	8.59 (3.78)	10.50 (2.90)	1.51	.13	1.9
Enj	8.68 (5.82)	12.33 (5.67)	1.76	.08	3.65
Chal	8.32 (4.66)	11.83 (4.93)	2.05	.04	3.51
SR	3.86 (3.74)	4.50 (5.64)	0.39	.69	0.63
Aff	6.86 (5.80)	6.50 (4.68)	-0.18	.85	-0.36
Comp	6.25 (4.27)	6.25 (6.13)	1.08	.28	1.97
HP	4.77 (2.94)	5.92 (3.77)	0.98	.33	1.14
IHA	12.59 (2.84)	11.83 (4.10)	-0.63	.53	-0.75
PH	13.14 (1.69)	12.83 (4.04)	-0.3	.76	-0.3
WM	15.00 (3.76)	14.75 (5.75)	-0.15	.87	-0.25
App	11.32 (4.34)	11.42 (5.74)	0.05	.95	0.09
S&E	14.23 (4.05)	15.00 (5.17)	0.48	.63	0.77
Nimb	10.55 (2.80)	11.00 (2.62)	0.46	.64	0.45
Locus	8.14 (4.46)	8.33 (2.83)	0.13	.89	0.19

Note: SM = Stress management; Rev = Revitalization; Enj = Enjoyment; Chal = Challenge; SR = Social recognition; Aff = Affiliation; Comp = Competition; HP = Health pressures; IHA = Ill-health avoidance; PH = Positive health; WM = Weight management; App = Appearance; S&E = Strength and endurance; Nimb = Nimbleness; Locus = Locus of causality

Table 12

Mean Differences and Effect Sizes for Motivational Scales Measured by the EMI-2 for Treatment and Control Groups

TG			CG		
Motivation Scale	Mean Diff	*d*	Motivation Scale	Mean Diff	*d*
SM	-0.77	0.19	SM	-1.58	0.4
Rev	-0.04	0.01	Rev	-1.33	0.41
Enj	-0.32	-0.07	Enj	-1.58	0.28
Chal	1.5	0.42	Chal	1	0.24
SR	0.09	0.02	SR	0.92	0.3
Aff	0.23	0.04	Aff	-0.17	0.03
Comp	-1.34	0.37	Comp	-0.75	0.12
HP	0.5	0.15	HP	0.75	0.15
IHA	0.46	0.17	IHA	0.92	0.36
PH	0.13	0.07	PH	1.25	1
WM	0.64	0.18	WM	0.58	0.1
App	-0.09	0.02	App	1.25	0.3
S&E	-0.32	0.07	S&E	0.83	0.26
Nimb	-0.19	0.06	Nimb	1.17	0.61
Locus	-0.96	0.24	Locus	-1.33	0.27

Note: SM = Stress management; Rev = Revitalization; Enj = Enjoyment; Chal = Challenge; SR = Social recognition; Aff = Affiliation; Comp = Competition; HP = Health pressures; IHA = Ill-health avoidance; PH = Positive health; WM = Weight management; App = Appearance; S&E = Strength and endurance; Nimb = Nimbleness; Locus = Locus of causality; TG = Treatment group; CG = Control group

Table 13

Dependent t-test Results and Effect Sizes for EMI-2 Changes in Total Population Sample Over 12-week Study

Motivational Scale	*t*	*p*	Mean Diff	*d*
SM	-1.71	.09	-1.05	0.25
Rev	-1.03	.31	-0.5	0.16
Enj	-1.14	.26	-0.76	0.15
Chal	1.74	.09	1.32	0.33
SR	0.63	.52	0.38	0.11
Aff	0.11	.90	0.08	0.01
Comp	0.22	.82	0.14	0.03
HP	1.12	.26	0.58	0.15
IHA	1.32	.19	0.61	0.24
PH	1.15	.25	0.52	0.21
WM	0.78	.43	0.61	0.14
App	0.68	.49	0.38	0.09
S&E	0.13	.89	0.08	0.02
Nimb	0.54	.59	0.29	0.1
Locus	-2.06	.04	-1.08	0.26

Note: SM = Stress management; Rev = Revitalization; Enj = Enjoyment; Chal = Challenge; SR = Social recognition; Aff = Affiliation; Comp = Competition; HP = Health pressures; IHA = Ill-health avoidance; PH = Positive health; WM = Weight management; App = Appearance; S&E = Strength and endurance; Nimb = Nimbleness; Locus = Locus of causality

FIGURES

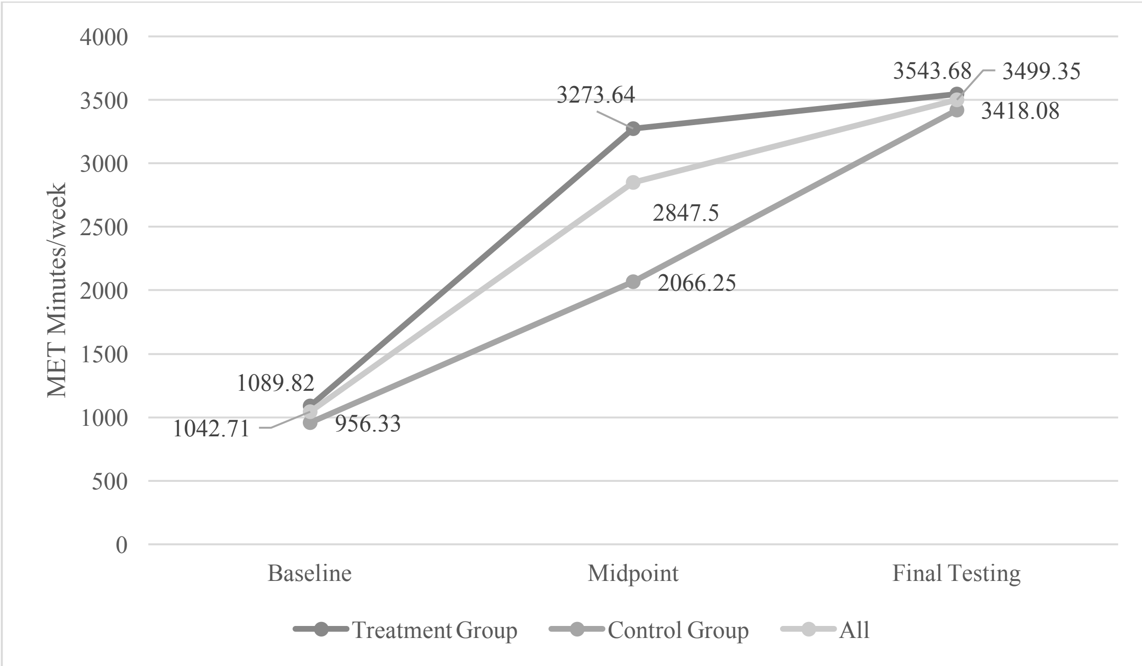

Figure 1. IPAQ MET-Minutes/Week Scores Over Time by Group.

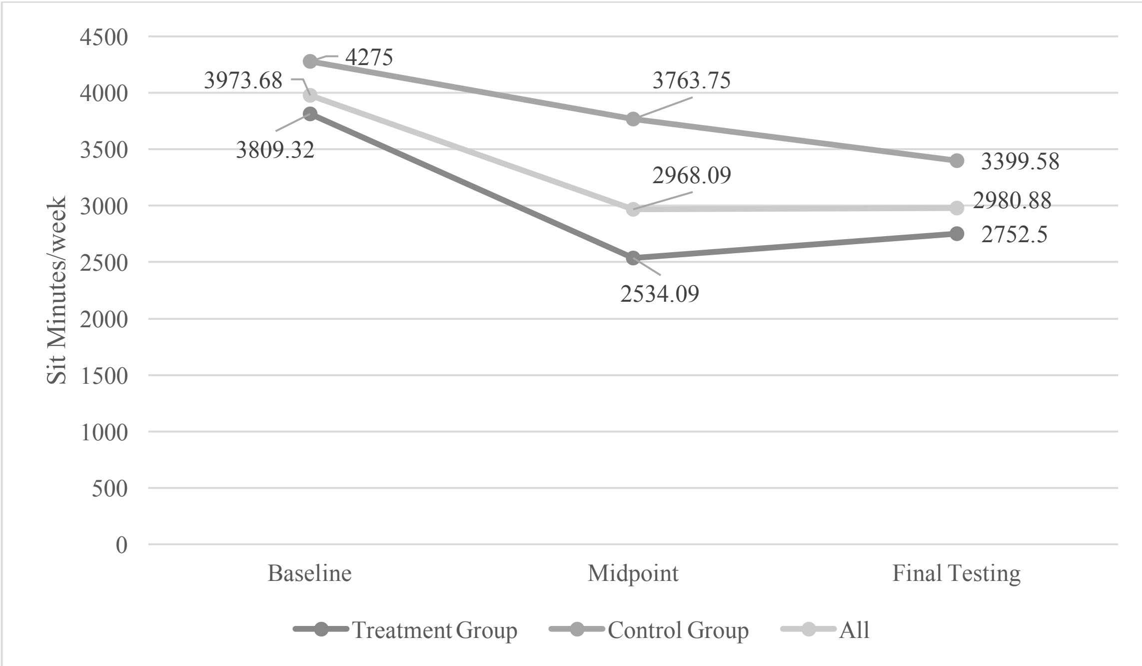

Figure 2. IPAQ Sit-Minutes/Week Scores Over Time by Group.

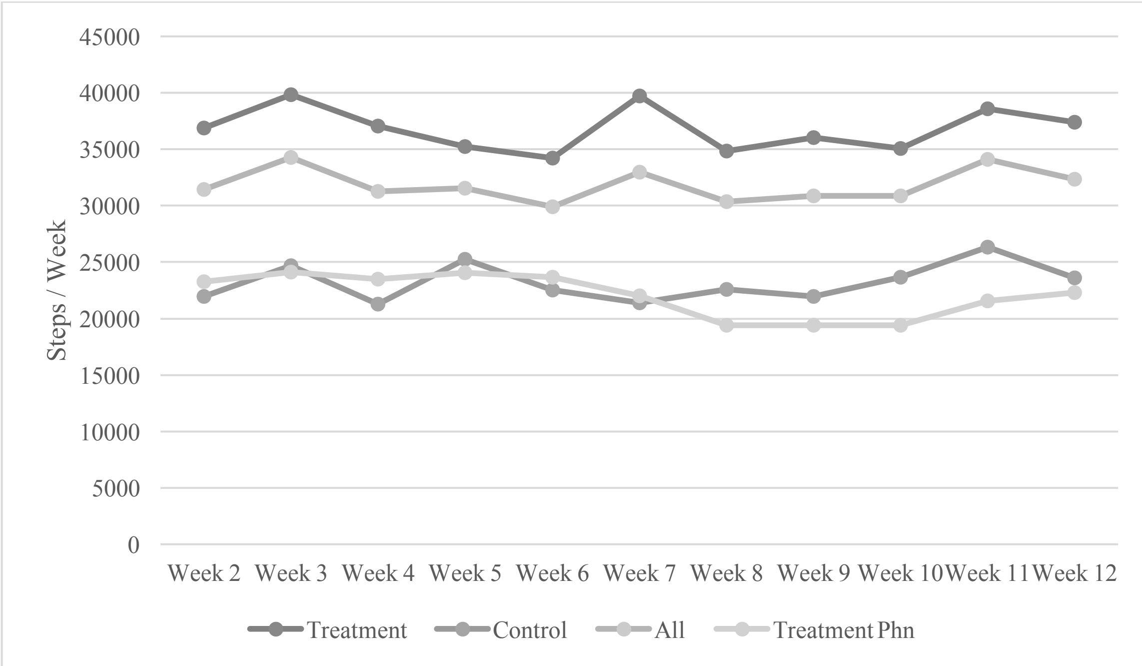

Figure 3. Mean number of steps measured per week for treatment, control, and total sample population.

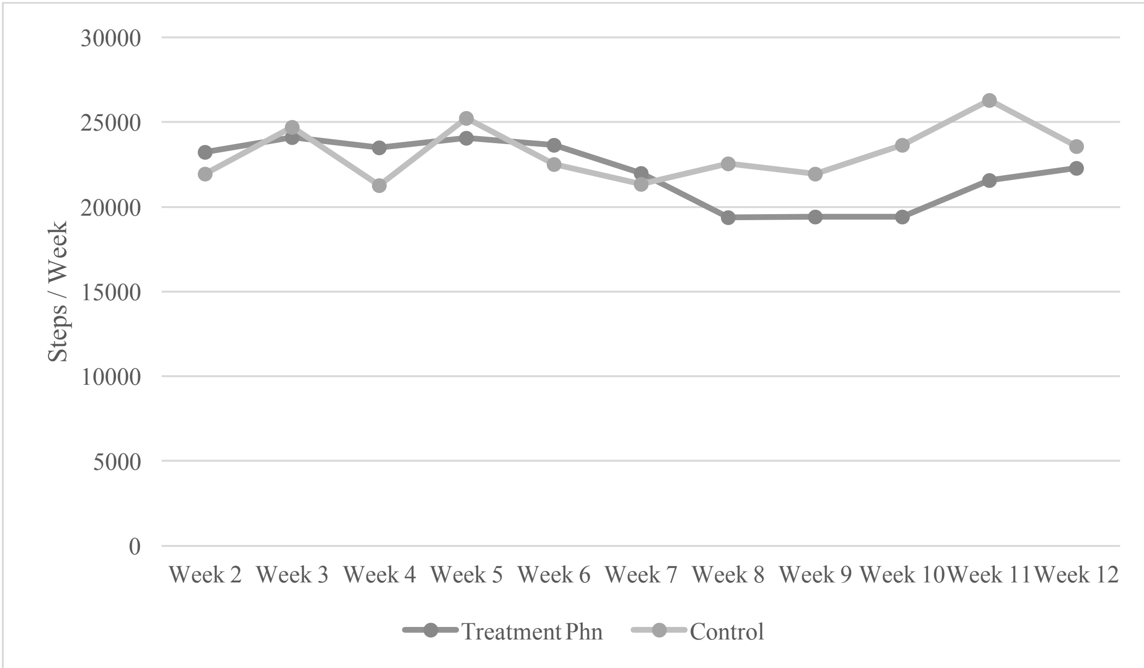

Figure 4. Mean number of steps measured by cellular phone per week for testing and control groups. Treatment Phn = Treatment group steps measured by phone.

Appendix A – IRB Approval

Document Attached

Michael Smith <msmith169@uco.edu>

Review: IRB #16200 Approval

IRB <IRB@uco.edu> Tue, Nov 22, 2016 at 12:52 PM
To: Michael Smith <msmith169@uco.edu>, Melissa Powers <MPowers3@uco.edu>

November 22, 2016 IRB Application #: 16200

Proposal Title: The Influence Of Activity Trackers On Physical Activity, Cardiorespiratory Endurance, Body Composition, And Exercise Motivation

Type of Review: Initial-Expedited

Investigator(s):

Mr. Michael Smith

Dr. Melissa Powers

Department of Kinesiology and Health Studies

College of Education & Professional Studies

Campus Box 189

University of Central Oklahoma

Edmond, OK 73034

Dear Mr. Smith and Dr. Powers:

Re: Application for IRB Review of Research Involving Human Subjects

We have received your materials for your application. The UCO IRB has determined that the above named application is APPROVED BY EXPEDITED REVIEW. The Board has provided expedited review under 45 CFR 46.110, for research involving no more that minimal risk and research category 7.

Date of Approval: 11/22/2016

Date of Approval Expiration: 11/21/2017

If applicable, informed consent (and HIPAA authorization) must be obtained from subjects or their legally authorized representatives and documented prior to research involvement. A stamped, approved copy of the informed consent form will be sent to you via campus mail. The IRB-approved consent form and process must be used. While this project is approved for the period noted above, any modification to the procedures and/or consent form must be approved prior to incorporation into the study. A written request is needed to initiate the amendment process. You will be contacted in writing prior to the approval expiration to determine if a continuing review is needed, which must be obtained before the anniversary date. Notification of the completion of the project must be sent to the IRB office in writing and all records must be retained and available for audit for at least 3 years after the research has ended.

It is the responsibility of the investigators to promptly report to the IRB any serious or unexpected adverse events or unanticipated problems that may be a risk to the subjects.

On behalf of the UCO IRB, I wish you the best of luck with your research project. If our office can be of any further assistance, please do not hesitate to contact us.

Sincerely,

Robert Mather, Ph.D.

Chair, Institutional Review Board

University of Central Oklahoma

100 N. University Dr.

Edmond, OK 73034

405-974-5497

irb@uco.edu

Approved-stamped ICF.pdf
1558K

Appendix B – Recruitment Email

Walking for Fitness

We are seeking individuals for a research study to evaluate the effectiveness of a walking program for fitness. With so many programs available to get fit, people should know if a particular program is effective. This study aims to evaluate a walking program over a 12-week study by testing participants before and after the program for changed to cardiovascular health and body composition changes.

What will I do?
You will be given a questionnaires to establish baseline Physical Activity Levels and ratings of exercise motivations. You will then complete a few tests to establish a baseline fitness level and body fat percentage. You will be given exercise recommendations and a walking program. Over the course of 12 weeks you will be asked for updates on your progress. At 6 weeks you will complete a questionnaire to determine your physical activity levels. At the conclusion of the study you will be given a physical activity questionnaire, a exercise motivation questionnaire, and you will complete one last round of testing.

What kind of exercise will I perform?
The program will be increasing walking distances and intensities. The program will also offer guidelines for restistance and flexibility training.

Eligibility to Participate

- Persons aged 18-64 years.
- Ability to maintain a walking program over the 12-week study period

Contact Information
For further details or to sign up for participation please contact:

Michael Smith
Principal Investigator
Msmith169@uco.edu
405-308-6045

This research project is being conducted by Michael Smith (Student Principal Investigator) and Dr. Melissa Powers (Faculty Advisor) at the University of Central Oklahoma and has been approved by UCO's Institutional Review Board.

Appendix C – Recruitment Flier

Document Attached

Walking for Fitness Study for Faculty and Staff

Ready to take charge of your Fitness?

We are seeking individuals for a research study to evaluate the effect of activity trackers on fitness and motivation.

What will I do?

Participants will complete a12-week walking program designed for people who want to improve fitness. You will be asked about your activity levels throughout the 12-week plan.

What kind of exercise will I perform?

Self-selected walking pace and distances over a 12-week program.

Eligibility to Participate

All UCO faculty and staff are eligible to participate if they are between the ages of 18 and 72 years of age, do not currently exercise on 5 or more days per week, and are medically able to participate in a walking program. Due to the use of a bioelectric impedance analyzer (BIA) for the measurement of body fat, those with an implanted cardioverter defibrillator are not eligible to participate.

Contact Information

For further details or to sign up for participation please contact:
Michael Smith – Principal Investigator, msmith169@uco.edu, 405-308-6045

This research project is being conducted by Michael Smith (Student Principal Investigator) and Dr. Melissa Powers (Faculty Advisor) at the University of Central Oklahoma and has been approved by UCO’s Institutional Review Board (IRB # 16200).

Appendix D – IPAQ

Document Attached

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (October 2002)

LONG LAST 7 DAYS SELF-ADMINISTERED FORMAT

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health–related physical activity.

Background on IPAQ
The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (14 sites) during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages, and are suitable for national population-based prevalence studies of participation in physical activity.

Using IPAQ
Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instruments.

Translation from English and Cultural Adaptation
Translation from English is encouraged to facilitate worldwide use of IPAQ. Information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se. If a new translation is undertaken we highly recommend using the prescribed back translation methods available on the IPAQ website. If possible please consider making your translated version of IPAQ available to others by contributing it to the IPAQ website. Further details on translation and cultural adaptation can be downloaded from the website.

Further Developments of IPAQ
International collaboration on IPAQ is on-going and an ***International Physical Activity Prevalence Study*** is in progress. For further information see the IPAQ website.

More Information
More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000). *Assessment of Physical Activity: An International Perspective.* Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

☐ Yes

☐ No → ***Skip to PART 2: TRANSPORTATION***

The next questions are about all the physical activity you did in the **last 7 days** as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

_____ **days per week**

☐ No vigorous job-related physical activity → ***Skip to question 4***

3. How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work?

_____ **hours per day**
_____ **minutes per day**

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

_____ **days per week**

☐ No moderate job-related physical activity → ***Skip to question 6***

5. How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work?

_____ **hours per day**
_____ **minutes per day**

6. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

_____ **days per week**

☐ No job-related walking → ***Skip to PART 2: TRANSPORTATION***

7. How much time did you usually spend on one of those days **walking** as part of your work?

_____ **hours per day**
_____ **minutes per day**

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram?

_____ **days per week**

☐ No traveling in a motor vehicle → ***Skip to question 10***

9. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

_____ **hours per day**
_____ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No bicycling from place to place → ***Skip to question 12***

11. How much time did you usually spend on one of those days to **bicycle** from place to place?

_____ **hours per day**
_____ **minutes per day**

12. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No walking from place to place → ***Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY***

13. How much time did you usually spend on one of those days **walking** from place to place?

_____ **hours per day**
_____ **minutes per day**

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging **in the garden or yard**?

_____ **days per week**

☐ No vigorous activity in garden or yard → ***Skip to question 16***

15. How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

_____ **days per week**

☐ No moderate activity in garden or yard → ***Skip to question 18***

17. How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

_____ **days per week**

☐ No moderate activity inside home → ***Skip to PART 4: RECREATION, SPORT AND LEISURE-TIME PHYSICAL ACTIVITY***

19. How much time did you usually spend on one of those days doing **moderate** physical activities inside your home?

_____ **hours per day**
_____ **minutes per day**

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

_____ **days per week**

☐ No walking in leisure time → ***Skip to question 22***

21. How much time did you usually spend on one of those days **walking** in your leisure time?

_____ **hours per day**
_____ **minutes per day**

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming **in your leisure time**?

_____ **days per week**

☐ No vigorous activity in leisure time → ***Skip to question 24***

23. How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time?

_____ **hours per day**
_____ **minutes per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis **in your leisure time**?

_____ **days per week**

☐ No moderate activity in leisure time → ***Skip to PART 5: TIME SPENT SITTING***

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?
_____ **hours per day**
_____ **minutes per day**

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

_____ **hours per day**
_____ **minutes per day**

27. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekend day**?

_____ **hours per day**
_____ **minutes per day**

This is the end of the questionnaire, thank you for participating.

Appendix E – PAR-Q+

Document Attached

PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

Regular physical activity is fun and healthy, and more people should become more physically active every day of the week. Being more physically active is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

SECTION 1 - GENERAL HEALTH

	Please read the 7 questions below carefully and answer each one honestly: check YES or NO.	YES	NO
1.	Has your doctor ever said that you have a heart condition OR high blood pressure?	☐	☐
2.	Do you feel pain in your chest at rest, during your daily activities of living, OR when you do physical activity?	☐	☐
3.	Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months? Please answer NO if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4.	Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)?	☐	☐
5.	Are you currently taking prescribed medications for a chronic medical condition?	☐	☐
6.	Do you have a bone or joint problem that could be made worse by becoming more physically active? Please answer NO if you had a joint problem in the past, but it does not limit your current ability to be physically active. For example, knee, ankle, shoulder or other.	☐	☐
7.	Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

If you answered NO to all of the questions above, you are cleared for physical activity.

Go to Section 3 to sign the form. You do not need to complete Section 2.

- Start becoming much more physically active – start slowly and build up gradually.
- Follow the Canadian Physical Activity Guidelines for your age (www.csep.ca/guidelines).
- You may take part in a health and fitness appraisal.
- If you have any further questions, contact a qualified exercise professional such as a CSEP Certified Exercise Physiologist® (CSEP-CEP) or CSEP Certified Personal Trainer® (CSEP-CPT).
- If you are over the age of 45 yrs. and NOT accustomed to regular vigorous physical activity, please consult a qualified exercise professional (CSEP-CEP) before engaging in maximal effort exercise.

If you answered YES to one or more of the questions above, please GO TO SECTION 2.

Delay becoming more active if:

- You are not feeling well because of a temporary illness such as a cold or fever – wait until you feel better
- You are pregnant – talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the PARmed-X for Pregnancy before becoming more physically active OR
- Your health changes – please answer the questions on Section 2 of this document and/or talk to your doctor or qualified exercise professional (CSEP-CEP or CSEP-CPT) before continuing with any physical activity programme.

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SECTION 2 - CHRONIC MEDICAL CONDITIONS

		Please read the questions below carefully and answer each one honestly: check YES or NO.	YES	NO
1.		Do you have Arthritis, Osteoporosis, or Back Problems?	☐ If yes, answer questions 1a-1c	☐ If no, go to question 2
	1a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	1b.	Do you have joint problems causing pain, a recent fracture or fracture caused by osteoporosis or cancer, displaced vertebra (e.g., spondylolisthesis), and/or spondylolysis/pars defect (a crack in the bony ring on the back of the spinal column)?	☐	☐
	1c.	Have you had steroid injections or taken steroid tablets regularly for more than 3 months?	☐	☐
2.		Do you have Cancer of any kind?	☐ If yes, answer questions 2a-2b	☐ If no, go to question 3
	2a.	Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of plasma cells), head, and neck?	☐	☐
	2b.	Are you currently receiving cancer therapy (such as chemotherapy or radiotherapy)?	☐	☐
3.		Do you have Heart Disease or Cardiovascular Disease? This includes Coronary Artery Disease, High Blood Pressure, Heart Failure, Diagnosed Abnormality of Heart Rhythm	☐ If yes, answer questions 3a-3e	☐ If no, go to question 4
	3a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	3b.	Do you have an irregular heart beat that requires medical management? (e.g. atrial fibrillation, premature ventricular contraction)	☐	☐
	3c.	Do you have chronic heart failure?	☐	☐
	3d.	Do you have a resting blood pressure equal to or greater than 160/90 mmHg with or without medication? (Answer YES if you do not know your resting blood pressure)	☐	☐
	3e.	Do you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months?	☐	☐
4.		Do you have any Metabolic Conditions? This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes	☐ If yes, answer questions 4a-4c	☐ If no, go to question 5
	4a.	Is your blood sugar often above 13.0 mmol/L? (Answer YES if you are not sure)	☐	☐
	4b.	Do you have any signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, and the sensation in your toes and feet?	☐	☐
	4c.	Do you have other metabolic conditions (such as thyroid disorders, pregnancy-related diabetes, chronic kidney disease, liver problems)?	☐	☐
5.		Do you have any Mental Health Problems or Learning Difficulties? This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome)	☐ If yes, answer questions 5a-5b	☐ If no, go to question 6
	5a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	5b.	Do you also have back problems affecting nerves or muscles?	☐	☐

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		Please read the questions below carefully and answer each one honestly: check YES or NO.	YES	NO
6.		Do you have a Respiratory Disease? This includes Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary High Blood Pressure	☐ If yes, answer questions 6a-6d	☐ If no, go to question 7
	6a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	6b.	Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy?	☐	☐
	6c.	If asthmatic, do you currently have symptoms of chest tightness, wheezing, laboured breathing, consistent cough (more than 2 days/week), or have you used your rescue medication more than twice in the last week?	☐	☐
	6d.	Has your doctor ever said you have high blood pressure in the blood vessels of your lungs?	☐	☐
7.		Do you have a Spinal Cord Injury? This includes Tetraplegia and Paraplegia	☐ If yes, answer questions 7a-7c	☐ If no, go to question 8
	7a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	7b.	Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting?	☐	☐
	7c.	Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)?	☐	☐
8.		Have you had a Stroke? This includes Transient Ischemic Attack (TIA) or Cerebrovascular Event	☐ If yes, answer questions 8a-c	☐ If no, go to question 9
	8a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer NO if you are not currently taking medications or other treatments)	☐	☐
	8b.	Do you have any impairment in walking or mobility?	☐	☐
	8c.	Have you experienced a stroke or impairment in nerves or muscles in the past 6 months?	☐	☐
9.		Do you have any other medical condition not listed above or do you live with two chronic conditions?	☐ If yes, answer questions 9a-c	☐ If no, read the advice on page 4
	9a.	Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months OR have you had a diagnosed concussion within the last 12 months?	☐	☐
	9b.	Do you have a medical condition that is not listed (such as epilepsy, neurological conditions, kidney problems)?	☐	☐
	9c.	Do you currently live with two chronic conditions?	☐	☐

Please proceed to Page 4 for recommendations for your current medical condition and sign this document.

PAR-Q+

If you answered NO to all of the follow-up questions about your medical condition, you are ready to become more physically active:

- It is advised that you consult a qualified exercise professional (e.g., a CSEP-CEP or CSEP-CPT) to help you develop a safe and effective physical activity plan to meet your health needs.
- You are encouraged to start slowly and build up gradually – 20-60 min. of low- to moderate-intensity exercise, 3-5 days per week including aerobic and muscle strengthening exercises.
- As you progress, you should aim to accumulate 150 minutes or more of moderate-intensity physical activity per week.
- If you are over the age of 45 yrs. and NOT accustomed to regular vigorous physical activity, please consult a qualified exercise professional (CSEP-CEP) before engaging in maximal effort exercise.

If you answered YES to one or more of the follow-up questions about your medical condition:

- You should seek further information from a licensed health care professional before becoming more physically active or engaging in a fitness appraisal and/or visit a or qualified exercise professional (CSEP-CEP) for further information.

Delay becoming more active if:

- You are not feeling well because of a temporary illness such as a cold or fever – wait until you feel better
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise profesional, and/or complete the PARmed-X for Pregnancy before becoming more physically active OR
- Your health changes - please talk to your doctor or qualified exercise professional (CSEP-CEP) before continuing with any physical activity programme.

SECTION 3 - DECLARATION

- You are encouraged to photocopy the PAR-Q+. You must use the entire questionnaire and NO changes are permitted.
- The Canadian Society for Exercise Physiology, the PAR-Q+ Collaboration, and their agents assume no liability for persons who undertake physical activity. If in doubt after completing the questionnaire, consult your doctor prior to physical activity.
- If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.
- Please read and sign the declaration below:

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that a Trustee (such as my employer, community/fitness centre, health care provider, or other designate) may retain a copy of this form for their records. In these instances, the Trustee will be required to adhere to local, national, and international guidelines regarding the storage of personal health information ensuring that they maintain the privacy of the information and do not misuse or wrongfully disclose such information.

NAME ______________________________ DATE ______________________________

SIGNATURE ______________________________ WITNESS ______________________________

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER ______________________________

For more information, please contact:
Canadian Society for Exercise Physiology
www.csep.ca

KEY REFERENCES

1. Jamnik VJ, Warburton DER, Makarski J, McKenzie DC, Shephard RJ, Stone J, and Gledhill N. Enhancing the eectiveness of clearance for physical activity participation; background and overall process. APNM 36(S1):S3-S13, 2011.
2. Warburton DER, Gledhill N, Jamnik VK, Bredin SSD, McKenzie DC, Stone J, Charlesworth S, and Shephard RJ. Evidence-based risk assessment and recommendations for physical activity clearance; Consensus Document. APNM 36(S1):S266-s298, 2011.

The PAR-Q+ was created using the evidence-based AGREE process (1) by the PAR-Q+Collaboration chaired by Dr. Darren E. R. Warburton with Dr. Norman Gledhill, Dr. Veronica Jamnik, and Dr. Donald C. McKenzie (2). Production of this document has been made possible through financial contributions from the Public Health Agency of Canada and the BC Ministry of Health Services. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada or BC Ministry of Health Services.

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Appendix F – EMI-2

Document Attached

Participant Code: __________ Session (Circle One): Baseline Final

Exercise Motivations Inventory – 2

On the following pages are a number of statements concerning the reasons people often give when asked why they exercise. Whether you currently exercise regularly or not, please read each statement carefully and indicate, by circling the appropriate number, whether or not each statement is true for you personally, or would be true for you personally if you did exercise. If you do not consider a statement to be true for you at all, circle the '0'. If you think that a statement is very true for you indeed, circle the '5'. If you think that a statement is partly true for you, then circle the '1', '2', '3' or '4', according to how strongly you feel that it reflects why you exercise or might exercise.

Remember, we want to know why you personally choose to exercise or might choose to exercise, not whether you think the statements are good reasons for anybody to exercise.

Personally, I exercise (or might exercise) …	**Not at all true for me**					**Very true for me**
1. To stay slim	0	1	2	3	4	5
2. To avoid ill-health	0	1	2	3	4	5
3. Because it makes me feel good	0	1	2	3	4	5
4. To help me look younger	0	1	2	3	4	5
5. To show my worth to others	0	1	2	3	4	5
6. To give me space to think	0	1	2	3	4	5
7. To have a healthy body	0	1	2	3	4	5
8. To build up my strength	0	1	2	3	4	5
9. Because I enjoy the feeling of exerting myself	0	1	2	3	4	5

Participant Code: __________ Session (Circle One): Baseline Final

10. To spend time with friends	0	1	2	3	4	5
11. Because my doctor advised me to exercise	0	1	2	3	4	5
12. Because I like trying to win in physical activities	0	1	2	3	4	5
13. To stay/become more agile	0	1	2	3	4	5
14. To give me goals to work towards	0	1	2	3	4	5
15. To lose weight	0	1	2	3	4	5
16. To prevent health problems	0	1	2	3	4	5
17. Because I find exercise invigorating	0	1	2	3	4	5
18. To have a good body	0	1	2	3	4	5
19. To compare my abilities with other peoples'	0	1	2	3	4	5
20. Because it helps to reduce tension	0	1	2	3	4	5
21. Because I want to maintain good health	0	1	2	3	4	5
22. To increase my endurance	0	1	2	3	4	5

Participant Code: ___________ Session (Circle One): Baseline Final

23. Because I find exercising satisfying in an of itself	0	1	2	3	4	5
24. To enjoy the social aspects of exercising	0	1	2	3	4	5
25. To help prevent an illness that runs in my family	0	1	2	3	4	5
26. Because I enjoy competing	0	1	2	3	4	5
27. To maintain flexibility	0	1	2	3	4	5
28. To give me personal challenges to face	0	1	2	3	4	5
29. To help control my weight	0	1	2	3	4	5
30. To avoid heart disease	0	1	2	3	4	5
31. To recharge my batteries	0	1	2	3	4	5
32. To improve my appearance	0	1	2	3	4	5
33. To gain recognition for my accomplishments	0	1	2	3	4	5
34. To help manage stress	0	1	2	3	4	5
35. To feel more healthy	0	1	2	3	4	5
36. To get stronger	0	1	2	3	4	5
37. For enjoyment of the experience of exercising	0	1	2	3	4	5

Participant Code: __________ Session (Circle One): Baseline Final

38. To have fun being active with other people	0	1	2	3	4	5
39. To help recover from an illness/injury	0	1	2	3	4	5
40. Because I enjoy physical competition	0	1	2	3	4	5
41. To stay/become flexible	0	1	2	3	4	5
42. To develop personal skills	0	1	2	3	4	5
43. Because exercise helps me to burn calories	0	1	2	3	4	5
44. To look more attractive	0	1	2	3	4	5
45. To accomplish things that others are incapable of	0	1	2	3	4	5
46. To release tension	0	1	2	3	4	5
47. To develp my muscles	0	1	2	3	4	5
48. Because I feel at my best when exercising	0	1	2	3	4	5
49. To make new friends	0	1	2	3	4	5
50. Because I find physical activities fun, especially when competition is involved	0	1	2	3	4	5

51. To measure myself against personal standards	0	1	2	3	4	5	

Locus of Causality of Exercise Scale

	Strongly disagree					**Strongly agree**	
1. I exercise because I like to rather than because I feel I have to	0	1	2	3	4	5	6
2. Exercising is not something I would necessarily choose to do, rather it is something that I feel I ought to do	0	1	2	3	4	5	6
3. Having to exercise is a bit of a bind, but it has to be done	0	1	2	3	4	5	6

Appendix G – Informed Consent

UNIVERSITY OF CENTRAL OKLAHOMA

INFORMED CONSENT FORM

Research Project Title: he Use Of Activity Trackers For Motivation And Wellness Management

Researcher (s): Michael Smith, Principal Investigator; Dr. Melissa Powers, Co-Principal Investigator

A. Purpose of this research: The purpose of the proposed research is to determine if activity tracker use increases exercise motivation, phsyical activity (PA), and physical fitness more than education alone in a population of adults not meeting American College of Sports Medicine (ACSM) guidelines for PA. There are few studies that examine whether fitness trackers improve the fitness, PA levels, or exercise motivation of their users. This study may be able to help determine if fitness trackers can provide effective motivation for PA and improved fitness as a result.

B. Procedures/treatments involved: You will complete the informed consent, a physical activity readiness questionnaire (PAR-Q+), and the International Physical Activity Questionnaire (IPAQ) before being considered for inclusion for the research. The PAR-Q+ consists of a number of questions about your general health that will assess your ability to safely perform exercise. If your responses to the PAR-Q+ determine you need a physician approval before beginning a physical activity program, you will be given one week from the date of PAR-Q completion to obtain physican approval to participate. The International Physical Activity Assessment Questionnaire (IPAQ) form consists of a series of questions that will assess your current level of physical activity. Upon selection for inclusion in the study you will be given a form to collect information such as age, and sex. You will complete an Exercise Motivations Inventory Questionnaire (EMI-2) which consists of 51 questions about your motivations for exercise. You will be tested in the laboratory for height and weight using a stadiometer, waist and hip circumference, and body fat percentage using an Omron HBF-306BL body fat analyzer. You will complete the Rockport 1 mile walking test by completing 12 laps on an indoor track at the University of Central Oklahoma Wellness Center. Total approximate time for you to complete the informed consent, IPAQ, EMI-2, and testing will be 1.5 hours. All of your testing data will be recorded and stored in a locked file cabinet where only authorized personnel will have access. You will be randomly assigned to an activity tracker group (n = 24) or a control group (n = 24). If selected for the fitness tracker group, you will be given a tracker to be worn for the duration of the study. In either group you will be given printed physical activity education that will include ACSM recommended physical activity guidelines and a walking program. Walking program will be designed for sedentary individuals starting an exercise program for cardiorespiratory fitness and weight management. You will be monitored throughout the study for updates on your progress by collecting step data from the activity tracker every two weeks. Step count data collected every two weeks during the intervention will be a 30-minute meeting where step data history will be reviewed and recorded. At the halfway point (6 weeks), you will be asked to complete the IPAQ to assess physical activity level changes from baseline. The IPAQ testing should take approximately 30 minutes and will be completed at a location convenient to you. Assessment of physical activity levels, exercise motivations, cardiorespiratory endurance, and body composition will be repeated at the end of the 12-week intervention. Testing and completion of an IPAQ at the conclusion of the study will take no longer than one hour.

C. Expected length of participation: 12-weeks

D. Potential benefits: Participating in a fitness program will improve your fitness levels. Results from this research may help fitness professionals when recommending methods to motivate clients/partients to increase their physical activity levels and overall fitness.

E. Potential risks or discomforts: Risks and discomforts include the inherent risk and discomfort of performing strenuous physical activity. Risks and discomforts of physical activity would include physical exertion and/or injury during exercise. You will complete a physical activity readiness questionnaire before performing any exercise. This questionnaire determines if you have any medical risk factors for performing exercise and it is considered sensitive and personal information.

F. Medical/mental health contact information (if required): _____

G. Contact information for researchers: Michael Smith, msmith169@uco.edu, 405-308-6045. Dr. Melissa Powers, mpowers3@uco.edu, UCO Extension: 5309

H. Contact information for UCO IRB: UCO-IRB Office, NUC 341, 405-974-5497

I. Explanation of confidentiality and privacy: All information provided is private and will not be shared with outside entities or individuals. Names of participants will only be on the informed consent form and a master coding sheet for subject identification. Code sheet will be kept separate from the data in a locked file cabinet in CTL room 206. The code sheet is destroyed at the conclusion of the study.

J. Assurance of voluntary participation: Participation in this research study is completely voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are entitled. You may withdraw from the study at any time without penalty or loss of benefits.

AFFIRMATION BY RESEARCH SUBJECT

I hereby voluntarily agree to participate in the above listed research project and further understand the above listed explanations and descriptions of the research project. I also understand that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time without penalty. I acknowledge that I am at least 18 years old. I have read and fully understand this Informed Consent Form. I sign it freely and voluntarily. I acknowledge that a copy of this Informed Consent Form has been given to me to keep.

Research Subject's Name: _____

Signature: ____ Date _____

Appendix H – Research Participant Questionnaire

Participant Questionnaire

Age: _____________

Sex: _____________

Height: ______________

Weight: _____________

Baseline Testing Results:

Rockport Test Time: ______________ Heart rate at Finish: ______________

Body Fat %: _______________

BMI: _______________

Waist Circumference: ___________________

Hip Circumference: _________________

IPAQ Score: __________________

Midpoint Testing Results:

IPAQ Score: __________________

Completion Testing Results:

Rockport Test Time: ______________ Heart rate at Finish: ______________

Body Fat %: _______________

BMI: _______________

Waist Circumference: ___________________

Hip Circumference: _________________

IPAQ Score: __________________

Appendix I – Walking Program

Document Attached

Walking fit!

TAKE A WALK TODAY

The popularity of walking as a fitness activity is growing by leaps and bounds. Low risk and easy to start, walking has proved its health benefits in numerous studies.

A classic eight-year study of 13,000 people conducted at the Institute of Aerobics Research under the direction of Dr. Steven Blair found that those who walked the equivalent of 30 minutes a day had significantly lower risk of premature death than those who rarely exercised.

A regular walking program can help:

- Reduce blood cholesterol
- Lower blood pressure
- Increase cardiovascular endurance
- Boost bone strength
- Burn calories and keep weight down

GET READY

A walking program is simple to start. All you need are comfortable clothes and shoes. It is a good idea to layer loose clothing, keeping in mind that exercise elevates the body's temperature. Shoes specifically designed for walking are your best option.

Every workout should begin with a brief warm-up and a few simple stretches. Walk around the house or in place for a few minutes to get the blood flowing to the muscles before you attempt to stretch them. Although walking primarily works the major muscles of the legs, don't forget to stretch your back, shoulders, and arms. This will help loosen up any tension you may be carrying and make your walk more enjoyable, as well as more effective.

GET MOVING

Beginning walkers can make their workouts less strenuous by limiting how fast and far they walk. Keep the following in mind:

- Walk short distances – begin with a five-minute stroll and gradually increase your distance.
- Forget about speed – walk at a comfortable pace. Focus on good posture, keeping your head lifted and shoulder relaxed.
- Swing your arms naturally – breathe deeply. If you can't catch your breath, slow down or avoid hills.

GET FIT

Walking is one fitness activity that allows you numerous options. Once you have reached a point where you can walk a few miles with relative ease, you can start to vary the intensity. Walking hills, in addition to increasing your cardiovascular endurance, is a great way to tone the legs. Concentrate on lengthening your stride or increasing your speed. Don't forget to reward yourself after each workout with a few minute of relaxing stretches to to help prevent sore muscles.

Listening to lively music while you walk is also a great way to energize your workout. If you wear headphones, keep the volume down and watch out for traffic that you may not hear.

Keep track of your progress. Many experts recommend that you walk a minimum of 30 minutes a day, but there are no hard and fast rules. Fit walking into your schedule whenever you can. That may mean three 10-minute walks each day, or even hour-long walks two to three times a week. The best schedule is one that keeps you walking and keeps you fit.

Walking fun facts

1. **Walking is good medicine: It can help you reduce the risk of coronary heart disease**
2. Dog owners walk significantly more than their non-pooch owning counterparts
3. A 15-minute walk can curb chocolate and sugar cravings
4. The fastest 5k (3.1 miles) time for walking is 21:58 (about a 7-minute mile) for a woman and 19:09 (about a 6-minute mile) for a man – faster than most runners!
5. The first Wednesday in April is National Walking Day.
6. Walking can boost creativity by up to 60 percent.
7. Replacing 1 ½ miles of driving with walking will reduce the amount of greenhouse gases produced by about 75 percent.
8. **Walking is good medicine: It can help you improve blood pressure and blood sugar levels.**
9. About 2,000 steps equal one mile.
10. A lunchtime walk can make you more productive at work.
11. The risk of exercise-related injuries is 1 to 5 percent for walkers compared to 20 to 70 percent for runners.

12. Your walking speed can predict how long you'll live.
13. Jobs that get you moving: waiters (23,000 steps a day), nurses (16,000) and retail workers (15,000).
14. Race walking made its Olympic debut in 1908.
15. Walking is good medicine: It can help elevate your mood and enhance mental well-being.
16. Interval walkers lost six times more weight than walkers who maintained a steady pace, according to a Danish study.
17. Walking just 21 minutes a day can cut your risk of heart disease by 30 percent.

18. Taking less than 5,000 steps each day is considered sedentary.

19. The claim that you'll burn 100 calories whether you walk or run a mile is false. Your speed and body weight affect the amount of calories you burn. The faster and heavier you are, the more calories you'll burn.
20. Walk to the beat of "Shut Up and Dance" and you'll be going about 3.5 mph. If you can keep up with "Shake It Off," you'll be cruising at more than 5 mph.
21. Focusing on an object ahead of you can increase your speed by as much as 23 percent.
22. **Walking is good medicine: It can help you reduce the risk of breast and colon cancer.**
23. Walking uphill activates three times more muscle fibers than walking on flat terrain. It also burns up to 60 percent more calories.
24. The ultimate calories burner: stair climbing. You'll burn calories two to three times faster than walking without an incline.
25. Australians walk the most, taking an average of 9,695 steps each day. Americans stroll the least (5,117 steps each day) of all the industrial countries surveyed.
26. Being short doesn't have to slow you down: At the 2008 Olympics, 5'2½" Olga Kaniskina of Russia beat our Norway's 5'8" Kjersti Plätzer for the gold in women's 20k race walk.
27. The longest uninterrupted walk was 19,019 miles from the southern tip of South America to the northern most part of Alaska and took 2,425 days.
28. It would take a person walking nonstop at a 3-mph pace approximately 347 days to walk around the world.

29. Walking is good medicine: It can help you avoid osteoporosis and osteoarthritis

30. A typical pair of athletic shoes will last for approximately 500 miles of walking.
31. Babies typically begin to walk around 12 to 13 months of age, though some may start as early as 9 or 10 months and as late as 15 or 16 months.
32. Walking is the most popular form of exercise in the U.S.
33. Today, less than one out of seven children walk to school. In 1970, two out of three children walked to school.
34. The average walking speed for the typical adult is approximately 3 mph.
35. The average person will walk an estimated 65,000 miles in his or her lifetime – the equivalent of three trips around the world.

36. Walking is good medicine: It can help you maintain body weight and lower your risk of obesity

37. A person needs to walk the length of a football field to burn enough calories to offset eating a single piece of candy-coated chocolate.
38. Adding 150 minutes of brisk talking to your routine each week can add a little over three years to your lifespan.
39. **Walking is good medicine: It improves your cerebral flow and lowers the risk of vascular disease that may help you avoid dementia later in life.**
40. You use an estimated 200 muscles during walking.
41. You need to walk roughly 13 minutes or the equivalent of a half marathon to burn off a super-sized meal.

42. To get a rough estimate of how fast you walk, count the number of steps you take in a minute and divide by 30.
43. Listening to music while walking has been observed to improve mood, motivation and performance.
44. A significant difference between walking and running is the amount of time each food contacts the ground. During walking, at least one foot is in contact with the ground at any given time, and the length of time the foot is in contact is longer than while running.

45. Hippocrates had it right – “walking is man’s best medicine.”

46. Since the days of Socrates, walking has been linked to enhanced cognitive functioning and creativity.
47. Thomas Jefferson, who lived to be 83 when life expectancy was 40, walked four miles a day.
48. During a typical day of walking, the cumulative impact forces on the feet can total several hundred tons – so invest in good quality footwear.
49. **Walking a typical 18-hole golf course equates to about 12,000 steps.**

50. Walking can be FUN!

HOW TO BEGIN YOUR WALKING PROGRAM

Walking is one of the best ways to reap the benefits of regular exercise. Why? Because it's SO convenient! Life is complicated enough without having to rearrange your schedule, drive across town, buy gear or learn new moves to get in a workout. Keep it simple with walking, and you'll be surprised at how much easier it will be to make exercise a habit.

Just do it!

As soon as you finish reading this piece (or right now!), slip on comfortable shoes that you can walk in (no high heels or flip flops) and head out the door for a 10-minute stroll. Walk five minutes out and five minutes back, or make a loop around your neighborhood. There, you did it! Walking is so doable that you don't have to wait until you finish a big work project or your sick kid is feeling better (walk around your house or up and down your driveway if necessary). And now you did it, do it again tomorrow, and the next day, and the next, and so on.

Start Small

You just did (or are going to do) 10 minutes of walking. It may sound like nothing, but if you normally would have spent those 10 minutes sitting you just made a 100% improvement! That's awesome! Breaking this whole exercise thing down into manageable chunks makes it feel less overwhelming. And even though they're small, succeeding at accomplishing these short bouts of walking will make you feel good, motivate you, and boost your confidence to do more.

Add on

Ensure class participants obey traffic signals and use crosswalks. If you are walking in areas without sidewalks, always walk in the opposite direction of the traffic flow so you can see cars coming except when going up a hill or around a curve. In these situation, walk on the opposite side until you can see oncoming cars. If you can't see them, they can't see you. Encourage participants to wear bright colors. If you are walking at dawn or disk, reflective gear is a must.

Warm up and stretch

As your walks get longer and you pick up the pace, add a warm-up to your routine. Simply walk at a slower pace for three to five minutes before hitting your usual stride. At the end of your walk, slow your page for two to three minutes and finish by stretching.

Challenge yourself

When you've been walking regularly (30 minutes at least three times a week) for about a month, change it up to avoid a plateau and ensure that you continue to see benefits. You can do this by walking for longer distances or pick up your pace, aiming to cover your regular distance in less time. Intervals are another great way to increase the intensity of your walks for faster results. Pick up the pace (or increase the incline if you're on a treadmill) of 30 to 60 seconds, then slow down (or lower the incline) for one to two minutes to recover. Then kick it up again, repeating the intervals for your desired workout time. To avoid overtraining or injury, limit high-intensity interval or speed walks and long walks to two or three days a week. You can do moderate-intensity walks or other activities on alternate days.

Go solo and social

There are benefits to walking by yourself and with others – so mix it up. Walking with others is a great way to make walking fun and to help you stick with your routine. It's harder to skip a walk if you are meeting a friend. But heading out by yourself can also be a good idea. If you're looking to push yourself to go faster or want to get in a good interval walk, so solo. Chatting while you walk usually slows you down, and if your walking partner isn't a speed demon, you'll be less likely to push yourself. Walking by yourself can also be relaxing, almost meditative.

Now if you haven't taken that 10-minute walk yet, lace up your sneakers and go! These are your first steps to leading a healthier, happier life.

9 TIPS TO PERFECT YOUR WALKING FORM

Good posture will make it easier to go the distance. Here are some posture pointers for stronger striding during your next walk

TIP 1: STAND UP TALL

Imagine that a wire attached to the down of your head is gently pulling you upward

TIP 2: KEEP YOUR EYES ON THE HORIZON

This will help you to stand taller and avoid stress on your neck and low back.

TIP 3: LIFT YOUR CHEST AND TIGHTEN YOUR ABS

Using muscles in the front of your body to straighten up will take pressure off your back.

TIP 4: BEND YOUR ARMS

You'll be able to swing your arms faster, which helps increase your speed. It also prevents swelling caused from blood pooling in your hands as you walk longer distances.

TIP 5: RELAX YOUR SHOULDERS

Your arms will swing more freely, and you'll avoid upper back and neck tension.

TIP 6: MAINTAIN A NEUTRAL PELVIS

Don't tuck your tailbone under or overarch your back.

TIP 7: KEEP YOUR FRONT LEG STRAIGHT BUT NOT LOCKED

You’ll have a smoother stride and be able to propel yourself forward more easily.

TIP 8: AIM YOUR KNEES AND TOES FORWARD

Proper alignment will reduce your changes of injury.

TIP 9: LAND ON YOUR HEEL

This facilitates the heel-to-toe walking motion that will carry you farther and faster than if your foot slaps down on the ground with each step.

That may seem like a lot to think about, but you don’t have to do it all at once. Start from the top of the list and focus on one tip at a time. Pay attention to this area of your body at the beginning of your walk, and periodically check about every 15 to 20 minutes (don’t constantly focus on it) to see if you’re maintaining good posture. If not, simply get back in alignment. Do this for about a week and then move onto the next tip. Some changes may happen quickly while others may take some time to become habits.

INCORPORATE WALKING INTO YOUR EVERYDAY ROUTINE

Exercise and eating a balanced diet is a more influential solution than medicine alone, but this doesn't mean you have to run a marathon to improve your health. Walking is one of the easiest and most affordable ways to engage in physical activity. It benefits individuals of all fitness levels, not only those beginning to become physically active. Elite athletes can positively affect their recovery time on top of other benefits by adding walking to their day, and walking is ideal for those starting out.

Here are a few ideas to start incorporating walking into your everyday routine:

- Track minutes walked, rather than miles walked. Establish a goal that relates to a certain number of minutes walked per week, rather than number of minute walked per day. This provides flexibility to adjust for unexpected events that may prevent you from walking on certain days.
- Use a stopwatch to track every minute of walking throughout your day and make notes of the total time at bed time.
- If it's raining, icy, or too hot to walk outside, plan to walk indoors at a mall or use the stairs to achieve your desired level of walking for the day. It is good to change up your location to keep your motivation high
- Consider your walking time as "me time" and enhance it by using the time to listen to music, podcasts, audio-books, or catch up with friends and family. Make sure to stay alert and aware of your surroundings at all times.
- Set your alarm a few minute earlier each day to squeeze in a morning walk.
- Establish a new family tradition of a 15-minute walk after dinner on a given day of the week.
- Write down your goals each week; you're more likely to accomplish them if you track them.
- Keep a pair of good walking shoes at work so you're always prepared to take a walk during the workday.

ACSM-AHA PRIMARY PHYSICAL ACTIVITY RECOMMENDATIONS

The American College of Sports Medicine (ACSM) and American Heart Association (AHA) make the following recommendations for physical activity:

- All healthy adults aged 18-65 years should participate in moderate intensity, aerobic physical activity for a minimum of 30 minutes on 5 days per week or vigorous intensity, aerobic activity for a minimum of 20 minutes per day on 3 days per week.
- Combinations of moderate and vigorous intensity exercise can be performed to meet this recommendation.
- Moderate intensity, aerobic activity can be accumulated to total the 30 minute minimum by performing bouts each lasting 10 or more minutes.
- Every adult should perform activities that maintain or increase muscular strength and endurance for a minimum of 2 days per week.
- Because of the dose-response relationship between physical activity and health, individuals who with to further improve their fitness, reduce their risk for chronic diseases and disabilities, and/or prevent unhealthy weight gain may benefit by exceeding the minimum recommended amounts of physical activity.

12-week Beginner Walking Plan

This 12-week program is for the beginner walker who wants to improve overall health and increase energy. Walks start at 10 minutes or less and gradually work up to 30-plus minutes. Health experts have found that about 30 minutes a day of regular moderate exercise is effective for improving health and reducing the risk of many diseases.

Monday, Wednesday and Thursday are the core workout days, with Tuesdays and the weekends optional at the beginning. Fridays are rest days or "Alternate Activity" days. Pick which days of the week work best for you and your schedule. Always start your walk with 3-5 minutes at an easy warm-up pace.

	Monday	Tuesday	Wednesday	Thursday	Friday	Weekend Workout (optional)
Week 1	Easy walk: 5-10 mins Stretch: 2 mins Brisk walk: 5-10 mins	Easy walk: 10-15 mins NOTE: Always rest when necessary	Easy walk: 5-10 mins Stretch: 2 mins Brisk walk: 5-10 mins	Easy walk: 10-15 mins	Rest	Easy walk: 15-20 mins Window shopping is great!
Week 2	Easy walk: 5-10 mins Stretch: 2 mins Brisk walk: 5-10 mins	Easy walk: 10-15 mins	Easy walk: 10-15 mins Stretch: 2 mins Brisk walk: 5-10 mins	Easy walk: 10-15 mins Remember: Rest when necessary	Rest	Easy walk: 15-20 mins
Week 3	Easy walk: 5-10 mins Stretch: 2 mins Brisk walk: 5-10 mins	Easy walk: 15-20 mins Stretch: 2 mins	Easy walk: 10-15 mins Stretch: 2 mins Brisk walk: 5-10 mins	Easy walk: 15-20 mins Stretch: 2 mins	Rest	Easy walk: 15-20 mins Don't window shop! Keep moving!
Week 4	Easy walk: 10-15 mins Brisk walk: 5-10 mins Stretch: 2 mins	Easy walk: 15-20 mins Stretch: 2 mins	Easy walk: 10-15 mins Brisk walk: 5-10 mins Stretch: 2 mins	Easy walk: 15-20 mins Stretch: 2 mins	Rest	Brisk walk: 20-25 mins
Week 5	Easy walk: 10-15 mins Brisk walk: 10-15 mins Stretch: 2 mins	Easy walk: 25-30 mins Stretch: 2 mins	Easy walk: 10-15 mins Brisk walk: 10-15 mins Stretch: 2 mins	Easy walk: 25-30 mins Stretch: 2 mins	Alternate Activity of your choice: Go dancing, rake leaves for 20+ mins	Easy walk: 25-30 mins
Week 6	Easy walk: 15-20 mins Power Intervals Power walk: 30 seconds Easy walk: 1 min Repeat 4-6 times. Easy walk: 3-5 mins	Alternate activity of your choice for 20-30 mins	Easy walk: 30-35 mins Stretch: 2 mins	Easy walk: 25-30 mins Stretch: 2 mins	Rest	Easy walk: 25-35 mins

	Monday	Tuesday	Wednesday	Thursday	Friday	Weekend Workout (optional)
Week 7	Easy walk: 15-20 mins Power Intervals Power walk: 30 seconds Easy walk: 1 min Repeat 4-6 times. Easy walk: 3-5 mins	Alternate activity of your choice for 20-30 mins	Easy walk: 30-35 mins Stretch: 2 mins	Easy walk: 25-30 mins Stretch: 2 mins	Rest	Easy walk: 25-35 mins
Week 8	Easy walk: 10-15 mins Brisk walk: 10-15 mins Stretch: 2 mins	Easy walk: 20-30 mins Stretch: 2 mins	Easy walk: 15-20 mins 4-6 Power Intervals Easy walk: 5 mins	Easy walk: 30-35 mins Stretch: 2 mins	Alternate activity of your choice for 25-30 mins	Easy walk: 30-35 mins
Week 9	Easy walk: 15-20 mins Power Intervals Power walk: 30-60 seconds Easy walk: 1 min Repeat 4-6 times. Easy walk: 3-5 mins	Easy walk: 25-30 mins Stretch: 2 mins	Easy walk: 10-15 mins Brisk walk: 20-25 mins Stretch: 2 mins	Easy walk: 25-30 mins Stretch: 2 mins	Rest	Easy walk: 35-40 mins
Week 10	Easy walk: 10-15 mins Brisk walk: 20-30 mins Stretch: 2 mins	Easy walk: 30-35 mins Stretch: 2 mins	Easy walk: 15-20 mins 4-6 Power Intervals Easy walk: 3-5 mins	Easy walk: 25-30 mins Stretch: 2 mins	Alternate activity of your choice for 25-35 mins	Easy walk: 35-40 mins
Week 11	Easy walk: 10-15 mins Brisk walk: 20-30 mins Stretch: 2 mins	Easy walk: 30-35 mins Stretch: 2 mins	Easy walk: 10-15 mins Brisk walk: 10-15 mins Stretch: 2 mins	Easy walk: 30-40 mins Stretch: 2 mins	Rest	Easy walk: 35-45 mins
Week 12	Easy walk: 10-15 mins Brisk walk: 25-30 mins Stretch: 2 mins	Easy walk: 35-40 mins Stretch: 2 mins	Easy walk: 10-15 mins Brisk walk: 10-15 mins Stretch: 2 mins	Easy walk: 30-45 mins Stretch: 2 mins	Alternate activity of your choice for 30-45 mins	Easy walk: 40-45 mins

Important dates to remember

Initial testing: ______________________

Follow-up appointments:

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Final testing: _____________________

For questions about this research study contact:

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