Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 10-week intervention

by

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ABSTRACT

Sedentary behavior elevates the risk of developing hypokinetic related diseases and early mortality. Despite known benefits and efforts to promote exercise as preventive medicine, only a small percentage of adults meet exercise recommendations and even a lower number can maintain this lifestyle. This study targeted sedentary employees using two different walking programs promoting self-regulation and self-efficacy, to observe the effect of both interventions on specific physiological and psychological constructs. Sixty-eight sedentary employees, 17 men and 51 women were randomly assigned to one of three groups. The two experimental conditions were time and intensity matched and consisted of: multiple bouts of walking (Age = 46±9 old years, BMI= 30.33±5.79 kg/m^2, mean±standard deviation values) and continuous walking (Age = 48±9 old years, BMI= 30.53±6.17 kg/m^2). A third group served as the control group (Age = 42±10 old years, BMI= 27.66±5.11 kg/m^2). Self-regulation and self-efficacy questionnaires, accelerometry, and VO_2 were obtained at baseline, week 6, and week 11. Glycated hemoglobin (HbA1c) and body were obtained at baseline and week 11. Daily walking was measured via a wrist worn accelerometer (MOVband). Mixed-design ANOVA analyses showed that the continuous group improved significantly overall in self-regulation and its sub-scales from pre-test to 6 weeks and to week 11 (p<0.05). Self-efficacy decreased significantly from pre-test to week 6 (p=0.047) and to week 11 (p=0.008) for all groups. Moderate intensity

physical activity increased significantly from pre-test to week 6 ($p=0.016$), then significantly reduced from week 6 to week 11 ($p=0.028$). The continuous walking group significantly increased moves from pre-test to week 6 ($p=0.033$), and had a significant higher percentage of change compared to the control group ($p<0.05$). There were no changes in VO_{2max} ($p>0.05$) for all three groups. Glycated hemoglobin (HbA1c) was reduced significantly in the continuous group ($p<0.05$) with a large effect size ($n^2=0.297$). The intermittent walking group increased lean mass significantly ($p<0.001$). Fat mass decreased, body weight and fat percentage decreased significantly for all three groups ($p<0.05$). For sedentary employees, continuous or intermittent walking activity produce similar benefits on body weight, fat mass, and body fat. Meanwhile, intermittent walking allowed sedentary employees to increase lean mass and fat free mass. Intermittent walking could provide at least similar benefits on body composition compared to a continuous walking program. Continuous walking activity seems to be a better approach to improve self-regulatory skills, physical activity and HbA1c in sedentary employees; it may provide a more feasible approach to prescribing exercise in sedentary office employees to reduce the risk of sedentary behavior. In future research, to improve aerobic fitness in this population, walking intensity should be constantly monitored.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

T2D: Type 2 Diabetes

MVPA: Moderate to Vigorous Physical Activity

iDXA: Dual-Energy X-ray Absorptiometry

BMI: Body mass Index

HbA1c: Glycated hemoglobin

I. INTRODUCTION

Introduction

Sedentary behavior is considered a risk factor for developing non-communicative maladies such as cardiovascular disease, diabetes, osteoporosis, and other hypokinetic disease (Dempsey, Owen, Biddle, & Dunstan, 2014; Dunstan, Howard, Healy, & Owen, 2012; Healy et al., 2008; Healy, Matthews, Dunstan, Winkler, & Owen, 2011). Sedentary behavior is defined by low energy expenditure (1.0 to 1.5 METs) and the posture in which people remain for long periods of time either sitting or reclining (Dempsey et al., 2014); independently of time spent doing exercise (Owen, Healy, Howard, & Dunstan, 2012). For example, time spent watching television, playing video games, driving a car, sitting in the office, and other activities that are related to low energy expenditure (Saidj, Jorgensen, Jacobsen, Linneberg, & Aadahl, 2013). Sedentary behavior is not only the absence of physical activity or whether or not a person meets exercise recommendations, but used to qualify the activities a person performs during the waking period independently of the time that person spends in moderate to vigorous intensity physical activity (MVPA), (Owen et al., 2012). The most common sedentary behavior is the time spent sitting. Although, it is not clear how much time adults spend sitting, data does exist for certain groups of the populations and is thought to account for the majority of waking time behavior (Matthews et al., 2008). For example, the average time that people spent in work-related sitting behavior is reported to be nearly 70% (Kozey-Keadle, Libertine, Staudenmayer, & Freedson, 2012).

Obesity and sedentary behavior are often related. In the United States in 2013, 64.1% of the adult population were overweight or obese, and 17.2% of children between 2-19 years old are obese (CDC, 2015). Obesity is considered one of the most important risk factors of developing serious chronic diseases and having health consequences, such as high blood pressure, dyslipidemia, type 2 diabetes, heart disease, low quality of life, and elevated mortality (Chau et al., 2010). Obesity is a costly issue for the United States. For example, by 2008 obesity cost to this country was $147 billion U.S. dollars per year. In terms per capita, in 2006, obese individuals spent $1,429 more than a normal weight person in medical expenses (Finkelstein, Trogdon, Cohen, & Dietz, 2009).

Another disease linked to sedentary behavior and obesity is diabetes. In 2012, 29.1 million or 9.3% of U.S citizens had diabetes. Every year 1.4 million of people are diagnosed with diabetes and 86 million people age 20 and older had prediabetes, with diabetes ranked as the 7th cause of death in United States (Association, 2014). According to Dempsey, Owen, Biddle, and Dunstan (Dempsey et al., 2014), 30% of mortality accounts for type 2 diabetes (T2D). Furthermore, the Center for Disease Control and Prevention (CDC) (CDC, 2015) showed that 47% of the U.S. population have at least one of the three key risk factors for heart disease: high blood pressure, high cholesterol, and smoking and more than 600,000 people die of heart disease in the United States every year; accounting for 23.5% of deaths in 2008. Due to the relationship between these diseases and sedentary lifestyles; sedentary behavior is now considered a primary health detriment, linked to weight gain and excessive adiposity as well as other chronic negative

outcomes such as heart disease, type 2 diabetes, cancer, and premature mortality (Neuhaus et al., 2014; Prince, Saunders, Gresty, & Reid, 2014).

The American College of Sports Medicine's (ACSM) guidelines for physical activity (American College of Sports Medicine, 2018) suggest that people should exercise for at least 150 minutes per week to be able to maintain overall good health and quality of life and to be considered physically active. In terms of exercise behavior, according to the CDC (CDC, 2015) in 2013 only 20.2% of adults and 27.1% of adolescents in the United States met the exercise recommendations for aerobic and muscle strengthening guidelines. The National Center for Health Statistics (Statistics, 2015), using data released in 1997, reported that 4 in 10 adults never participate in any exercise, sport, or physical activity in their leisure time. The CDC in 2013 (CDC, 2015) based on information from the Behavioral Risk Factor Surveillance System reported the rate of adults that did not meet the exercise recommendations was 4 in 5; with only 20% of adults meeting exercise recommendations.

Different approaches have been conducted to diminish the negative effect of sedentary behavior and recently research led to consider intermittent physical activity as a possible advantageous solution to ameliorate those adverse effects and be able to maintain a regular exercise regimen.

Breaking sedentary time during the day has shown positive outcomes on health-related variables (Bassett, Freedson, & Kozey, 2010; Taylor, 2011). It has been shown to improve

outcomes linked to health (Owen, Healy, Matthews, & Dunstan, 2010) and an important key factor here, appears to be the improvement in energy expenditure associated to the incremented level physical activity (Duvivier et al., 2013), which normalize key variables associated with disease risk and early mortality (Dunstan, Howard, et al., 2012; Saidj et al., 2013).

Questioning in regards to the accumulation of sedentary behavior has promoted inquiry into continuous versus intermittent bouts of exercise and to identify barriers faced during the adherence process such as the lack of time (Hamer, Stamatakis, & Steptoe, 2014), lack of energy, and also lack of motivation and support (CDC, 2015). In this regard, intermittent exercise bouts may lead to better adherence in terms of time management (Dunstan, Howard, et al., 2012) and motivation (Jakicic, Winters, Lang, & Wing, 1999; Sherwood & Jeffery, 2000). Furthermore, it should be easier to incorporate to the schedule (Sherwood & Jeffery, 2000).

Walking interventions may produce important health benefits while reducing the possibility of negative situations (Pelssers et al., 2013; Taylor et al., 2004). Walking is a normal a good alternative of physical activity (Williams, Matthews, Rutt, Napolitano, & Marcus, 2008), and may be an affordable option to overcome barriers that refrain from getting up and moving (Perri et al., 2002). Regular walking activity is highly related to psychological benefits such as stress reduction, depression, anxiety (Craft & Perna, 2004), and physiological benefits such as blood glucose regulation (Larsen et al., 2017), body composition (Kajioka, Shimokata, & Sato, 2000). These benefits are correlated to risk reductions of developing diseases as well as early

mortality related to low energy expenditure (Owen et al., 2012). Previous long-term studies that included walking or aerobic activity have mostly focused on continuous physical activity developed in one single bout. In addition, interventions focused on the effect of short bouts of physical activity, neglecting the long-term effects (Dunstan, Kingwell, et al., 2012; Healy et al., 2008; Holmstrup, Fairchild, Keslacy, Weinstock, & Kanaley, 2014; Peddie et al., 2013). When the intervention included short bouts of exercise in long term programs, the bouts were set for 10 or 15 minutes (Serwe, Swartz, Hart, & Strath, 2011; Woolf-May et al., 1999) or 5 minutes (Woolf-May et al., 1999). Likewise, only few variables have been included in previous researches such as: blood glucose (Dunstan, Kingwell, et al., 2012), body composition (Amiri, Mirzaie, & Elmieh, 2013; Karstoft et al., 2013), or $V0_2$ (Macfarlane, Taylor, & Cuddihy, 2006a; Osei-Tutu & Campagna, 2005b; Serwe et al., 2011). To our knowledge, there are not previously reported long-term interventions comparing continuous versus intermittent walking and the effect that these two different styles of physical activity may have over physiological and psychological variables in sedentary employees.

Despite of multiple and apparently insufficient efforts, only 1 in 5 adults meets exercise recommendations in United States (CDC, 2015) and this can be translated to the appearance of hypokinetic diseases and early mortality (Dunstan, Howard, et al., 2012). To our knowledge, the particular approach of comparing continuous walking versus intermittent walking in an experimental design to see effects on physiological and psychological variables in a long-term intervention and in sedentary office employees has not been performed.

Office employees face the disadvantage of long periods of sedentary time and the lack of motivation to work out after long hours of office occupations. According to Clemes, O'Connell, and Edwardson (Clemes, O'Connell, & Edwardson, 2014), office employees do not compensate long hours of sedentary behavior by increasing physical activity outside work. Moreover, office workers are highly exposed to sedentary behavior and to perform longer bouts of sedentary time without interruption (Parry & Straker, 2013). One can speculate that these individuals are exposed to a higher risk of developing hypokinetic diseases and early mortality. To avoid this situation, office employees should start accumulating some physical activity during working time and progressing towards a more physically active working time (Buckley et al., 2015). Thus, our novelty intervention provides these individuals with knowledge and tools to modify their currently behavior, opening an advanced scope that should be beneficial for further application in this specific population.

Changing physical activity levels is a challenge when people have remained for long time in a sedentary based behavior (Prince et al., 2014). Therefore, psychological aspects such as self-regulation and self-efficacy must be included within long-term interventions to be able to change people's behavior incrementing physical activity, reducing significantly sedentary behavior long-term (Anderson, Wojcik, Winett, & Williams, 2006) (Findorff, Wyman, & Gross, 2009; Gell & Wadsworth, 2014; Wilbur, Vassalo, Chandler, McDevitt, & Miller, 2005; Williams & French, 2011). According to Teixeira et al. (Teixeira et al., 2015) skills such us autonomous motivation, self-efficacy, and self-regulation are important predictors to improve physical activity. The

success of these strategies are based on individual's needs and willingness for behavior change to improve walking activity (Ogilvie et al., 2007).

Based on previous literature findings, the utilization of a walking intermittent intervention accompanied with a self-regulation intervention would be the most likely intervention to produce long-term changes in sedentary behavior. However, this type of intervention has not been examined in the literature and intermittent breaks have not been observed in terms of reducing sedentary behavior in a long-term intervention. Therefore, the goal of this study was to target sedentary employees with two different walking programs assisted with psychological tasks, such as self-regulatory and self-efficacy tools, to observe the effect of both interventions on specific physiological and psychological constructs.

Purpose of the Study and Study Objectives

The purpose of this study was to examine the effect of two different walking interventions on physiological and psychological variables in sedentary employees.

Primary objective: Decrease physical inactivity levels in sedentary employees from baseline measures.

Secondary objective: Observe the effects of continuous walking activity on physiological and psychological variables.

Tertiary objective: Observe the effects of intermittent walking activity on physiological and psychological variables.

Quaternary Objective: Compare the effects of a continuous walking program versus intermittent walking in a long-term intervention.

Research Questions and Hypotheses

a. What is the effect of an intermittent walking program and a continuous walking program on exercise adherence in sedentary adults during 10-week intervention?

   i. We have hypothesized that intermittent physical activity may result in higher levels of exercise adherence in sedentary employees measured with a wrist worn MOVband and waist worn Actigraph accelerometer.

b. What is the effect of an intermittent walking program and a continuous walking program on physical activity behavior in sedentary adults during 10-week intervention?

   i. We have hypothesized that intermittent physical activity may result in higher levels of physical activity behavior in sedentary employees measured with a wrist worn MOVband and waist worn Actigraph accelerometer.

c. What is the effect of an intermittent walking program and a continuous walking program on self-regulation in sedentary adults during 10-week intervention?

i. We have hypothesized that intermittent physical activity may have a similar impact on self-regulation in sedentary employees measured with the self-regulation questionnaire.

d. What is the effect of an intermittent walking program and a continuous walking program on self-efficacy in sedentary adults during 10-week intervention?

i. We have hypothesized that intermittent physical activity may have a similar impact on self-efficacy in sedentary employees measured with the self-efficacy questionnaire.

e. What is the effect of an intermittent walking program and a continuous walking program on body composition in sedentary adults during 10-week intervention?

i. We have hypothesized that intermittent physical activity may have a similar result on body composition in sedentary employees measured with iDXA.

f. What is the effect of an intermittent walking program and a continuous walking program on oxygen consumption ($VO_{2\ max}$) in sedentary employees during a 10-week intervention?

i. We have hypothesized that intermittent physical activity may have a similar result on oxygen consumption ($VO_{2\ max}$) in sedentary employees measured with Bruce protocol.

g. What is the effect of an intermittent walking program and a continuous walking program on glycated hemoglobin (HbA1c) in sedentary adults during 10-week intervention?

i. We have hypothesized that intermittent physical activity may have a similar impact on glycated hemoglobin (HbA1c) in sedentary employees measured with the A1cNOW+ System.

II. LITERATURE REVIEW

Overview

Sedentary behavior is nowadays considered a primary risk of having health consequences including obesity, heart disease, type 2 diabetes, cancer, and early mortality (Neuhaus et al., 2014). Sedentary behavior is categorized by long periods of low energy expenditure (Owen et al., 2010), that conduce to metabolic disorders (Peddie et al., 2013). For example, sitting for long periods is detrimental for health and increases the risk of developing all-cause disease (Dunstan, Howard, et al., 2012; Hamer et al., 2014; Healy et al., 2013; Owen et al., 2012) independent of the time used to perform exercise (Dunstan, Howard, et al., 2012; Owen et al., 2012). In a systematic review, Saunders, et al. (Saunders, Larouche, Colley, & Tremblay, 2012), demonstrated that uninterrupted sedentary behavior accumulated in acute bouts reduces insulin sensitivity, increases circulating level of triglycerides, increases LDL levels, reduces glucose tolerance, and produces rapid and deleterious changes in skeletal muscle. Sitting time is associated to waist circumference, plasma glucose, triglycerides, HDL, and these deleterious health consequences are independent of the protective effect of regular physical activity performed at moderate to vigorous intensity (Owen et al., 2010). In an experimental study, 14 fit, healthy young men sat for a period of 16.9 hours, significant deleterious changes were shown in whole-body insulin sensitivity compared to those who sat a minimal time of 5.8 hours (Owen et al., 2012).

Another frequent low energy expenditure behavior is TV watching. It is reported to have a negative link with all-cause disease and mortality independently of the time spent doing moderate to vigorous intensity exercise (Dunstan et al., 2010). Adults who spent 7 hours per week performing MVPA, but also spent more than 7 hours watching TV per day, had 50% more chance of all-cause mortality and double risk of death from cardiovascular disease, compared to those who performed the same amount of MVPA but spent less than 1 hour watching TV (Dunstan, Howard, et al., 2012; Owen et al., 2012). In another study, TV watching time was associated with all-cause mortality and cardiovascular disease mortality by 11% and 18% respectively. Watching TV 4 hours or more has an increased risk of all- cause mortality and increased cardiovascular disease mortality by 46% and 80% respectively (Dunstan et al., 2010; Owen et al., 2010).

Still, questions remain in sedentary behavior research. For example, the mode in which sedentary time is accumulated may also be important in terms of the type of sedentary behavior (sitting, TV viewing), length of bouts of sedentary behavior and fragmentation of sedentary behavior. In addition, is sedentary time different for people who meet exercise recommendations? Specifically, the percentage of time expended performing moderate to vigorous physical activity in most of the adults who meet exercise recommendations is extremely low compared to sedentary time, less than 5% of the waking time is expended in meeting exercise recommendations. If a person spends 16 hours in waking behavior, with 30 minutes of moderate exercise, then the remaining 15 hours may be spent in a low energy expenditure style,

which is still considered prejudicial with negative health outcomes (Hamilton, Healy, Dunstan, Zderic, & Owen, 2008). For example, a person meeting exercise recommendations may have a remarkable sedentary behavior during non-exercise time. Alternatively stated, even though that person performs a single bout of moderate to vigorous intensity exercise, if the person sits prolonged periods during the rest of the day, the effects of that specific behavior may still have detriment effects on health and negate or be independent of exercise effects on health (Dempsey et al., 2014; Owen et al., 2010).

As mentioned above, sitting too long has health implications independent of meeting exercise recommendations. However, it is important to understand that being physically inactive is an even more detrimental behavior in which the risk of developing chronic diseases and early mortality is higher. Physical inactivity or the complete absence of physical activity is cataloged as a steady low energy expenditure, below 1.5 METs, which is the energy expended during sitting, bed resting, or reclining and it is even more dangerous than sedentary behavior performed by those that regularly do exercise due to absence of physiological activation of the organism (Healy et al., 2013; Owen et al., 2012; Owen et al., 2010).

The determinants of long bouts of sitting, has led researchers to consider breaking sedentary time with light intensity physical activity. This method of exercise prescription may prove advantageous for individuals who have difficulty maintaining a regular schedule of exercise. Intermittent physical activity during the day can help people reduce the risk of

premature diseases and early mortality (Bassett et al., 2010; Taylor, 2011). Physical activity breaks produce positive improvements in health; specifically, a reduction in waist circumference, body mass index, triglycerides and improved HDL (Owen et al., 2010). These health benefits may be linked to improvements in energy expenditure associated light physical activity (Duvivier et al., 2013). Metabolic benefits such as lowering blood glucose and insulin have been observed with breaks of 2 minutes every 20 minutes at light intensity walking (Dunstan, Howard, et al., 2012; Saidj et al., 2013). After six months of an intervention program that included 2 daily breaks of 15 minutes, participants significantly improved HDL cholesterol from 50 to 56 mg/dl ($p<0.05$) and lost 14 pounds or 8% of body weight (Taylor et al., 2010). Walking five minutes each hour over the course of twelve hours attenuated postprandial glucose and insulin concentrations in obese people (Holmstrup et al., 2014). Intermittent breaks of walking less than two minutes each thirty minutes reduces postprandial glucose by 39% and insulin by 26% (Dempsey et al., 2014). Short breaks of physical activity during nine-hour period have better effects on reducing postprandial glucose and insulin compared to a single bout time matched exercise, in healthy normal weight adults (Peddie et al., 2013).

Since most of the population is inactive, it is important to identify interventions that promote long-term exercise adherence. These questions regarding sedentary daily accumulation have promoted inquiry into continuous versus intermittent bouts of exercise and to identified barriers that people experience when trying to adhere to an exercise program. In this regards, the most common excuses that people use to do not do exercise is the lack of time (Hamer et al.,

2014), lack of energy, and also lack of motivation and support (CDC, 2015). Intermittent exercise bouts throughout the day appear to have the similar or better physiological and psychological results as a single bout of exercise (Owen et al., 2012; Owen et al., 2010). In addition, intermittent exercise bouts may lead to better adherence in terms of time management (Dunstan, Howard, et al., 2012), and increase motivation due to the capability of performing short bouts of physical activity (Jakicic et al., 1999; Sherwood & Jeffery, 2000). Furthermore, short bouts of exercise may be easier for unfit people to perform, and incorporate it to the schedule (Sherwood & Jeffery, 2000). For example, intermittent physical activity based on short bouts of exercise improved exercise participation and adherence, weight loss, cardiorespiratory fitness in overweight adult women (Jakicic et al., 1999). Breaking sedentary time in short bouts of physical activity may also produce benefits for attention, anxiety, pain reduction, and depression (Chastin, Fitzpatrick, Andrews, & DiCroce, 2014).

Walking interventions

Walking interventions have been successful in increasing exercise participation over time. Walking is related to many health benefits and quality of life while reducing the possibility of injuries or overstress (Pelssers et al., 2013; Taylor et al., 2004). Walking is the most preferred physical activity (Williams et al., 2008), and a good alternative for people that are sedentary and/or never engaged in an exercise program before (Ogilvie et al., 2007). Since time, motivation, and facilities are the main barriers that people experiment when they try to engage in physical activity, a walking program may be a better option to overcome those barriers and

adhere to physical activity (Perri et al., 2002). There are multiple benefits reported from walking interventions. For example, in 8 week-walking program with 2 conditions, walking 30 minutes in a single bout or three 10-minutes walking, researchers found positive statistically significant changes in waist circumference, reductions in blood pressure, and improvements in aerobic fitness (Serwe et al., 2011). In an18-week intervention with three walking groups: 20-40, 15-20, and 5-10 minutes, it was reported that those who walked longer improved significantly aerobic fitness and blood lipid profile, and lactate concentration decreased as well (Woolf-May et al., 1999). In another 8-week-intervention; a 45 minutes-walk, 2 times per week, researchers reported significant reductions in blood pressure and maintenance of body fat (Murphy, Murtagh, Boreham, Hare, & Nevill, 2006). Walking programs have been shown to increase walking behavior after the intervention (Williams et al., 2008). These researchers found that for exercise adherence, it is more effective to increase minutes of walking before increasing the number of days per week that participants performed walking exercise. Adherence to exercise is negative correlated to intensity, meaning that intensities from light to moderate are a better reinforcement for exercise adherence rather than walking or running bouts that are higher in exertion (Perri et al., 2002).

However, targeting sedentary behavior is not as simple as it seems. In a meta-analysis performed by Prince et al. (Prince et al., 2014), they concluded that several studies have focused on changing physical activity levels, some have had success and other portion have not produced any positive effect after long term interventions, and there are not conclusive explanations about

what type of intervention must be performed to change definitely sedentary behavior in adult population.

Interventions aiming physical activity itself without intervening psychological variables to improve exercise adherence are reported as weak interventions in terms of modification in sedentary behavior (Sallis, Pinski, Grossman, Patterson, & Nader, 1988). Thus, it is important that intervention programs looking for modifications in sedentary behavior focus on knowledge factors that should influence the response; being more physically active and long-term adherence to an exercise regime (Burke, Beilin, Cutt, Mansour, & Mori, 2008; Findorff et al., 2009). If determinants of physical activity, such as self-regulation and self-efficacy are not targeted, then it is not likely that people will adhere to a more active behavior (Williams & French, 2011).

In case of self-regulation, people must pay attention on their own capacities and be able to modulate their thoughts, affects, behavior, or attention by cognitive control mechanisms (Buckley, Cohen, Kramer, McAuley, & Mullen, 2014; Karoly, 1993), and the level of motivation as well (Bandura, 1991). Previous studies have showed that the interventions that targeted self-regulation for physical activity had positive outcomes in self-regulation and those results were associated with increments in physical activity, reducing significantly sedentary behavior (Anderson et al., 2006). According to Buckley, et al. (Buckley et al., 2014), cognitive control abilities are very important to improve self-regulation of physical activity and reducing sedentary behavior; an important issue to overcome barriers, face changes, reach new goals, resist

temptation of being sedentary, and overcome all negative influences that lead finally to reductions of physical activity (Daly, McMinn, & Allan, 2014). In a recently study, Gell and Wadsworth (Gell & Wadsworth, 2014), reported that self-regulation is an important predictor of physical activity adherence, which helps improving physical activity levels and decrease women's sedentary behavior. Self-regulation has a strong influence on a more active lifestyle (Anderson et al., 2006) and may be the most important variable related to improvements in physical activity adherence (Stadler, Oettingen, & Gollwitzer, 2009) in sedentary people.

Self-efficacy, or the conviction that a person can perform a specific behavior (Bandura, 1997), is related to continued exercise participation. Several studies have reported that self-efficacy is a strong predictor of changes in physical activity behavior in long-term interventions (McAuley & Blissmer, 2000; Oman & King, 1998; Sallis et al., 1986) and can be accounted as a predictive factor for adoption and maintenance of physical activity (Sallis et al., 1986; Strachan, Woodgate, Brawley, & Tse, 2005).

Currently changes in walking behavior and its relationship with body composition, VO2, self-regulation and self-efficacy for physical activity remains unclear. Furthermore, it is unclear how different types of walking programs (i.e. continuous versus intermittent) affect these variables. Therefore, the purpose of this project was to determine the effect of two different walking interventions on physiological and psychological variables in sedentary office employees.

III. METHODOLOGY

Human Subjects Approval

To begin recruiting participants for this randomized trial, a full-board research protocol document was submitted to the Auburn University Institutional Review Board for Research Involving Human Subjects (IRB). Following the regulations set forth by Auburn University IRB, this study protocol was approved for use from 9/07/2016 to 8/23/2017 under the following the protocol number 16-272 MR 1608 (Appendix A).

Participants and Setting

Male and female participants were recruited by word of mouth, e-mail, flyers and social network blast from the Auburn/Opelika community (Appendices B and C). Participants were accepted for this study if they met the following qualifications: age 25-60, healthy (as determined by screening PAR-Q document (Appendix D), agreed and able to complete a 10-week walking program, sedentary and not currently engaged in any structured physical activity program, and had access to a computer and internet connection to access the account, to charge, and to download the MOVband data. A total of 84 participants met the study criteria (17 males and 67 females) and completed the baseline measures: demographics, body composition, physical activity, sedentary behavior, VO_2, self-regulation, and self-efficacy. Prior to initiating the intervention participants were assigned to one of the three groups based on gender and Body Mass Index (BMI). BMI was calculated and participants were grouped as normal, overweight, and obese categories and then randomly assigned to one of the three intervention groups.

Twenty-eight participants per group were allocated to start the intervention. Figure 1 summarizes the study protocol.

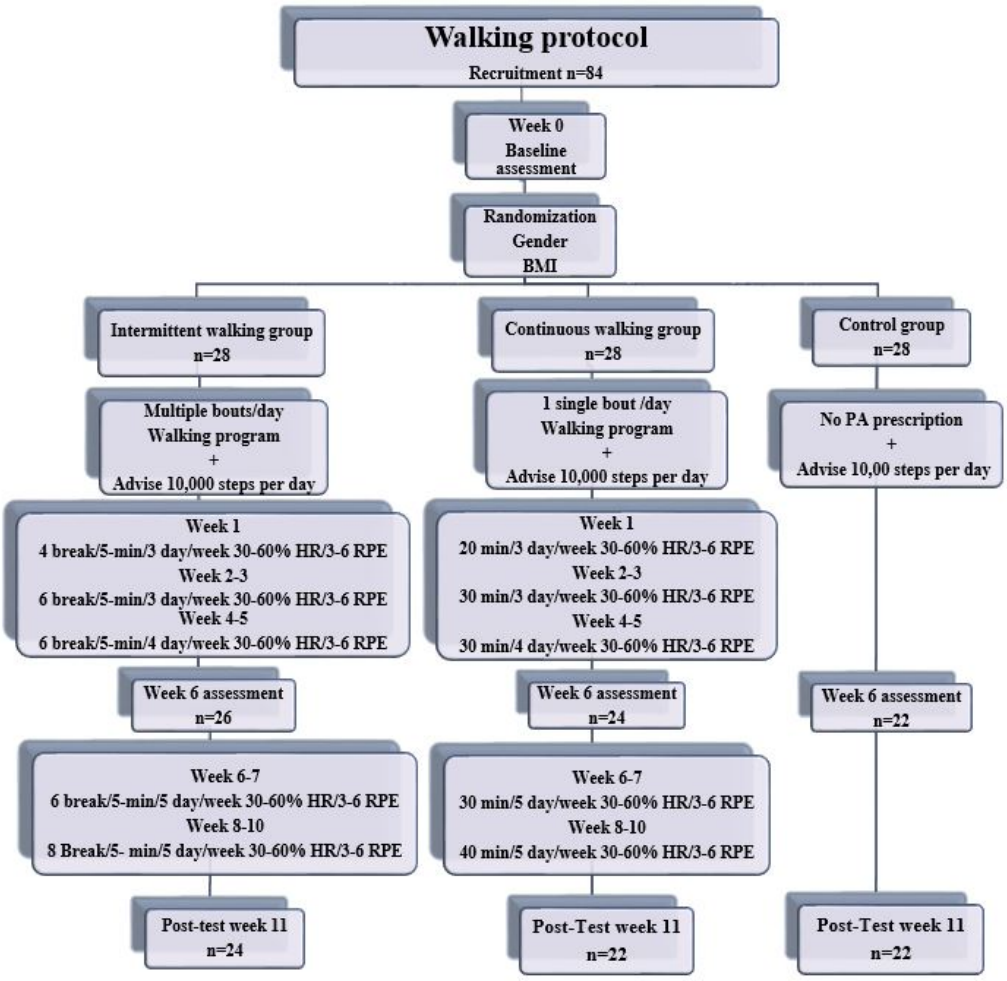


Figure 1 Study protocol

Procedures

This free-living condition intervention consisted of three experimental groups: 1) a continuous walking group, 2) an intermittent walking group, and 3) a control group. Participants met at the lab to sign the informed consent and to complete the PAR-Q. At baseline, participants were measured on body composition, aerobic fitness, physical activity behavior, HbA1c, Self-Regulation, and Self-Efficacy (Appendix G). Body composition was assessed with an iDXA total body scan at baseline and week 11. Physical activity and sedentary behavior were evaluated with an accelerometer (Appendix F) at baseline, week 6, and week 11 for seven days. For the 10-week intervention, weekly physical activity was measured with a wrist worn accelerometer (MOVband). Aerobic fitness was analyzed by assessing VO_{2max} through a Bruce Protocol at baseline, week 6, and week 11. Self-regulation and self-efficacy (Appendix E) were measured through Likert-scale based questionnaire at baseline, week 6, and week 11. All participants were required to bring an email and a cellphone number that were linked to a google account to be able to send weekly messages and emails with content targeting self-regulation and self-efficacy plus remainders about the walking prescription and tips to be aware of sedentary behavior (Appendix I).

Participants who were not in the control group received a 10-week walking program to be completed within their own environment (Appendix H). The intervention for the two walking groups, aimed to establish self-regulation skills and enhance self-efficacy via mobile health

facilitation (Table 1). At week 6 to perform aerobic fitness, actigraph, self-regulation, and self-efficacy testing, and week 11 all participants returned to the lab for post-testing, which included the same lab tests as baseline testing.

Table 1 Week-by-week intervention

Intervention							
	Exercise prescription			**Self-regulation**		**Self-efficacy**	
	Intermittent	Continuous	**Delivery strategy**		**Delivery strategy**		**Delivery strategy**
W-0	Physical activity, A1c, body composition pre-testing. Familiarization, training. Set up	Physical activity, A1c, body composition pre-testing. Familiarization, training. Set up	Meeting at the lab	Questionnaire pre-test Goal Setting, Self-monitoring, time management, relapse prevention, social support, reinforcements.	Meeting at the lab	Questionnaire pre-test Self-management strategies, motivation, perceived barriers, outcome expectancy, enjoyment, and physical activity	Meeting at the lab
W-1	Walk 20 minutes divided in 4 bouts of 5 minutes per day 3 days per week at 3-6 RPE or 40-60% HR.	Walk a single bout of 20 minutes per day 3 days per week at 3-6 RPE or 30-60% HR	E-mail	Movband download	Computer program		
W-2	Walk 30 minutes divided in 6 bouts of 5 minutes per day 3 days per week at 4-6 RPE or 40-60% HR.	Walk a single bout of 30 minutes per day 3 days per week at 4-6 RPE or 40-60% HR	E-mail	Movband download	Computer program		
W-3	Walk 30 minutes divided in 6 bouts of 5 minutes per day 3 days per week at 4-6 RPE or 40-60% HR.	Walk a single bout of 30 minutes per day 3 days per week at 4-6 RPE or 40-60% HR	E-mail	**Video: Goal setting** Setting up strategies to stick with exercise Establishing and sharing personal goals. PA and steps per day. Overcoming negative situations against doing PA Nutrition management	**Video/E-mail** 3 Text messages	Identifying personal experiences for PA Self-appraisal of capabilities Identifying barriers Overcoming barriers	4 Text messages

				Movband download	E-mail Computer program	Feedback focus on progress	E-mail
W-4	Walk 30 minutes divided in 6 bouts of 5 minutes per day 4 days per week at 4-6 RPE or 40-60% HR.	Walk a single bout of 30 minutes per day 4 days per week at 4-6 RPE or 40-60% HR	E-mail	**Video: Self-monitoring** Self-behavioral analysis (personal behavior inventory). Self-analysis of the goals, what to keep, what to change Movband download	**Video/E-mail** 1 Text message E-mail Computer program	Look for what others are doing to keep up with PA. Identifying personal experiences for PA Feedback focus on progress	2 Text messages E-mail
W-5	Walk 30 minutes divided in 6 bouts of 5 minutes per day 4 days per week at 4-6 RPE or 40-60% HR.	Walk a single bout of 30 minutes per day 4 days per week at 4-6 RPE or 40-60% HR	E-mail	**Video: Time management** Plan positive outcomes and negative outcomes Setting up the time for PA Movband download	**Video/E-mail** 2 Text messages Computer program	Arranging the time. PA schedule Tips to stay physically active Feedback focus on progress	2 Text messages E-mail.
W-6	**Week 6 assessments: Self-Regulation, self-efficacy, aerobic fitness, waist, weight.**						
	Walk 30 minutes divided in 6 bouts of 5 minutes per day 5 days per week at 4-6 RPE or 40-60% HR.	Walk a single bout of 30 minutes per day 5 days per week at 4-6 RPE or 40-60% HR	E-mail	**Video: Relapse prevention** Overcoming negative situations against doing PA Plan B for unexpected events Managing time Movband download	**Video/E-mail** 2 Text messages Computer program	Identifying barriers for PA. Knowing and managing body reactions. Feedback focus on progress	2 Text messages E-mail
W-7	Walk 30 minutes divided in 6 bouts of 5 minutes per day 5 days per week at 4-6 RPE or 40-60% HR.	Walk a single bout of 30 minutes per day 5 days per week at 4-6 RPE or 40-60% HR	E-mail	**Video: Social support** Peer support. Family support Find someone to work out with. Movband download	**Video/E-mail** 2 Text messages Computer program	Find someone physically active and share goals and find support Feedback focus on progress	1 Text messages E-mail

W-8	Walk 40 minutes divided in 8 bouts of 5 minutes per day 5 days per week at 4-6 RPE or 40-60% HR.	Walk a single bout of 40 minutes per day 5 days per week at 4-6 RPE or 40-60% HR	E-mail	**Video: Reinforcements** Overcoming negative situations against doing PA Understanding sedentary behavior Movband download	**Video/E-mail** 2 Text messages Computer program	Tips to stay physically active Feedback focus on progress	1 Text message E-mail
W-9	Walk 40 minutes divided in 8 bouts of 5 minutes per day 5 days per week at 4-6 RPE or 40-60% HR.	Walk a single bout of 40 minutes per day 5 days per week at 4-6 RPE or 40-60% HR	E-mail	**Video: Goal setting, self-monitoring, and Time management** Self-analysis of the goals, what to keep, what to change Movband download	**Video/E-mail** E-mail Computer program	Arranging the time. PA schedule Tips to stay physically active Feedback focus on progress	2 Text messages E-mail
W-10	Walk 40 minutes divided in 8 bouts of 5 minutes per day 5 days per week at 4-6 RPE or 40-60% HR.	Walk a single bout of 40 minutes per day 5 days per week at 4-6 RPE or 40-60% HR	E-mail	**Video: Relapse prevention, social support, and reinforcements.** Movband download	**Video/E-mail** Computer program	Look for what others are doing to keep up with PA. Identifying personal experiences for PA Feedback focus on progress	2 Text messages E-mail
W-11	**Physical activity, A1c, Body composition and aerobic fitness post-testing**	**Physical activity, A1c, Body composition and aerobic fitness post-testing**	**Meeting at the lab**	**Self-regulation post-testing**	**Meeting at the lab**	**Self-efficacy post-testing**	**Meeting at the lab**

Measures

Physical Activity and Sedentary Behavior

To measure Exercise Adherence and Physical Activity behavior an Actigraph accelerometer GT3X (ActiGraph GT3X; ActiGraph Corp., Pensacola, FL) was attached on the right hip of each participant to assess the changes in regard to sedentary, light, moderate, and vigorous physical activity. The GT3X accelerometer is a device that records all physical activity that a person

performs such as walking, jogging, or running. The device is a small trial-axial device weighing 27g and measuring 3.8 cm x 3.7 cm. x 1.8 cm. The GT3X records accelerations ranging from 0.05 to 2 g at a rate of 30 Hz in three different axes: vertical, antero-posterior, and medio-lateral (John & Freedson, 2012).

Each participant wore the accelerometer for 7 days at baseline, week s6, and week 11. Based on previous studies and best practice guidelines (Cain & Geremia, 2012; Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005), an epoch length of 1-minute is chosen as the standard for the current study with a sampling rate of 30 Hz. Additional criteria for analysis include a minimum of 10-hour daily wear time and 3-5 days of monitoring. There is relative consensus of a minimum of 10 hours per day of wear time needed for sampling wake-time behavior with 3-5 days of monitoring required to achieve 80% reliability for total and moderate-to-vigorous intensity physical activity (Hart, Swartz, Cashin, & Strath, 2011; Matthews et al., 2008; Trost, McIver, & Pate, 2005). Non-wear time was identified by participants completing a daily log of wear time and non-wear time was removed from the analysis. Previously validated cut points were used to classify accelerometer data as sedentary (<100 counts/minute), moderate (<5,999 counts/minute) and vigorous (>5,999), (Troiano et al., 2008). Light activity was defined as 500-2019 counts per minute (Tudor-Locke, Johnson, & Katzmarzyk, 2009).

After each assessment, accelerometers were collected and the data downloaded to the ActiLife software. Data was divided into four activity categories: sedentary, light, moderate, and vigorous based on accelerometer cut points.

Physical activity data (MOVband)

In addition, each participate wore a wrist worn accelerometer for the duration of the intervention. A MOVABLE MOVband3 activity tracker (Dynamic Health Solutions, LLC; Houston, TX.) is a wrist-worn activity monitor that measured daily physical activity as moves taken per day (24-hours) for the entire intervention. The MOVband3 has companion software that can estimate daily physical activity. Approximately 12,000 moves are equivalent to 10,000 steps (i.e. 1.2 moves are equivalent to one-step). Each participant information (height, weight, date of birth, and sex) was used to calibrate the activity tracker and set up the account though the companion software. Reliability for the MOVband on a treadmill has been reported as $r=0.92$, $p<0.02$ (Barkley, Rebold, Carnes, Glickman, & Kobak, 2014), and for free living PA as $r=0.974$ (Williamson, Rebold, Carnes, Glickman, & Barkley, 2014). Each week, daily and hourly data was downloaded from the Movable device to online software. Each participant was given a charger and an account to link the movable device. Once the devices were linked, data was downloaded from the online software weekly to track daily moves.

Self-Regulation

Self-regulation operationally defined in this study as a process of monitoring and controlling one's own thoughts, behaviors, and feelings to reach goals, targeted through six sub concepts that include: self-monitoring, goal setting, social support, reinforcements, time management, and relapse prevention. Self-regulation was targeted by daily text messages, video, and by wearing a MOVband through the intervention, and measured with a questionnaire

(Petosa, 1993a). This instrument contains six subscales: 1) reinforcements (items 24-32), 2) social support (items 15-23), 3) goal setting (items 6-14), 4) self-monitoring (items 1-5), 5) time management (33-36) and 6) relapse prevention (items 37-43). Items were set in a Likert scale 1 through 5 (appendix C). The minimum and maximum values are 43-215. A high score indicated frequent use of self-regulation skills. The purpose of this instrument was to assess the degree to which self-regulation strategies are used to support the acquisition of regular exercise. For this instrument, self-regulation is defined as skills used to carry out exercise intentions and to overcome personal and situational barriers. Face and content validity were established in a two-stage expert panel review. The test-retest reliability for the total instrument was reported as $r = 0.92$, $p < 0.0001$. Internal consistency for the total instrument was reported as 0.88 (Chronbach's alpha). This instrument has been considered to be the most comprehensive instrument identified, in terms of operationalizing defining self-regulation (Bandura, 1991).

Self-Efficacy

Self-efficacy defined as the level of confidence in one's ability to change physical activity behavior, was targeted by weekly text messages and e-mails. To assess self-efficacy a 12-item instrument was used to measure participant's confidence in his/her ability to change physical activity behaviors (Sallis et al., 1988). This scale consists of two subscales: "Resisting relapse" (five items; e.g., stick to your exercise program when your family is demanding more time from you) and "Making time" for exercise (seven items; e.g., get up earlier to exercise). Self-Efficacy questionnaire is a self-reported measure using a Likert-type scale ranging from 1

("I know I cannot do it") to 5 ("I know I can do it"), with higher scores indicating greater self-efficacy (appendix D). Sallis et al. (Sallis et al., 1988) reported internal consistency reliability ranged from 0.83 and 0.85 in a college age population. Speck and Looney (Speck & Looney, 2001) reported the internal consistency of this scale as 0.91 in middle age women participating in moderate or higher intensity physical activity. Factor test-retest reliabilities were 0.68. When correlating self-efficacy factor score with reported physical activity habits both subscales were significantly correlated with reported vigorous activity ($r=0.32$, $p<0.001$) (Sallis et al., 1988).

Body composition

Body composition was assessed by iDXA, which provides accurate data related to body composition in terms of BMI, body fat, lean mass, bone mineral density, and exact data from sections of the body if necessary. iDXA body composition analysis is a standardized test for health assessment due to its precision on measuring fat mass, lean mass, and bone mineral density of each segment of the body. It measures the diffusion of X-rays through the body at high and low energies. The X-ray beam energy is diminished with the passage through the three human body components that are distinguishable by their X-ray attenuation properties: bone mineral, fat tissue, and lean soft tissue (Toombs, Ducher, Shepherd, & De Souza, 2012). This measurement takes between 7 to 13 minutes depending on the thickness of a person's body mass. According to previous studies the precision error for total body mass 0.9%, total body lean mass 0.4 to 0.5%, total bone mineral content 0.6%, fat mass 0.7 to 0.8%, and 0.6 to 0.9% percent body

fat (Hind, Oldroyd, & Truscott, 2011; Rezzi, Ginty, Beaumont, & Ergun, 2009; Rothney et al., 2012).

Aerobic Fitness

Aerobic fitness was measured with a maximal Bruce Protocol (volitional fatigue) with a reported standard error of estimates (SEEs) range from ±2.7 to ±4.7 $mL*kg^{-1}*min^{-1}$ (ACSM, 2010). In this test, $VO2_{max}$ is estimated by asking the participant to walk- jog, and/or run on a treadmill at stages of three minutes each one, beginning at:

1. 10% of incline and 1.7 miles per hour (MPH)
2. 12% incline and 2.5 MPH
3. 14% incline and 3.4 MPH
4. 16% incline and 4.2 MPH
5. 18% incline and 5.0 MPH

Once the participant reached the maximum fatigue tolerance the test was stopped and the VO_{2max} was estimated by using a standardized and validated formula (Bruce, Kusumi, & Hosmer, 1973).

Formula to predict $VO_{2\ max}$:

$$VO2\ (mL*kg^{-1}*min^{-1}) = 6.7 - 2.82(2) + .056(\text{time in seconds})$$

$$VO2\ (mL*kg^{-1}*min^{-1}) = 1.06 + .056(\text{time in seconds})\ (\text{WOMEN})$$

$$VO2\ (mL*kg^{-1}*min^{-1}) = 3.88 + .056(\text{time in seconds})\ (\text{MEN})$$

Even though, submaximal exercise testing is not as precise, it provides a general idea on a person's physical fitness, reduces cost, reduces risk of negative events, needs less time and effort on the part of the subject, and also assumptions related to submaximal test are easily met. According to ACSM (ACSM, 2014) when a repeated submaximal GXTs are applied over a period of weeks or months and with a HR response decreasing over time with a fixed workload, it is likely that the cardio respiratory fitness of that person can be improved.

HbA1c

To perform this test an A1cNOW^{+} system was used at baseline and week 11. The HbA1c test is a blood test to analyze the average levels of glycosylated hemoglobin over a period of three months to determine diabetes development; normal values are below 5.7%, pre-diabetic levels range from 5.7-6.4%, and diabetes is classified as levels of6.5% or above. This assay is also called the hemoglobin A1c, HbA1c, or a glycohemoglobin test.

When comparing the A1CNOW^{+} system to the National Glycohemoglobin Standardization Program (NGSP) certified method (National Glycohemoglobin Standardization Program), the accuracy of the A1cNOW on average is 99%, meaning that a true 7.0 %A1c could be approximately 6.9-7.1 %A1c. An individual A1CNow^{+} result may differ by as much as -1.0% HbA1c to +0.8% HbA1c from the true result(Polymer Technology Systems).

When this test was performed, a small amount of blood sample (5 microliters (µL)) was collected from a finger prick using a 28-gauge lancet (Unistick 3 comfort, Owen Mumford, Marietta, GA). The blood sample was then placed in a portable A1CNOW device (Polymer Technology Systems, Inc. Indianapolis, IN). The results were recorded after 5 minutes. Figure 1 explains the study design and procedures.

Statistical Analyses

Descriptive statistics were used to present participant's physical characteristics. To answer the research questions a mixed factor ANOVA was utilized to analyze all dependent variables. Between factors examined differences between the three groups, whereas, within factors assessed changes over time. A Bonferroni post hoc test was performed whenever the critical admissible $p<0.05$ criteria was reached, to examine between group differences when all time points were collapsed. Also, this post hoc test was performed when there was a time effect detected, to examine between time point differences when all groups were collapsed. In addition, when a group*time interaction was found, a one-way ANOVA at each time point was performed with Bonferroni post hoc test as well as within-group analyses over time. To analyze data, the IBM Statistical Package for the Social Sciences (SPSS) System (version 23.0) for Windows® was used.

MANUSCRIPT I. ARTICLE 1

The effect of two walking programs on VO_2, body composition, and physical activity in sedentary workers

Introduction

Sedentary behavior is considered a risk factor for developing non-communicative maladies such as cardiovascular disease, diabetes, osteoporosis, and other hypokinetic diseases (Dempsey et al., 2014; Dunstan, Howard, et al., 2012; Healy et al., 2008; Healy et al., 2011). Sedentary behavior is defined as low energy expenditure and the posture in which people remain for long periods of time either sitting or reclining (Dempsey et al., 2014). Due to the relationship between chronic diseases and sedentary lifestyles, sedentary behavior is now considered a primary health detriment, linked to weight gain and excessive adiposity as well as other chronic negative outcomes (Neuhaus et al., 2014; Prince et al., 2014). In addition, according to the Center for Disease Control and Prevention (CDC) (CDC, 2015) in 2013 only 20% of adults in the United States met the exercise recommendations for aerobic and muscle strengthening guidelines. Objective measures of physical activity show that less than 10% of the adult population in United States meet the exercise recommendations (Troiano et al., 2008). This elevated rate of sedentary behavior has the potential for negative consequences on public health and quality of life (Martin et al., 2015).

Determinants of long bouts of inactivity have prompted studies to investigate interrupting sedentary time with physical activity intermittently. Intermittent physical activity during the day can help people reduce the risk of premature diseases and early mortality (Dempsey et al., 2014; Taylor, 2011). Specifically, reductions in waist circumference and body mass index (Owen et al., 2010; Taylor et al., 2010), and other determinants of metabolic disease development (Dempsey et al., 2014; Dunstan, Howard, et al., 2012; Holmstrup et al., 2014; Peddie et al., 2013; Saidj et al., 2013; Taylor et al., 2010) have been shown with intermittent exercise. Intermittent exercise bouts throughout the day appear to have the similar or better physiological results compared to continuous forms of exercise, as a single bout of exercise (Owen et al., 2012; Owen et al., 2010). In addition, it has been hypothesized that intermittent exercise bouts may lead to better adherence in terms of time management (Dunstan, Howard, et al., 2012), and increase motivation due to the capability of performing short bouts of physical activity (Jakicic et al., 1999; Sherwood & Jeffery, 2000). Furthermore, short bouts of exercise may be easier for unfit people to perform, and incorporate it to the schedule (Sherwood & Jeffery, 2000).

Sedentary time is the most common behavior among office employees. According to Clemes, O'Connell, and Edwardson (Clemes et al., 2014), office employees do not compensate long hours of sedentary behavior by increasing physical activity outside work. Moreover, this population is highly exposed to sedentary behavior and inclined to perform longer bouts of sedentary time without interruption (Parry & Straker, 2013). Intermittent physical activity may

allow office employees to accumulate some physical activity during working time (Buckley et al., 2015).

Walking is a type of activity that can be used to disrupt sedentary behavior. Walking is related to many health benefits and quality of life while reducing the possibility of injuries or overstress (Pelssers et al., 2013; Taylor et al., 2004). Walking is the most preferred physical activity (Williams et al., 2008), and a good alternative for people that are sedentary and/or never engaged in an exercise program before (Ogilvie et al., 2007). Multiple benefits are reported from walking interventions (Hanson & Jones, 2015) including: changes in waist circumference, improvements in aerobic fitness (Serwe et al., 2011), reduction in body fat and improvements in overall health (Amiri et al., 2013). Longer bouts of walking showed greater aerobic fitness improvements (Woolf-May et al., 1999) and prevented body fat increments (Murphy et al., 2006).

The majority of walking interventions have focused on continuous walking versus short bout or intermittent walking (less than 10 minutes). Therefore, this study compares the effect of two different randomized exercise programs: intermittent walking and single bout of walking in sedentary employees on physical activity behavior, $VO_{2\,max}$, and body composition.

Methods

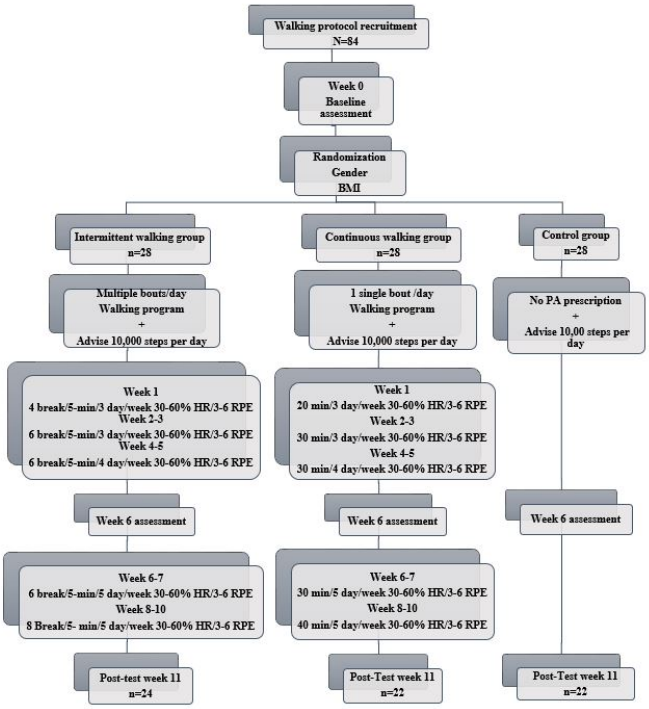
Participants, design, and study protocol

All procedures described herein were approved by the Institutional Review Board and conformed to the standards set by the latest revision of the Declaration of Helsinki. Prior to participation all subjects were asked to sign an informed consent and complete the Physical Activity Readiness Questionnaire (PAR-Q).

This study involved 68 (females = 51, males=17) sedentary office employees who participated in a 10-week walking intervention. Subjects were randomly assigned to one of three groups consisting of two walking protocols; multiple micro-bout of walking (Age = 46±9 years old, BMI= 30.33±5.79 kg/m^2, mean±standard deviation values) and continuous walking (Age = 48±9 years old, BMI= 30.53±6.17 kg/m^2), for both groups time and intensity were matched. A third group served as the control group (Age = 42±10 years old, BMI= 27.66±5.11 kg/m^2) and were not prescribed with a physical activity program. Randomization was designed to equate males and females and BMI status among the three groups.

Baseline and post assessments (week 11) included height and weight assessed using a stadiometer (SECA Model 769, Seca gmbh & Co.kg., Hamburg, Germany), body composition via dual-energy X-ray absorptiometry (iDXA) (GE Healthcare Lunar, Madison, WI), submaximal oxygen consumption (VO_2) and daily physical activity via an accelerometer (ActiGraph GT3X; ActiGraph Corp., Pensacola, FL). Accelerometers were also worn for 7 days

during week 6. A MOVband (DHS Group, Houston, TX; wrist worn accelerometer) was assigned to each participant to wear for the entire intervention with access to online cloud software to synchronize and view data from the device. Figure 1 explains the protocol design.



Assessments

Aerobic fitness

Aerobic fitness was measured with a maximal Bruce Protocol (volitional fatigue) with a reported standard error of estimates (SEEs) range from ±2.7 to ±4.7 $mL*kg^{-1}*min^{-1}$ (ACSM,

2010). In this test, $VO2_{max}$ was estimated by asking the participant to walk- jog, and/or run on a treadmill at stages of three minutes each one, beginning at:

10% of incline and 1.7 miles per hour (MPH)

12% incline and 2.5 MPH

14% incline and 3.4 MPH

16% incline and 4.2 MPH

18% incline and 5.0 MPH

Once the participant reached the maximum fatigue tolerance the test was stopped and the VO_{2max} was estimated by using a standardized and validated formula (Bruce et al., 1973). [VO_2 ($mL*kg^{-1}*min^{-1}$) = 6.7 - 2.82(2) + .056(time in seconds)]; [Women VO_2 ($mL*kg^{-1}*min^{-1}$) = 1.06 + .056(time in seconds)]; [Men VO_2 ($mL*kg^{-1}*min^{-1}$) = 3.88+ .056(time in seconds)].

Even though, submaximal exercise testing is not as precise, it provides a general idea on a person's physical fitness, reduces cost, reduces risk of negative events, needs less time and effort on the part of the subject, and assumptions related to submaximal test are easily met. According to American College of Sports and Medicine (ACSM, 2014) when repeated submaximal graded exercise tests (GXTs) are applied over a period of weeks or months and with a HR response decreasing over time with a fixed workload, it is likely that the cardio-respiratory fitness of that person improved.

Body composition

Body composition was assessed by iDXA, which provides data related to body composition in terms of BMI, body fat, lean mass and bone mineral density. We have previously reported (Kephart et al., 2016) that test-re-test reliability of the iDXA on 10 participants produced intra-class correlation coefficients of 0.998 for total body fat mass [mean difference between tests (mean ± standard error) = 0.40 ± 0.05 kg] and 0.998 for total body lean mass [mean difference between tests (mean ± standard error) = 0.29 ± 0.13 kg].

Physical Activity measures

Physical activity was measured with a waist worn and wrist worn accelerometer. To measure Physical Activity behavior an Actigraph accelerometer GT3X (ActiGraph GT3X; ActiGraph Corp., Pensacola, FL) was attached on the right hip of each participant to assess changes in regard to sedentary, light, moderate, and vigorous physical activity at baseline, week 6 and week 11. The device is a small trial-axial device weighing 27 g and measuring 3.8 cm x 3.7 cm. x 1.8 cm. The GT3X records accelerations ranging from 0.05 to 2 g at a rate of 30 Hz in three different axes: vertical, antero-posterior, and medio-lateral (John & Freedson, 2012). Based on previous studies and best practice guidelines (Cain & Geremia, 2012; Ward et al., 2005), an epoch length of 1-minute was chosen as the standard for the current study with a sampling rate of 30 Hz. Additional criteria for analysis include a minimum of 10 hours daily wear time and 3-5 days of monitoring. There is relative consensus of a minimum of 10 hours per day of wear time

needed for sampling wake-time behavior with 3-5 days of monitoring required to achieve 80% reliability for total and moderate-to-vigorous intensity physical activity (Hart et al., 2011; Matthews et al., 2008; Trost et al., 2005). Non-wear time was identified by participants completing a daily log of wearing time and non-wear time was removed from the analysis. Previously validated cut points were used to classify accelerometer data as sedentary (<100 counts/minute), moderate (<5,999 counts/minute) and vigorous (>5,999), (Troiano et al., 2008). Light activity was defined as 500-2019 counts per minute (Tudor-Locke et al., 2009).

A second device was given to the all three groups to track daily moves during the entire intervention. A movable (Movband; DHS Group, Houston, TX.), a wrist-worn activity monitor that measures daily physical activity and reports that activity as "moves". Approximately 12,000 moves are equal to 10,000 steps. Reliability for the Movband on a treadmill has been reported as $r=0.92$, $p<0.02$ (Barkley et al., 2014), and for free living PA as $r=0.974$ (Williamson et al., 2014). Participants used a username and password to log in, sync, charge and download the recorded information each week via cloud based software. Each group could see daily physical activity for themselves and for members of their group, but not members of the two other groups. Participants in the two experimental groups were given a MOVband and the walking prescription according to the intervention group. Participants in the control group were given the MOVband, but did not have access to a walking program. Participants returned to the lab on week 6 of the program (6-week), and at week 11 for post-testing. MOVband data was monitored for the

duration of the study and steps were recorded and presented for comparison purposes as weekly means per group.

Statistical analysis

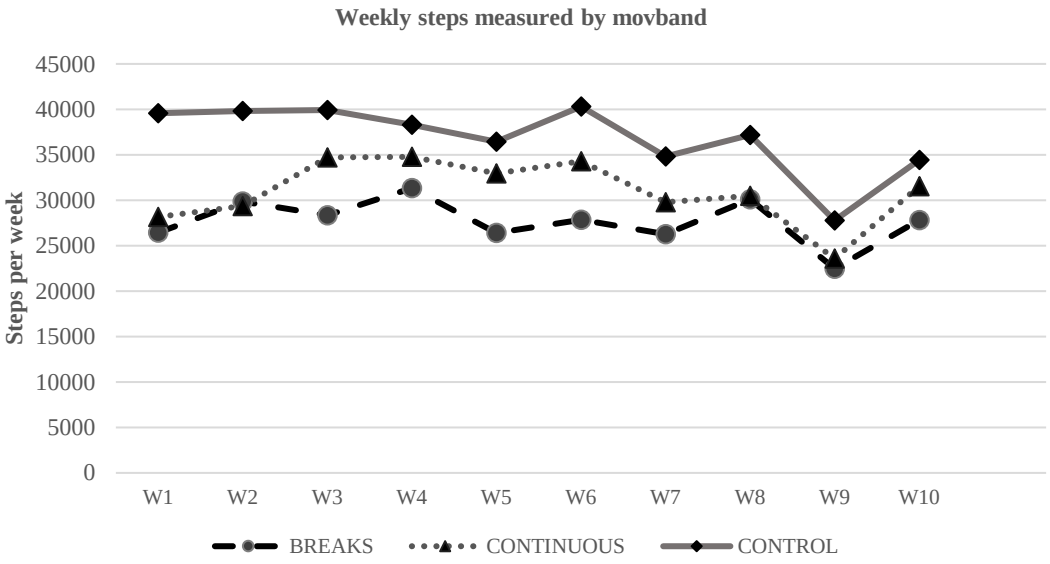
All analyses were performed with SPSS 23.0. To answer the research questions a mixed factor ANOVA was utilized to analyze all dependent variables. Between factors examined differences between the three groups, whereas, within factors assessed changes over time. A Bonferroni post hoc test was performed whenever the critical admissible $p<0.05$ criteria was reached, to examine between group differences when all time points were collapsed. Also, this post hoc test was performed when there was a time effect detected, to examine between time point differences when all groups were collapsed. In addition, when a group*time interaction was found, a one-way ANOVA at each time point was performed with Bonferroni post hoc test as well as within-group analyses over time.

Results

Sixty-eight sedentary office employees completed the intervention. At the onset of the study, groups did not differ by BMI ($p=0.279$).

Accelerometer and MOVband results

MOVband results



Accelerometer

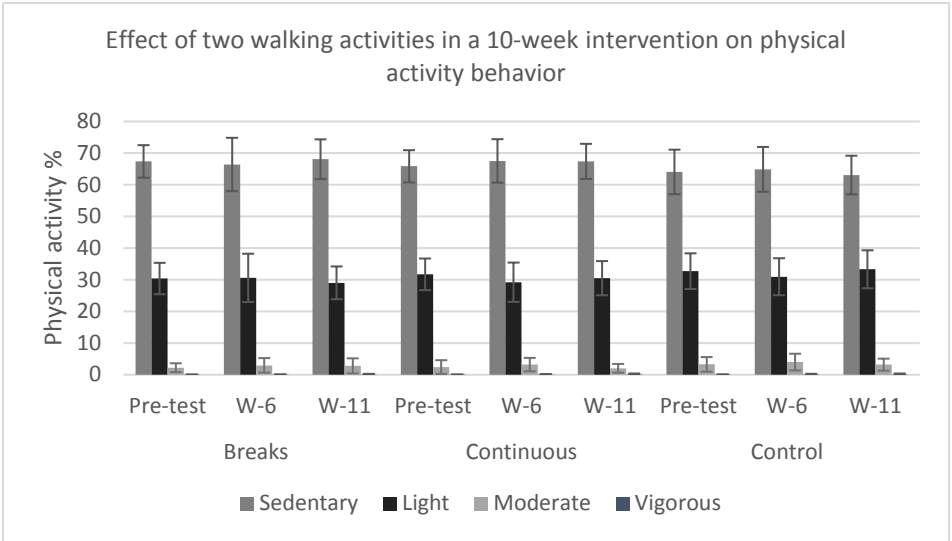


Figure 4. Physical activity behavior measured by accelerometer

Sedentary behavior from the waist worn accelerometer did not change as a main effect of group (F(2,47) =1.865, p=0.166), or as a main effect of time (F(2,94) =0.183, p=.833) and no main effect of time by group interaction was observed (F(4,94) =0.886, p=.475). For all three groups light intensity physical activity did not change as a main effect of group (F(2,47) =1.127, p=0.333), or as a main effect of time (F(2,94) =1.295, p=.279), nor main effect of time by group interaction was observed (F(4,94) =1.160, p=.334). Moderate intensity physical activity did not change as a main effect of group (F(2,47) =1.608, p=0.211), nor by time by group interaction (F(4,94) =.841, p=.503). There was a main effect of time (F(2,94) =4.976, p=.009) with a medium effect size of n^2=.096. Overall, moderate intensity physical activity increased significantly from pre-test to week 6 (p=.016), followed by a significant reduction from week 6 to post-test (p=.028). No significant changes observed from pre-test to post-test (p>0.05). Overall, for the three groups, vigorous intensity physical activity did not change as a main effect of group (F(2,47) =0.379, p=0.687), it did change as a main effect of time (F(1.214,57.061) =4.119, p=.040) with a medium effect size of n^2=0.081, but no main effect of time by group interaction was observed (F(2.428, 57.061) =.178, p=.875).

VO_2 results

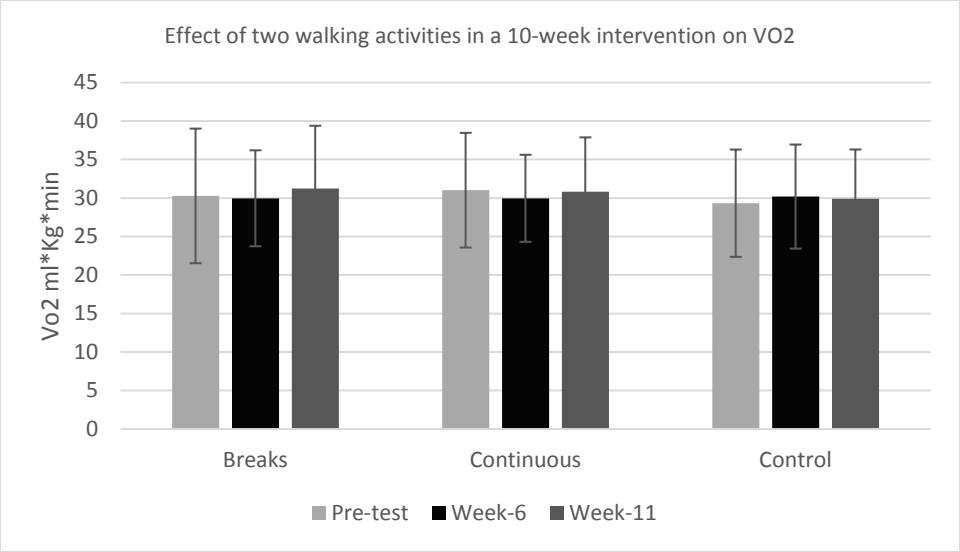


Figure 3 maximum oxygen uptake measured by Bruce protocol

The results from the mixed-design ANOVA show no significant changes for VO_2 measured by the Bruce Protocol. There was no main effect of group (F(2,64)=.091, p=0.913), or of time (F(1.62,105.07) =.997, p=0.358) or time by group interaction ($F(3.23,105.07)$=1.060, p=0.373).

Body composition results

The iDXA results show significant main effect of time changes for the three groups on total weight, fat mass, lean mass, fat free mass, fat percentage, android fat, and gynoid fat. A group*time interaction was observed for lean mass and fat-free mass changes and the *Post-Hoc* showed significant improvements in the intermittent and control groups as presented in table 1.

Table 1 Body composition main results obtained by iDXA scan.

		PRE-TEST	POST-TEST	Main effect of group			Main effect of time			Time by group interaction			Pre-test – Post-test
				F	p	n^2	F	p	n^2	F	p	n^2	p
Overall Mixed ANOVA	Total weight Kg.			1.301	.279		4.449	.039*	.064	2.395	.099		
	Fat mass Kg.			0.773	.466		23.491	.000*	.265	1.538	.223		
	Lean mass Kg.			1.414	.251		11.729	.001*	.153	3.488	.036*	.097	
	Fat free mass Kg.			1.427	.247		10.896	.002*	.144	3.434	.038*	.096	
	Visceral fat Kg.			0.127	.881		1.890	.174		0.579	.564		
	Fat %			0.592	.556		35.146	.000*	.354	1.565	.217		
	Android fat %			0.465	.630		20.581	.000*	.243	1.593	.211		
	Gynoid fat %			0.827	.442		10.298	.002*	.139	0.971	.384		
	Bone mass Kg.			1.352	.266		3.387	.070		0.729	.486		
Breaks	Total weight Kg.	79.51±25.30	79.05±25.51										
	Fat mass Kg.	33.11±12.61	32.03±12.62										
	Lean mass Kg.	43.92±14.24	44.56±14.66										.000**
	Fat free mass Kg.	46.40±14.91	47.02±15.32										.000**
	Visceral fat Kg.	1.18±0.77	1.12±0.74										
	Fat %	42.54±6.76	41.33±7.09										
	Android fat %	48.76±9.02	46.76±10.04										
	Gynoid fat %	45.07±7.55	43.88±7.77										
	Bone mass Kg.	2.48±0.73	2.46±0.72										
Continuous	Total weight Kg.	87.70±21.96	86.62±21.01										
	Fat mass Kg.	35.26±13.07	34.21±12.64										
	Lean mass Kg.	49.69±12.6	49.66±12.11										
	Fat free mass Kg.	52.44±13.07	52.40±12.59										
	Visceral fat Kg.	1.27±0.97	1.19±0.96										
	Fat %	40.78±8.96	40.07±8.96										
	Android fat %	45.64±12.91	44.58±12.88										
	Gynoid fat %	44.00±9.64	43.56±9.44										
	Bone mass Kg.	2.75±0.56	2.74±0.57										
Control	Total weight Kg.	77.40±15.09	77.53±15.42										
	Fat mass Kg.	30.33±11.41	29.92±11.46										
	Lean mass Kg.	44.52±7.48	45.07±7.79										.020**
	Fat free mass Kg.	47.06±7.80	47.61±8.12										.025**
	Visceral fat Kg.	1.09±1.06	1.09±1.03										
	Fat %	39.49±9.57	38.84±9.81										
	Android fat %	44.85±14.07	44.02±14.26										
	Gynoid fat %	41.52±9.22	40.91±9.46										
	Bone mass Kg.	2.59±0.40	2.54±0.41										

Mixed ANOVA results are presented at the top of the table, degrees of freedom are: main effect of group (2,64), main effect of time (1,64), and time by group interaction (2,64).

** Significantly different (p<.05)*

*** unique time by group interaction, significantly different (p<0.05)*

Discussion

This study focused on a 10-week intervention developed in sedentary adults randomly assigned to intermittent walking, continuous walking, and control group. We observed significant reduction in body weight, total fat mass, and body fat percentage in all three groups. However, VO_{2max} did not change for any group over the course of the time and physical activity measured by accelerometer indicated no significant changes in sedentary behavior or light

physical activity. Moderate physical activity improved for all three groups from baseline to 6-weeks but returned to baseline measures by week 11.

In previous studies, changes in aerobic fitness have been found after a walking intervention in where intermittent and continuous walking were compared. Serwe et al. (Serwe et al., 2011) found that for both models of walking, aerobic fitness, measure by 6 minutes walking tests, improved significantly. In another study, Macfarlane, et al. (Macfarlane, Taylor, & Cuddihy, 2006b) observed significant improvements on VO_{2max} after 8-week of intervention that included continuous walking and intermittent walking groups. Karstoft et al. (Karstoft et al., 2013) found in a 4-month intervention that the interval-walking group increased significantly VO_{2max}. after performing short bouts of walking (3x10 min/day per 8 weeks) as well as the continuous walking (30 min/day) group (Osei-Tutu & Campagna, 2005a). Different from those findings, our study did not show any significant improvement on aerobic fitness at week-6 or week-11. This may be explained by the fact that in our study we instructed our participants to perform moderate intensity walking, based on a rate of perceived exertion (RPE scale). Such as recommended by the ACSM (ACSM, 2014) to improve aerobic fitness on unfit people, the intensity may need to be at least 45% of the maximum heart rate reserve. For untrained people, the self-perception of exertion may be hard to figure out and likely, it does not match with the currently heart rate (Smutok, Skrinar, & Pandolf, 1980). Thus, it is possible that most of the participants did not achieve the physical exertion necessary to reach moderate intensity. Even though there were significant improvements on moderate intensity walking, those improvements

were not enough stimuli to positively affect $VO_{2\ max}$. It is important to mention that the baseline level and the walking speed will have a direct impact on increments in $VO_{2\ max}$ (Murphy, Nevill, Murtagh, & Holder, 2007) Likewise, our results show that moderate intensity physical activity significantly changed as a matter of time for all three groups. Moderate intensity increased for the first 6 weeks and then decreased the following weeks. However, the increment of moderate intensity time at week 6 was still too small to produce positive physiological effects in oxygen uptake. Then, the decreased moderate intensity from week 6 to post-test plus the overall low percentage of moderate intensity walking reached, could physiologically affect the performance of the participants to produce non-significant changes on aerobic fitness.

In our study, we observed significant positive reductions for body weight and body composition measures for all three groups. Our findings align with previous walking programs. For example, a meta-analysis (Murphy et al., 2007) observed that well controlled walking programs had significant reductions on body fat. Other interventions found that intermittent walking activity produced significant reductions on fat mass (Karstoft et al., 2013), furthermore continuous walking interventions showed lower body fat content (Steeves, Bassett, Fitzhugh, Raynor, & Thompson, 2012; Thompson, Rakow, & Perdue, 2004); more ambulatory physical activity accumulated and significant reductions in body fat percentages (Hornbuckle, Bassett, & Thompson, 2005).

Additional to our findings, we observed similar changes in body composition for all participants, however we noticed that the intermittent walking and control groups had significant improvements on lean mass and fat free mass compared to the continuous group. Karstoft et al. (Karstoft et al., 2013) in a well-controlled trial found that intermittent walking produced greater effects on body composition than the continuous walking, however, lean mass changes were not significant. In regards to continuous walking, Gaba et al. (Gaba et al., 2016), in their study they reported that, in a 10-week brisk walking intervention with women over 50 years old, no significant changes on body composition were evidenced post-intervention. The novel finding in our study pointing significant changes on lean mass in the intermittent walking group needs to be followed in future studies to confirm whether breaking sedentary time multiple times during the day may have positive implications over specific body composition elements such us lean mass.

The observed changes on physical activity, at least on moderate intensity for all groups are likely associated to the changes in body composition and this accounts also for the observed changes in the control group. To explain this observation, in a meta-analysis Murphy et al. (Murphy et al., 2007) found body composition changes associated to an incremented walking activity itself and not due to dietary changes, which allowed them to conclude that it is likely that the increments in energy expenditure related to walking activity produced changes on body composition. Yet, the most interesting fact to explain these changes in the control group is the elevated level physical activity observed in these individuals compared to the two experimental groups and this was unexpected during the intervention. This finding allows us to confirm that

move trackers are likely enough motivation to improve physical activity in sedentary people for the short term. Past studies have found similar results. In a preliminary study, Yuenyongchaiwat (Yuenyongchaiwat, 2015) found that pedometers increased physical activity and when people achieved 10k steps per day more during 12-week intervention they had positive changes in body composition. In a systematic review, Bravata et al. (Bravata et al., 2007) were able to determine that using pedometers, as motivators, increase physical activity and this physical activity produced significant changes in body composition. The meta-regression showed that having the pedometer and the goal of achieving 10k steps per day increased physical activity. In our study, participants independently of the group were given with a MOVband and the advice of reaching 10k steps per day as a good source of health, but the two experimental groups received a walking prescription. Our results provide explanation about the importance of tracking physical activity when interventions are targeting sedentary individuals. Similar to our findings, Rooney et al. (Rooney, Smalley, Larson, & Havens, 2003) gave over 500 sedentary employees with pedometers and encouraged them to walk 10k steps per day for eight weeks. They found that the pedometer was a predictor of significant improvements on physical activity.

Previous studies reported significant changes in sedentary behavior and improvements in adherence to physical activity after a walking intervention (Norton, Norton, & Lewis, 2015; Ogilvie et al., 2007). However, in our study, walking activity did not translate to changes in physical activity measured by the accelerometer at post-test. Based on anecdotal information provided by the participants, Thanksgiving holidays and the increase in social and work

obligations contributed to the decrease in physical activity at the end of the intervention. In addition, participants reported the change to daylight savings time decreased the amount of time people could walk outside after work. In support of this asseveration, in a particular systematic review that included studies from 1980 to 2006, researchers found that during the last months of the year, people tend to do less physical activity (Tucker & Gilliland, 2007). Also, the colder weather could affect negatively physical activity levels as stated by previous studies in which researchers found a significant lower level of physical activity when cold weather is present (Ma et al., 2006; Merrill, Shields, White, & Druce, 2005). Our results support this observation as we can see, for both intervention groups, moderate intensity PA increased significantly at week six, but then, it was significantly reduced at the post-test. Due to the changes in body composition, particularly changes in lean mass, it is likely that this decrease in physical activity occurred at the later end of the intervention.

In conclusion, when comparing the effect of intermittent vs continuous walking in our study, we could observe positive improvements from the two programs. A walking prescription accommodated to office employees' necessities, in which they can improve physical activity by doing moderate intensity continuous walking or intermittent walking during the day, could produce an important impact on body composition. In detail, reductions on body weight, fat mass, body fat percentage, gynoid and android fat percentage might be experienced. Meanwhile, intermittent walking allowed these sedentary employees to increase lean mass and fat free mass. The accumulated effect of physical activity during the day may have impacted in a greater

degree on those sedentary employees. Inferring that similar and/or better benefits can be achieved if sedentary employees with a tied schedule get up to do a brisk walk of 5-minutes multiple times during the day. In addition, wearing a wrist band to track daily physical activity appears to be a short-term motivator for walking behavior, but not enough to overcome environmental barriers.

Limitations

This study focused on sedentary office employees and results may differ with different populations.

The influence of the specific season of the year and the time change may have influenced the availability of the participants and limited their participation in the study.

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MANUSCRIPT II. ARTICLE 2

The effect of two walking programs on self-regulation and self-efficacy in sedentary workers

Introduction

Despite the known benefits of physical activity on overall health and quality of life, a majority of the United States adult population are inactive. According to the Center for Disease Control and Prevention (CDC, 2015) in 2013, approximately 80% of the United States did not meet physical activity recommendations based on self-report measures. Utilizing objective measures of physical activity about 95% of American adults are inactive (Troiano et al., 2008). Promoting walking is one potential strategy to increase physical activity. Walking is related to many health benefits and quality of life while reducing the possibility of injuries or overstress (Pelssers et al., 2013; Taylor et al., 2004). Walking is the most preferred physical activity (Williams et al., 2008), and a good alternative for people that are sedentary and/or never engaged in an exercise program before (Ogilvie et al., 2007).

Recently, walking interventions have shifted the focus from increasing physical activity to disrupting or decreasing sedentary behavior, (Prince et al., 2014) with intermittent bouts of walking. Intermittent physical activity is thought to have similar health benefits compared to continuous based physical activity (Bassett et al., 2010; Owen et al., 2012; Parry, Straker, Gilson, & Smith, 2013; Taylor, 2011). Intermittent physical activity may require less time

commitment (Dunstan, Howard, et al., 2012), and increase motivation due to the capability of performing short bouts of physical activity (Jakicic et al., 1999; Sherwood & Jeffery, 2000) compared to continuous bouts of 30 minutes or more. Furthermore, short bouts of exercise may be easier for unfit people to perform, and incorporate physical activity into their schedule (Sherwood & Jeffery, 2000).

The inability of an intervention to change physical activity over time, may be due to a lack of change in key mediators of continued physical activity and walking participation such as self-regulation and self-efficacy (Williams & French, 2011). Self-regulation for physical activity requires attention to one's own capacities and the ability to modulate thoughts, affects, behavior, or attention by cognitive control mechanisms (Buckley et al., 2014; Karoly, 1993). Satisfactory self-regulation depends on the level of motivation as well (Bandura, 1991). Likewise, self-regulation refers to a personal achievement of being able to change a condition in a positive way. Alternatively stated, this means that the behavior will be modified based on a mental challenge and the implementation of an intention (Bandura, 1991). This psychological combination may lead to an increase in physical activity and a reduction in sedentary lifestyle (Stadler et al., 2009). One of the key aspect of self-regulation is self-monitoring or being able to track physical activity. In a meta-regression Michie et al. (Michie, Abraham, Whittington, McAteer, & Gupta, 2009) stated that interventions targeting behavior change that used different self-monitoring tools produce positive effects on physical activity outcomes. For walking, a pedometer and/or wrist worn devices are typically used to measure physical activity. Bravata et al. (Bravata et al., 2007),

reported that people who track steps significantly increased physical activity by around 27% compare to the baseline. In qualitative studies, people reported that step trackers helped them to increase physical activity due to the awareness of the steps and the motivational and meaningful goal setting by being able to see steps taken per day (Lauzon, Chan, Myers, & Tudor-Locke, 2008). In a meta-analysis using 32 studies, Kang and colleagues (Kang, Marshall, Barreira, & Lee, 2009) found that as a self-monitoring tool, pedometers have a moderate and positive effect on incremented physical activity over the course of interventions, and 10,000 steps/day goal is an effective strategy for adult women to increase physical activity.

Self-efficacy, the conviction that a person can perform a specific behavior (Bandura, 1997), is related to continued exercise participation. Several studies have shown that self-efficacy is a strong predictor of changes in physical activity behavior in long-term interventions (McAuley & Blissmer, 2000; Oman & King, 1998; Sallis et al., 1986) and can be accounted as a predictive factor for adoption and maintenance of physical activity (Sallis et al., 1986; Strachan et al., 2005).

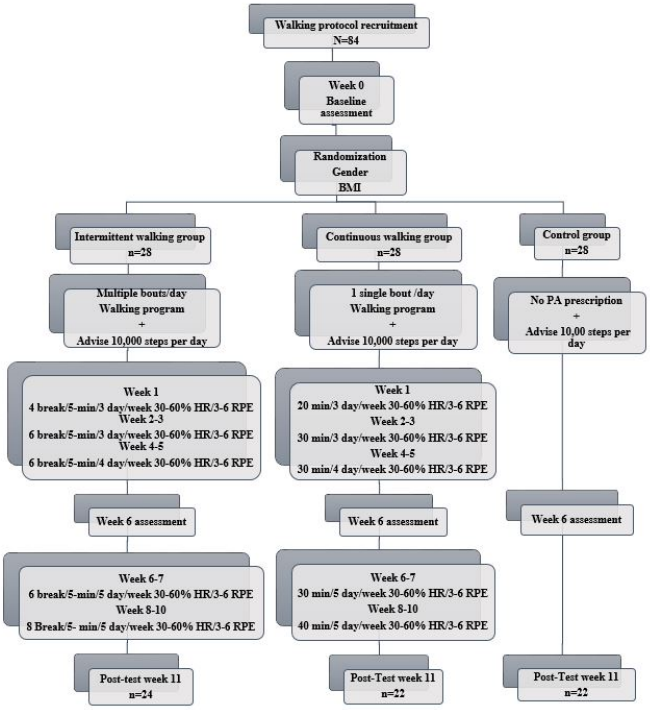
Currently changes in walking behavior and its relationship with self-regulation and self-efficacy for physical activity remains unclear. Furthermore, it is unclear how different types of walking programs (i.e. continuous versus intermittent) affect self-regulation and self-efficacy. Therefore, the purpose of this study was to examine the effect of two different walking programs

on self-regulation and self-efficacy for physical activity in sedentary office workers after 10 weeks of intervention.

Methods

Participants

All procedures described herein were approved by the Institutional Review Board and conformed to the standards set by the latest revision of the Declaration of Helsinki. Prior to participation, all subjects were asked to sign an informed consent and complete the Physical Activity Readiness Questionnaire (PAR-Q). Sixty-eight sedentary office employees (16 males and 52 females) participated in a 10-week walking intervention. Subjects were randomly assigned (based on initial BMI and gender) to one of three groups consisting of two walking protocols; multiple breaks of walking (Age = 46±9 years old, BMI= 30.33±5.79 kg/m^2 meand±standard deviation values) and continuous walking (Age = 48±9 years old, BMI= 30.53±6.17 kg/m^2). A third group served as the control group (Age = 42±10 years old, BMI= 27.66±5.11 kg/m^2) and were not given an exercise prescription nor self-regulatory training. Figure 1 describes the intervention protocol.



Procedures

At baseline, participants were assessed for self-regulation and self-efficacy via questionnaires and then randomly assigned, based on gender and BMI, to one of three groups. A MOVband (DHS Group, Houston, TX; wrist worn accelerometer) was assigned to each participant to wear for the entire intervention with access to online cloud software to sync and view data from the device.

The 10-week walking prescription for the intermittent and continuous groups followed an incremental increase in walking behavior over 10-weeks. These two groups were targeted with weekly strategies to improve self-efficacy and self-regulation skills via text messages, e-mails

and videos (Table 1). All content linked to tactics to improve control over personal actions and to improve self-confidence of changing physical activity behavior. The control group had access to the MOVband account but did not have access to a walking program nor to self-regulatory or self-efficacy strategies sent via text messages, e-mails and videos.

Table 1 text messaging and email containing videos targeting self-efficacy and self-regulation during the 10-week intervention

Text and email messaging system and videos for self-regulation				
	Self-Efficacy		Self-Regulation	
	Target		Target	
Week 1 Week 2	N/A		N/A	
Week 3	**Personal inventory**	**TM**: 'make an inventory of your past experience with exercise. List all positive and negative you can recall"	**Goal setting**	**Video: Goal setting** **TM: "**Park your vehicle further, take the stairs, and walk to your friend's office. Walk when you getting your lunch. Stand up from your chair frequently"
Week 4	**Obstacles**	TM: "Stay aware of negative events that may set you back from your walking routine"	**Self-Monitoring**	**VIDEO: Self-monitoring** **TM:** "are you aware of the time you spend being physically inactive?"
Week 5	**Vicarious experience**	**TM**: "look for what others are doing to keep up with PA and benefits they are getting"	**Time Management**	**VIDEO: Time management** **TM:** "are you making time to go over your physical activity prescription?"
Week 6	**Persuasion**	**TM:** "Make sure you have a plan to keep up with your walking prescription. Physical inactivity is really dangerous for your quality of life and overall health"	**Relapse Prevention**	**VIDEO: Relapse prevention** **TM: "**If something unexpected comes up and it feels like the perfect excuse to do not do exercise, are you able to make a plan B?"
Week 7	**Self-appraisal**	**TM**: "take a moment to reflect how are you doing with your walking activity"	**Social Support**	**VIDEO: Social Support** **TM: "**Keep doing physical activity with your friend, family, coworker, etc. If you don't have one find someone if that helps"
Week 8	**Motivation**	**TM:** "Keep walking, you are making a huge progress. Way to go!"	**Reinforcements**	**VIDEO: Reinforcements** **TM:** "reward yourself for keeping up with your physical activity program"
Week 9	**Time**	**TM:** "Are you having troubles to meet the exercise prescription? Make sure you put it within your priorities. Try to you separate the time to do exercise"		**VIDEO: Goal setting, self-monitoring, and Time management**
Week 10		**TM:** "Share your achievements with your friends, coworkers, and family. Show them your improvements"		**Video: Relapse prevention, social support, and reinforcements**

Participants were asked to complete a self-regulation and a self-efficacy questionnaire again on week 6 of the program, and at the end of the 10-week intervention (week 1). MOVband data was monitored for the duration of the study and moves from baseline, week 6, and the post-test were used for comparison.

Measures

Self-regulation

Self-regulation was measured with a 43-item questionnaire (Petosa, 1993b) in order to assess the degree to which self-regulation strategies are used to support the acquisition of regular exercise. This instrument contains six subscales 1) reinforcements (items 24-32) 2) social support (items 15-23) 3) goal setting (items 6-14) 4) self-monitoring (items 1-5) 5) time management (33-36) and 6) relapse prevention (items 37-43). All items are set in a Likert scale ranging from 1 (never) to 5 (very often). Self-regulation was defined as skills used to carry out exercise intentions and to overcome personal and situational barriers. Face and content validity were established in a two-stage expert panel review. The test-retest reliability for the total instrument was reported as $r=0.92$, $p<0.0001$. Internal consistency for the total instrument was reported as 0.88 (Chronbach's alpha). The minimum and maximum summed values are 43-215. A high score indicates frequent use of self-regulation skills.

Self-Efficacy

Self-efficacy defined as the level of confidence in one's ability to change physical activity behavior, was targeted by weekly text messages and e-mails. To assess self-efficacy a 12-item instrument was used to measure participant's confidence in his/her ability to change physical activity behaviors (Sallis et al., 1988). This scale consists of two subscales: "Resisting relapse" (five items; e.g., stick to your exercise program when your family is demanding more

time from you) and “Making time” for exercise (seven items; e.g., get up earlier to exercise). The questionnaire is measured with a Likert-type scale ranging from 1 (“I know I cannot do it”) to 5 (“I know I can do it”), with higher scores indicating greater self-efficacy. Sallis (Sallis et al., 1988) reported internal consistency reliability ranged from 0.83 and 0.85 in a college age population. Speck and Looney (Speck & Looney, 2001) reported the internal consistency of this scale as 0.91 in middle age women participating in moderate or higher intensity physical activity. Factor test-retest reliabilities were 0.68. When correlating self-efficacy factor score with reported physical activity habits both subscales were significantly correlated with reported vigorous activity ($r=0.32$, $p<0.001$) (Sallis et al., 1988).

MOVband

A movable device was given to the all three groups to track daily moves during the entire intervention. A movable (MOVband; DHS Group, Houston, TX.) is a wrist-worn activity monitor that measures daily physical activity and reports that activity as “moves”. Approximately 12,000 moves are equal to 10,000 steps. Reliability for the MOVband on a treadmill has been reported as $r=0.92$, $p<0.02$ (Barkley et al., 2014), and for free living PA as $r=0.974$ (Williamson et al., 2014). Participants used a username and password to login, sync, charge, and download the recorded information each week via cloud based software. Each group was able to see daily physical activity for themselves and for members of their group.

Statistical analysis

All analyses were performed with SPSS 23.0. To answer the research questions, a mixed design ANOVA approach was performed to examine the main effect over time and the main effect of time and group interaction. Between factors examined differences between the three groups, whereas, within factors assessed change over time within each group. When a significant main effect (i.e. $p<0.05$) was observed, a Post-Hoc test was performed using Bonferroni correction for multiple comparisons. Independent t-test was performed to compare percentage of change from move data points measured by MOVband.

Results

A total of 68 sedentary office employees completed the intervention. At the onset of the study, groups did not differ by BMI ($p=0.279$).

Table 2 presents the results from the overall mixed ANOVA at the top and by group for self-regulation questionnaire at pre-test, 6-weeks, and post-test.

		PRE-TEST	Week-6	POST-TEST	Main effect of group			Main effect of time			Time by group interaction			Pre-test-week 6 test	Pre-test – Post-test
					F	p	n^2	F	p	n^2	F	p	n^2	p	p
Overall Mixed ANOVA	**SELF-REGULATION**				1.088	.343		20.040	.000*	.236	8.017	.000*	.198		
	Self-monitoring				.788	.459		18.986	.000*	.226	2.972	.022*	.084		
	Goal setting				.494	.612		15.087	.000*	.188	5.588	.000*	.147		
	Social support				.017	.983		10.144	.000*	.135	6.463	.000*	.166		
	Reinforcement				2.002	.143		7.112	.001*	.099	4.197	.003*	.114		
	Time management				.053	.948		32.930	.000*	.336	10.161	.000*	.238		
	Relapse prevention				6.332	.003¥	.163	33.860	.000*	.343	2.694	.034*	.077		
Breaks	**SELF-REGULATION**	92.33±23.60	100.25±22.3	101.38±29.63											
	Self-monitoring	10.67±4.28	12.71±3.90	12.08±3.68											
	Goal setting	20.58±6.71	23.50±7.23	22.75±8.03											
	Social support	16.12±4.93	16.50±4.47	17.54±6.37											
	Reinforcement	24.04±6.69	24.71±4.89	25.00±6.73											
	Time management	8.46±3.06	9.17±3.28	9.38±3.70											
	Relapse prevention	12.46±4.15*	13.67±4.56	14.63±5.11*											.032**
Continuous	**SELF-REGULATION**	75.32±24.69	112.3±20.9*	108.18±23.05*										.000**	.000**
	Self-monitoring	8.09±3.15	14.05±4.03*	12.68±4.48*										.000**	.001**
	Goal setting	16.68±6.56	26.86±6.58*	25.27±6.97*										.000**	.001**
	Social support	12.59±4.66	18.82±5.84*	18.27±5.47*										.000**	.001**
	Reinforcement	20.45±7.81	26.86±5.99*	26.50±4.79*										.005**	.006**
	Time management	6.41±2.92	10.68±2.85*	10.18±3.23*										.000**	.001**
	Relapse prevention	11.09±3.52	15.00±4.38*	15.27±4.30*										.018**	.001**
Control	**SELF-REGULATION**	87.64±31.93	89.14±25.99	92.95±27.86											
	Self-monitoring	9.50±3.95	11.45±4.49	11.18±5.02											
	Goal setting	20.45±9.16	21.09±8.98	21.64±8.47											
	Social support	16.41±6.40	16.23±6.02	16.77±5.38											
	Reinforcement	21.55±7.86	21.23±5.89	22.59±7.31											
	Time management	8.05±3.99	7.23±2.88	8.09±2.99											
	Relapse prevention	11.68±3.71	11.91±3.73	12.68±4.00											

Mixed ANOVA results are presented at the top of the table, degrees of freedom are: main effect of group (2,65), main effect of time (2,130), and time by group interaction (4,130)

** significantly different (p<0.05), main effect of by group interaction.*

*** significantly different (P<0.05). Continuous walking group improved all sub-scales at week 6 and post-test. Intermittent walking improved only the sub-scale relapse prevention at post-test.*

¥ Control group significantly different from multiple breaks and continuous groups (p=.011 and p=.007 respectively)

The results from the mixed-design ANOVA showed that there was no main effect of group on self-regulation $F(2,65)=1.088$, p=0.343, however, total self-regulation changed significantly as a main effect of time $F(2,130) =20.140$, $p<.001$, with a large size effect of $n^2=.236$. When comparing self-regulation by group there was a significant interaction $F(4,130) =8.017$, $p<.001$, and a large effect $n^2= .198$. Bonferoni post-hoc test showed that for the

continuous group, overall self-regulation improved significantly from pre-test to 6-weeks (p<.001) and to the post-test (p<.001). The multiple breaks significantly increased in relapse prevention from pre-test to post-test (p<.037). The control group did not change significantly overall self-regulation at 6-weeks nor at post-test.

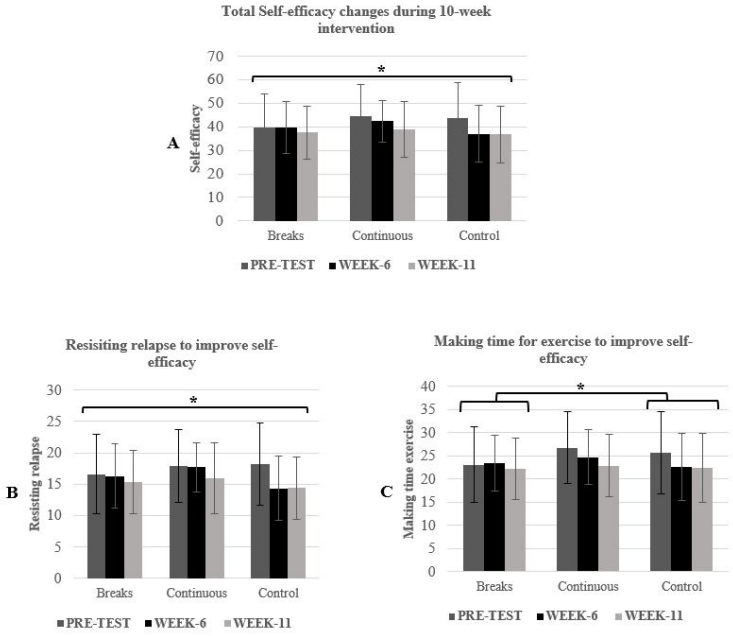


Figure 3. Overall self-efficacy results by group at pre-test, week 6 test, and post-test. B. Self-efficacy for resisting relapse by group at pre-test, week 6 test, and post-test. **C.** Self-efficacy for making time to perform exercise by group at pre-test, week 6 test, and post-test. *p<.05.

The results from the mixed-design ANOVA showed that there was no main effect of group on self-efficacy $F(2,64)=0.571$, p=0.568, total self-efficacy decreased significantly for all three groups as a main effect of time $F(1.821,116.52) =6.341$, p=.003) with a medium size effect

of n^2=.090. Overall, all three groups decreased perception of self-efficacy from pre-test to week 6 (*p*=.047) and from pre-test to post-test (*p*=.008). There was no effect of time by group interaction (*F*=1.207, *p*=.312) and groups were not different between them *F*=.571, p=.568. Resisting relapse as part of self-efficacy did not change as a main effect of group *F*(2,64) =.653, *p*=0.524, but it changed significantly as a main effect of time *F*(2,128) =7.012, *p*=.001, with a medium size effect of n^2=.099. The perception of resisting relapse decreased at week 6 (p=.038) and at post-test, (p=.003) for all three groups, compared to pre-test measures. There was not a significant main effect of time and group interaction (*F*=1.917, *p*=.112). Finally, making time for exercise did not have a main effect of group *F*(2,64) =.571, *p*=0.568, however a main effect of time was observed *F*(1.801,115.29) =4.682, p=.014, with a medium size effect of n^2=.068. The three groups were significantly lower at post-test compared to pre-test (p=.031) and there was no main effect of time; nor a time by group interaction (*F*=.881, *p*=.469).

Physical activity results as moves

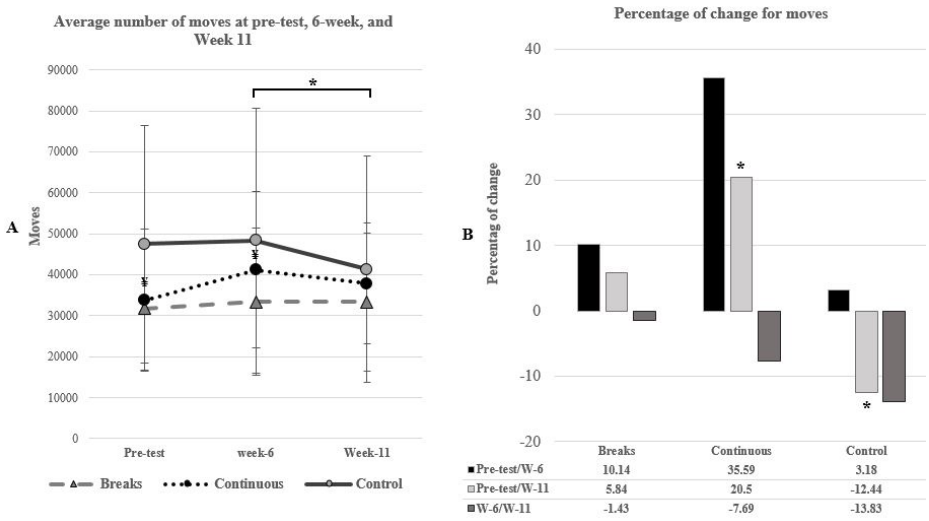


*Figure 4 A. Moves by group, at baseline, week 6, and post-test. Symbols denote significantly different: * Week 6 from post-test; ¥ Baseline from week 6, (p<0.05). B. Percentage of change by group at baseline to week 6, from baseline to post-test, and from week 6 to post-test. * Significantly different (p<0.05).*

The results from the mixed design ANOVA show that there was no main effect of group on physical activity $F(2,65)=2.135$, p=0.107. However, for the three groups, physical activity measured by moves changed significantly over the course of the intervention with a main effect of time $F(2,130) =4.497$, $p=.013$, a medium size effect of $n^2=.065$, and physical activity differed significantly as main effect of time by group interaction $F(4,130)=2.526$, p=.044) with a medium size effect of $n^2=.072$. There was a significant reduction on moves from week 6 to post-test (p=.014) for all groups combined. The Bonferroni Post-Hoc test showed that the continuous walking group increased moves significantly from baseline to week 6 (p=.033), no significant changes in moves from week 6 to post-test and from baseline to post-test were detected (p>0.05).

Multiple breaks of walking activity and the control groups did not have any significant change in PA between measures ($p>0.05$). (See Figure 4A) The independent t-test show that there were no significant differences on moves measured by percentage of change between multiple breaks and continuous walking groups from pre-test to week 6 ($p=169$), from pre-test to post-test ($p=.351$), and from week 6 to post-test ($p=.417$). Multiple breaks of walking and control groups were not significantly different from each other at pre-test to week 6 ($p=.527$), from pre-test to post-test ($p=.073$), and from week 6 to post-test ($p=.087$). Continuous walking and control groups were not significantly different from each other pre-test to week 6 ($p=.069$) and from week 6 to post-test ($p=.0.433$), but were significantly different from pre-test to post-test ($p=.042$).

Discussion

The purpose of this study was to examine the effect of two different walking programs on self-regulation and self-efficacy for physical activity in sedentary office workers after 10 weeks of intervention. The results showed individuals within a continuous walking program developed greater self-regulation skills compared to the control or intermittent walking group, and this was translated to physical activity at 6 weeks. Self-efficacy decreased significantly over the course of the intervention for all groups, showing a decrease in confidence to improve physical activity behavior.

We defined self-regulation as the degree to which self-regulation strategies were used to support the acquisition of regular exercise. Strategies such as goal setting and self-monitoring

require the individual to adopt a more conscious state about volition, planning, actions, monitoring, and inhibition. Bandura (Bandura, 1991) suggests that following the cognitive process, self-regulation, will improve by changing tasks, increasing corporal activity, improving motivation and challenging the currently behavior. Our results showed several significant changes in self-regulation, predominately in the continuous walking group. These findings suggest that performing a continuous walking program enabled individuals to self-regulate walking behavior better than those in the intermittent walking group and the control group. Both the continuous and the intermittent walking group were provided with the same mobile health intervention that targeted the six self-regulation skills assessed. However, only relapse prevention, the ability to overcome barriers associated with exercise, significantly changed over the course of the intervention for the intermittent group. This intervention shows that self-regulation can be changed via mobile health interventions, but that the exercise prescription for the intervention affects changes in self-regulation.

It is likely that the daily work demand and current sedentary behavior of our participants in the intermittent walking group interfered with motivation and cognitive control to overcome difficulties to meet the physical activity prescription. Thus, they perceived more challenging and less achievable tasks to intersperse multiple short walking bouts every day. This finding is supported by Serwe, et al. (Serwe et al., 2011), who found that people prescribed long bouts of brisk walking (30 minutes) participated in more physical activity than those set in a short bout of walking activity (3x10 minutes).

Our study targeted self-efficacy via pointed persuasion and barrier identification by text messages and emails. Our results showed that self-efficacy did not improve through the intervention, and in fact, self-efficacy decreased significantly over time showing that participants' confidence to keep up with physical activity decreased, and they were less able to make time for exercise and to resist relapses. Different studies have suggested that self-efficacy changes over time, being more potent during the stages of adoption and weaker during the maintenance stages of physical activity behavior (McAuley & Blissmer, 2000; Oman & King, 1998). In addition, Wadsworth and Hallam (Wadsworth & Hallam, 2010) found that self-efficacy decreased overtime with an online intervention. This decrease in self-efficacy may occur because as one begins an exercise program, the level of barriers is unknown and may increase as one moves closer to adoption and maintenance.

All our participants were able to self-monitor their walking behavior throughout the duration of the study. Based on previous research, monitoring physical activity with a step tracker has an important impact over sedentary behavior in interventions lasting at least 8 weeks (Kang et al., 2009). According to Hultquist et al. (Hultquist, Albright, & Thompson, 2005) when women were instructed to walk 10,000 steps per day, they were more active than those that were given with a walking prescription instructed to take a brisk walk 30 minutes per day all days of the week. In our design, all subjects received the MOVband and the goal to achieve 10,000 steps per day. However, having the self-monitoring tool did not translate to changes in physical activity for the control group. Only the continuous group was able to improve moves

significantly from baseline to week 6 and the percentage of change was significant different from the control group. The continuous walking group showed a significantly higher change on moves from the pre-test to post-test compared to the control group. For all groups, there was a reduction in moves from week 6 to the end of the intervention for all three groups. Based on anecdotal information from the participants, change to daylight savings, the Thanksgiving holidays and increase in social and work obligations contributed to the decrease in physical activity at the end of the intervention. This is supported by Tucker and Gilliland (Tucker & Gilliland, 2007), in a several studies systematic review they found that during the ending season of the year, people are more inactive. Another negative point for physical activity is the colder weather at this point of the year; previous studies pointed significant lower levels of physical activity during the cold weather (Ma et al., 2006; Merrill et al., 2005).

Our findings show that for sedentary employees a structured program based on a single continuous bout of walking may be a better approach to improve self-regulatory skills. Improvement in self-regulation has been shown as a key mediator of change and is associated with higher levels of adherence (Gell & Wadsworth, 2014; Wadsworth & Hallam, 2010). Therefore, a continuous walking program may provide a more feasible approach to prescribing exercise in sedentary office employees. Intermittent physical activity may have some positive impact on self-regulatory skills, however the amount of time and frequency of the bouts need to be tested to determine a feasible approach to include physical activity and meet daily obligations as well.

Limitations

This study only assessed sedentary office workers. Results might differ for individuals who have a more flexible work schedule or natural breaks within their workday.

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MANUSCRIPT III. ARTICLE 3

The effect of two walking programs on HbA1c in sedentary employees during a 10-week intervention

Introduction

Sedentary behavior and physical activity are two behavioral scenarios that have significant effects on health outcomes. While physical activity produces positive effects on overall health (Hamilton et al., 2008), chronic sedentary behavior is linked to health impairments such as increased obesity (Hu, Li, Colditz, Willett, & Manson, 2003), diabetes (Proper, Singh, van Mechelen, & Chinapaw, 2011), cardiovascular disease (Warren et al., 2010), cancer (Katzmarzyk, Church, Craig, & Bouchard, 2009), and early mortality (Stamatakis, Hamer, & Dunstan, 2011). Physical activity, particularly walking behavior has been linked to reductions in type 2 diabetes (T2D) risk.

For example, in a review conducted by Jeon, Lokken, and van Dam (Jeon, Lokken, Hu, & van Dam, 2007) in which, around 300,000 participants were included and almost 10,000 incident cases, walking activity at moderate intensity significant (approximately 2.5 hours/week) reduced T2D risk compared to those being sedentary (barely walking). In a meta-analysis, Boule et al. (Boule, Haddad, Kenny, Wells, & Sigal, 2001; Boule, Kenny, Haddad, Wells, & Sigal, 2003) determined that a higher walking activity level was associated to significant reductions in T2D risk.

In studies that targeted participants with type 2 diabetes and focused on different models of exercise training, some have found significant differences post intervention in favor of reductions of HbA_{1c} (Agurs-Collins, Kumanyika, Ten Have, & Adams-Campbell, 1997; Ronnemaa, Mattila, Lehtonen, & Kallio, 1986), a measure of long term blood glucose control.(Oberlin et al., 2014). In addition, results obtained from a meta-analysis (Boule et al., 2001) show that where exercise groups were compared to control groups, the weighted mean difference HbA1c was significant lower in the experimental groups. However, others have not found significant changes. For example, in a 16 week aerobic training conducted by Tessier et al. (Tessier et al., 2000) no significant changes regrading HbA1c were found. Although physical activity has constantly been linked to reductions in type 2 diabetes mellitus (T2D), and results seem promising (Dunkley et al., 2014; Laaksonen et al., 2005), the effect on HbA1c needs to be further clarified (McCarthy et al., 2017) particularly in terms of which type of walking activity has the greatest effective on HbA1c. Furthermore, the majority of the interventions have been performed on participants with T2D, versus as a method to prevent T2D. Thus, our experimental study investigated the effect of two different walking activity protocols and a control group on HbA1c in sedentary office workers.

Methods

Participants

This study involved 67 sedentary office employees, males and females who participated in a 10-week walking intervention. Subjects were randomly assigned to one of three groups consisting of two walking protocols; multiple micro-bout of walking (Age = 46±9 years old, BMI= 30.33±5.79 kg/$m^{2,}$ mean±standard deviation values) and continuous walking (Age = 48±9 years old, BMI= 30.53±6.17 kg/m^2), for both groups time and intensity were matched, and a third group served as a control group (Age = 42±10 years old, BMI= 27.66±5.11 kg/m^2).

Study design and Procedure

The walking intervention included a 10-week program consisting of two walking protocols; multiple micro-bout and continuous walking. For both experimental groups, time and intensity were matched and effort incrementally increased in both duration over the 10- week program (figure 1).

All procedures described herein were approved by the Institutional Review Board and conformed to the standards set by the latest revision of the Declaration of Helsinki. Prior to participation, all subjects were asked to sign an informed consent and complete the Physical Activity Readiness Questionnaire (PAR-Q). Then, participants were asked to complete the baseline assessments including the HbA1c test and wear an accelerometer for seven days

(ActiGraph GT3X; ActiGraph Corp., Pensacola, FL). A waist worn accelerometer was worn at baseline, week 6 and week 11. HbA1c measures were taken at baseline and week 11. At baseline groups were randomized to one of three groups, with equal randomization between males and females and BMI status. Baseline and post assessments (week 11) included height and weight assessed using a stadiometer (SECA Model 769, Seca gmbh & Co.kg., Hamburg, Germany) and body composition to determine BMI via dual-energy X-ray absorptiometry (iDXA) (GE Healthcare Lunar, Madison, WI). The two experimental groups were given walking exercise prescriptions based on group assignments in written and electronic format. A weekly email and three text messages a week was sent to remind and encourage walking participation. The control group was told that “10,000 steps a day is a minimum for good health”. Figure 1 details the intervention design.

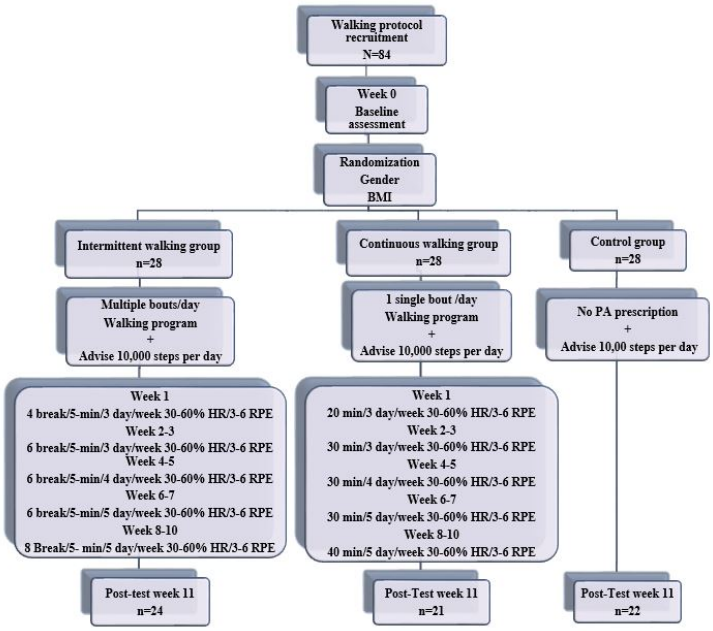

Figure 1 study design in a 10-week intervention. BMI (Body Mass Index), HR (heart rate), RPE (rated perceived exertion).

Hemoglobin A1c test

A1cNOW^{+} system was used to measure hemoglobin HbA1c. The HbA1c test is a blood test to analyze the average levels of blood glucose over a period of three months to determine diabetes development; normal range is stated below 5.7%, pre-diabetic levels range from 5.7-6.4%, and diabetes is considered when the levels of HbA1c are 6.5% or above.

When comparing the A1CNOW^{+} system to the National Glycohemoglobin Standardization Program (NGSP) certified method (National Glycohemoglobin Standardization Program), the accuracy of the A1cNOW on average is 99%, meaning that a true 7.0 % HbA1c

could be approximately 6.9 % HbA1c or 7.1% HbA1c. An individual A1CNow^{+} result may differ by as much as -1.0 % HbA1C to +0.8% HbA1C from the true result (Polymer Technology Systems). At baseline and week 11, a finger-stick was implemented to collect a small amount of blood through A1CNOW^{+} System to determine HbA1c levels. To perform the HbA1c test an A1CNOW system (Polymer Technology Systems, Inc. Indianapolis, IN) was used. A small amount of blood sample (5 microliters (µL)) was collected from a finger prick using a 28-gauge lancet (Unistick 3 comfort, Owen Mumford, Marietta, GA). Then, the sample was placed in a portable A1CNOW device (Polymer Technology Systems, Inc. Indianapolis, IN). Consisting in a sample dilution kit (to place the blood sample) a test cartridge and the A1CNOW^{+} analyzer, the cartridge is placed together with the analyzer to generate the final assessment. The results were recorded after 5 minutes.

Physical Activity measures

To measure Physical Activity behavior an Actigraph accelerometer GT3X (ActiGraph GT3X; ActiGraph Corp., Pensacola, FL) was attached on the right hip of each participant for seven days at baseline, week 6 and week 11. The device is a small trial-axial device weighing 27g and measuring 3.8 cm x 3.7 cm. x 1.8 cm. The GT3X records accelerations ranging from 0.05 to 2 g at a rate of 30 Hz in three different axes: vertical, antero-posterior, and medio-lateral (John & Freedson, 2012). Based on previous studies and best practice guidelines (Cain & Geremia, 2012; Ward et al., 2005), an epoch length of 1-minute was chosen as the standard for the current study with a sampling rate of 30 Hz. Additional criteria for analysis include a

minimum of 10 hours daily wear time and 3-5 days of monitoring. There is relative consensus of a minimum of 10 hours per day of wear time needed for sampling wake-time behavior with 3-5 days of monitoring required to achieve 80% reliability for total and moderate-to-vigorous intensity physical activity (Hart et al., 2011; Matthews et al., 2008; Trost et al., 2005). Non-wear time was identified by participants completing a daily log of wearing time and non-wear time was removed from the analysis. Previously validated cut points were used to classify accelerometer data as sedentary (<100 counts/minute), moderate (<5,999 counts/minute) and vigorous (>5,999), (Troiano et al., 2008). Light activity was defined as 500-2019 counts per minute (Tudor-Locke et al., 2009).

Statistical analysis

All analyses were performed with SPSS 23.0. To answer the research questions, a mixed design ANOVA approach was performed to examine the main effect over time and the main effect of time and group interaction. Between factors examined differences between the three groups, whereas, within factors assessed change over time. The Bonferroni Post-Hoc testing was used if a significant interaction occurred. To compare changes on specific variables, bivariate and partial correlations were performed.

Results

A total of 68 sedentary office employees randomly divided in 3 groups multiple micro-bout of walking (Age = 46±9 years old, BMI= 30.33±5.79 kg/m^2, mean±standard deviation), continuous walking (Age = 48±9 years old, BMI= 30.53±6.17 kg/m^2), and a control group (Age = 42±10 years old, BMI= 27.66±5.11 kg/m^2) completed a 10-week walking intervention according to each particular group.

Physical activity results

Accelerometer data were obtained and analyzed as time spent in sedentary, light intensity, moderate to vigorous intensity physical activity (MVPA) bouts. The figure 2 shows the average of minutes per hour spent in each of those behaviors per intervention group. Table 2 shows the Mixed ANOVA results as minutes per hour in sedentary, light, and MVPA in each intervention group.

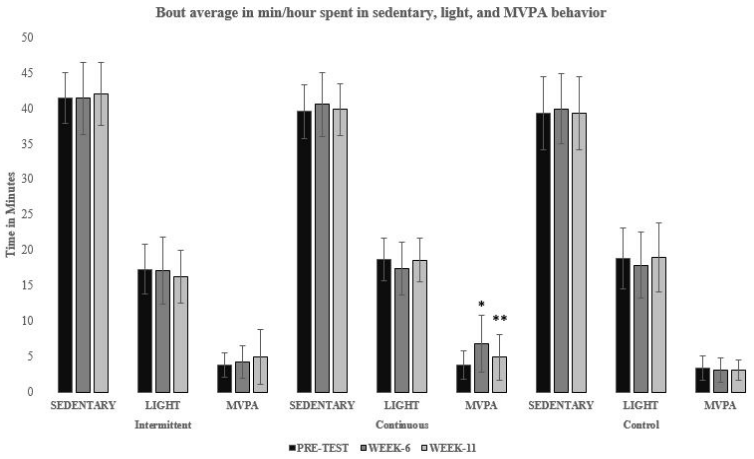

Figure 2 Average of minutes per hour spent in sedentary, light, and MVPA

**significantly different from pre-test*

***significantly different from week-6 test.*

Table 2 Results in terms of bout average in min/hour spent in sedentary, light, and MVPA behavior

		PRE-TEST	WEEK-6	POST-TEST	Main effect of group			Main effect of time			Time by group interaction			*Post-Hoc*
					F	p	n^2	F	p	n^2	F	p	n^2	p
Overall mixed ANOVA	Sedentary				1.705	0.190		0.594	0.554		0.399	0.809		
	Light				1.516	0.228		1.535	0.220		1.087	0.366		
	MVPA				4.956	0.010*	.138	5.031	0.010*	.075	5.091	0.001*	.141	
Intermittent	Sedentary	41.4±3.6	41.4±5.1	41.9±4.5										
	Light	17.3±3.5	17.1±4.7	16.3±3.7										
	MVPA	3.9±1.7	4.3±2.3	5±3.9										
Continuous	Sedentary	39.5±3.8	40.5±4.5	39.9±3.6										
	Light	18.7±3	17.4±3.7	18.6±3.1										
	MVPA	3.9±2	6.9±4.1	4.9±3.2										**
Control	Sedentary	39.3±5.2	39.9±5.2	39.2±5.2										
	Light	18.9±4.3	17.9±4.7	19±4.9										
	MVPA	3.4±1.7	3.1±1.7	3.1±1.4										

*Significantly different ($p<0.05$)

** Continuous group MVPA was significantly higher on week-6 compared to pre-test and then significantly lower at post-test compared to week-6 test ($p<0.05$).

Hemoglobin A1c results

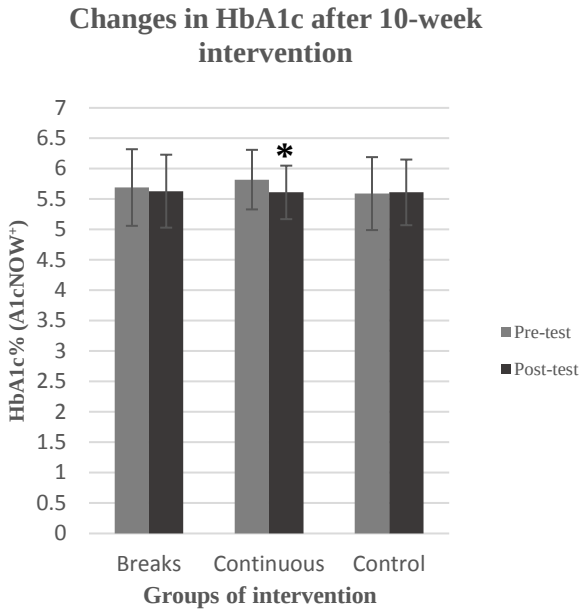

Figure 2 compares the A1cNOW+ results for the three intervention groups at pre-test and post-test.

*p<.05.

The results from the mixed-design ANOVA where two measurement points were compared across the three groups of intervention (intermittent PA, continuous PA, and control) showed that for HbA1c, there was no main effect of group (F(2,64)=0.397, p=0.674), however A1c decreased significantly from pre-test to post-test (F(1,64) =5.709, p=.020) with a medium size effect of n^2=082. There was a significant effect of time by group interaction F(2,64)=3.158, p=.049. The Bonferroni *Post-Hoc* test shows a significant reduction in HbA1c from pre-test to post-test within the continuous group (p=.005). There were no changes within the multiple break

group (p=.266) or control group (p=.661). The continuous walking group showed a significant reduction of glycated hemoglobin by 0.16% (40 to 38 mmol/mol) with a total mean change of 2.75% from pre-test to post-test. The multiple breaks group reduced HbA1c by 0.06% (39 to 38 mmol/mol) with a total mean change of 1.1% but it was not significant, and the control group increased HbA1c levels by 0.02% (38 mmol/mol) with a mean increment of 0.18%.

Table 1. HbA1c and weight values in terms of percentage of change and the association between these two variables.

	Pre-test	**Post-test**	**Mean change**	**% Change**	**r**	**p**
Overall						
HbA1c %	5.7±0.58	5.63±0.53	-0.07	-1.02±4.13	0.286	0.019*
Weight Kg	82.96±19.17	82.49±18.9	-0.47	-0.543±2.3		
Breaks						
HbA1c %	5.69±0.63	5.63±0.6	-0.06	-0.97±4.6	0.216	0.310
Weight Kg	82.97±19.22	82.48±19.6	-0.49	-0.67±2.42		
Continuous						
HbA1c %	5.82±0.5	5.66±0.44	-0.16	-2.64±3.8	0.541	0.011*
Weight Kg	88.79±21.9	87.68±20.9	-1.11	-1.1±2.1		
Control						
HbA1c %	5.59±0.6	5.60±0.54	0.01	0.47±3.4	0.004	0.978
Weight Kg	77.4±15.1	77.53±15.4	0.13	0.11±2.34		

**significantly correlated.*

The overall correlation shows a positive association between HbA1c and weight, meaning that for nearly 0.5 kg of weight loss there is a reduction on HbA1c of almost 0.1%. The continuous group showed a significant correlation as well and per each 1.11 kg of weight loss a nearly 0.2% on HbA1c reduction. There were no significant differences in body mass between groups (p>0.05) at pre-test and post-test. The mixed ANOVA showed that there was no main

effect of group on weight $F(1,63)=1.760$, p=0.180, however a significant main effect of time interaction was observed ($F(1,63)=4.502$, p=0.038) with a medium effect size ($n^2=0.067$). There was no effect of time by group interaction ($F(2,63)=2.388$, $p=.100$).

Discussion

The present study examined changes on HbA1c in sedentary employees exposed to two different walking programs during 10-week intervention, compared to a control group. The results show that people who performed a moderate intensity walking program, that comprehended a daily continuous bout of activity from 20-to-40 minutes 3 to 5 days/week during the 10-week intervention, have significant reductions on glycated hemoglobin or HbA1c, potentially reducing the risk of developing type 2 diabetes and subsequent health disorders.

Our observations have concordance with the results reported from two meta-analysis from Umpierre et al. (Snowling & Hopkins, 2006; Umpierre et al., 2011) where more than 8,000 participants were included, they found that programs that included 12 or more weeks of structured physical activity with more than 150 minutes per week were associated to significant HbA1c reductions compared to control participants. Comparing to the results from these meta-analyses, the fact that in our intervention, participants started at a low time of physical activity accumulated per week (60 minutes) provides more evidence to our findings. For our study, 150 minutes/week occurred on week 6 until a maximum of 200 minutes on weeks 8, 9 and 10.

The exercise recommendations such us time, intensity, and frequency may play a fundamental role on glucose changes throughout walking interventions to produce significant changes on HbA1c (Boule et al., 2003; Karstoft et al., 2013; Manjoo, Joseph, & Dasgupta, 2012). The way that the walking activity is accumulated may affect HbA1c changes in a different level, for example a program with only 3 workouts per week was not enough to change glycated hemoglobin in a nonrandomized trial even though they accumulated more than 150 minutes per week (Fritz, Wandell, Aberg, & Engfeldt, 2006). It is reported that the intensity of the walking is an important determinant of HbA1c changes (Boule et al., 2003; Qiu et al., 2014), in these two meta-analysis Boule et al. found exercise intensity as a predictor of HbA1c reductions, and Qiu et al. (Qiu et al., 2014) concluded that moderate intensity walking significantly decreased glycated hemoglobin compared to the control participation. The accelerometer data showed that the continuous groups reached longer bouts of moderate intensity walking which could explain changes in HbA1c in this group.

Additionally, our study was performed under free-living conditions, therefore, walking activity was not supervised and participants may have walked at lower intensities. In Qiu et al. (Qiu et al., 2014) study, they found that supervised walking programs had a better effect than non-supervised ones on HbA1c. A slow pacing of walking speed may not produce similar effects on blood glucose control (Johnson, Tudor-Locke, McCargar, & Bell, 2005). This evidence along with the physical activity results could explain why the intermittent walking group did not reach statistical significance on HbA1c, even though they were prescribed with the same amount of

time of walking activity per week. Since it could be hard for each participant to figure out how to reach moderate intensity walking just by perception, walking for longer periods could allow them to reach higher intensities than those walking just for small amounts of time such as those in our study performing intermittent walking. Short walking breaks with no supervision may be even harder in order to achieve the desired intensity when comparting to longer periods of walking, in which people have more time to improve exertion compared to the intermittent walking. The continuous walking group achieved longer bouts of moderate intensity during their walking activity compared to the intermittent walking group. This modality of walking activity may still produce positive outcomes on HbA1c, but it is likely that longer interventions with controlled or supervised walking activity are needed. To our knowledge at this instance, only acute interventions have pointed out the benefits that short bouts of physical activity, to break sedentary, have over blood glucose response (Dunstan, Kingwell, et al., 2012; Dunstan et al., 1998; Holmstrup et al., 2014; Peddie et al., 2013). There are also reported health benefits from long term interventions that included intermittent physical activity with bouts of 3x10 minutes (Murphy, Nevill, Neville, Biddle, & Hardman, 2002) or 2x15 minutes (Quinn, Klooster, & Kenefick, 2006). This fact makes valuable the approach presented in our study that involves a long-term intervention showing the potential effects of continuous walking and intermittent walking (5minutes bouts) on blood glucose response.

We found a positive association between weight change and HbA1c reductions; however, weight change was not significantly different between experimental groups and control group.

Since diet was not targeted in this intervention, we assumed that the level of physical activity in the continuous group improved muscle activation and energy expenditure in a higher degree, allowing us to see significant HbA1c reductions, independently of body mass changes. Our results are similar to Boule (et al., 2001) in which a meta-analysis of controlled trials that included T2D individuals, found changes in HbA1c related to the experimental groups that performed exercise, but when they compared body mass, the experimental groups did not have significant weight reductions compared to the control groups at post intervention. When diet and exercise where combined in the analysis, the outcome on HbA1c was similar to the effect of exercise alone, supporting the importance of regular exercise on glucose management independently of changes on body weight. This idea is also reinforced by Annessi and Johnson (Annesi & Johnson, 2013), who suggest that changes in HbA1c could be explained by the increment in moderate physical activity in contrast with body mass reductions. They conclude that, independently of weight change, increments in weekly physical activity affect positively glucose response. We observed increments in moderate intensity physical activity in the continuous group and reductions in HbA1c, which aligns with those previous results.

Based on our results and previous reports, we conclude that continuous walking activity at moderate intensity for at least 10 weeks is enough to reduce glycated hemoglobin percentages in adult sedentary employees. Since breaking sedentary time is a major concern to reduce health impairment risks, intermittent walking activity may have some incidence reducing HbA1c levels, however our conclusion supports the statement that this is an unknown field that needs to be

explored to identify the certain prescription to promote intermittent physical activity as a mediator to reduce HbA1c levels and reduce the risk of developing T2D on sedentary population.

Limitations

We did not test for hemoglobin levels to compare with A1cNOW results but previous validations have been performed. With high levels of hemoglobin, the A1cNOW may report incorrect results. We did not test participants for any other blood related disease (e.g. hemolytic anemia or other hemolytic disease, blood loss) that may change HbA1c levels and produce inaccurate readings.

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V. FINAL CONCLUSIONS

The purpose of this intervention was to determine which walking prescription would affect psychological and physiological variables for sedentary office employees. Our findings showed that a continuous walking prescription was advantageous for variables such as self-regulation, moderate physical activity at 6-weeks and HbA1c. Whereas, an intermittent walking prescription was more beneficial for increases in lean mass. In addition, wearing a fitness tracker was effective for changes in physical activity in the short term, but not enough to overcome environmental barriers.

Whereas the intermittent walking group had fewer significant changes during the intervention. Improvements on body composition with higher changes on lean mass and fat free mass, also a significant change was found on relapse prevention for self-regulation. It is likely that intermittent physical activity generates a more difficult challenge for sedentary office employees and this interfered with motivation and cognitive control to overcome barriers, generating the questioning of whether intermittent physical activity to meet daily recommendations is applicable to the conditions in which this specific population behave on their quotidian tasks. There were no significant changes on sedentary behavior for all conditions and this may be related to the fact that self-efficacy was reduced significantly.

According to anecdotal information provided by our participants, they struggled to meet the program prescription at the end of the intervention and cited season holidays, augmented job

tasks due to the approaching end of the year, and the colder weather conditions in this specific time of the year. These are barriers that could have produced an uncontrolled negative effect on individuals' physical activity generating also the feel of being incapable of accomplishing the prescribed level of daily physical activity. The idea of lower level of confidence to be more active can be aligned with our results that show no significant changes in sedentary behavior or a more active life-style at the post-test. As a normal behavior, during the ending season of the year, people are more inactive (Tucker & Gilliland, 2007) and the particular colder weather during this time of the year negatively affect people's physical activity behavior (Ma et al., 2006; Merrill et al., 2005).

When referring to the control group, the fact that they were given with an accelerometer MOVband and were told about meeting 10,000 steps, affected their level of physical activity, motivating them to move more. This unexpected effect, further produced significant changes on body composition parameters. These findings were unanticipated and future research should be necessary to explain the unique effect that monitoring physical activity using wrist bands produce independently of physical activity prescription. Since diet was not controlled, participants could likely modify eating behavior and that plus a more physically active behavior also may have affected body composition.

Based on our findings, we conclude that for sedentary employees, continuous walking activity is a more feasible prescription to improve psychological and physiological variables that

could reduce the risk of developing a hypokinetic disease and improve overall health. However, based on the results of this study, intermittent physical activity is still a good option for physical activity recommendations, it shows important outcomes that can account for general health control as well, yet, more controlled research must be performed in future trials to consider long-term interventions with multiple breaks of walking as a practicable physical activity prescription for sedentary employees. It is also important to consider the impact that physical activity trackers, such us step counters, have on physical activity in sedentary employees. This small device may produce enough motivation to get people involved in a more physically active behavior, however, intervention is required to overcome environmental barriers.

Limitations

We did not control for heart rate during the walking activity, participants were told to reach between 4 and 6 from the rate of perception scale, which can lead to underrate the physiologic response of a brisk walking. It could be possible that some individuals did not reach the 40 to 60 percent of reserve heart rate.

Diet was not controlled or targeted, however the two experimental groups received advice on modifying lifestyle. Hence, it is likely that participants were more aware of their currently behavior and could modify their currently eating conducts, reflecting some changes in body composition for example.

Sedentary office employees only constituted the sample; therefore, the results cannot be applicable to the entire sedentary population.

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APPENDICES

Appendix A: IRB Protocol

AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMAN SUBJECTS
RESEARCH PROTOCOL REVIEW FORM
FULL BOARD or EXPEDITED

For Information or help contact **THE OFFICE OF RESEARCH COMPLIANCE (ORC),** 115 Ramsay Hall, Auburn University
Phone: 334-844-5966 **e-mail:** IRBAdmin@auburn.edu **Web Address:** http://www.auburn.edu/research/vpr/ohs/index.htm

Revised 2.1.2014 **Submit completed form to IRBsubmit@auburn.edu or 115 Ramsay Hall, Auburn University 36849.**

Form must be populated using Adobe Acrobat / Pro 9 or greater standalone program (do not fill out in browser). Hand written forms will not be accepted.

1. PROPOSED START DATE of STUDY: 09-06-2016

PROPOSED REVIEW CATEGORY (Check one): ☐ **FULL BOARD** ☑ **EXPEDITED**

SUBMISSION STATUS (Check one): ☑ **NEW** ☐ **REVISIONS (to address IRB Review Comments)**

2. PROJECT TITLE: Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 12-week intervention.

Mynor G. Rodriguez	Doctoral Candidate	Kinesiology	mgr0018@auburn.edu
PRINCIPAL INVESTIGATOR	**TITLE**	**DEPT**	**AU E-MAIL**
301 Wire Road, Auburn University, 36849	334-275-5394		mynorgrh@gmail.com
MAILING ADDRESS	**PHONE**		**ALTERNATE E-MAIL**

4. FUNDING SUPPORT: ☑ N/A ☐ Internal ☐ External Agency: _____ ☐ Pending ☐ Received

For federal funding, list agency and grant number (if available). _____

5a. List any contractors, sub-contractors, other entities associated with this project:

b. List any other IRBs associated with this project (including Reviewed, Deferred, Determination, etc.):

PROTOCOL PACKET CHECKLIST

All protocols must include the following items:

- ☑ Research Protocol Review Form (All signatures included and all sections completed)
  (Examples of appended documents are found on the OHSR website: http://www.auburn.edu/research/vpr/ohs/sample.htm)
- ☑ CITI Training Certificates for all Key Personnel.
- ☑ Consent Form or Information Letter and any Releases (audio, video or photo) that the participant will sign.
- ☐ Appendix A, "Reference List"
- ☑ Appendix B if e-mails, flyers, advertisements, generalized announcements or scripts, etc., are used to recruit participants.
- ☑ Appendix C if data collection sheets, surveys, tests, other recording instruments, interview scripts, etc. will be used for data collection. Be sure to attach them in the order in which they are listed in # 13c.
- ☐ Appendix D if you will be using a debriefing form or include emergency plans/procedures and medical referral lists (A referral list may be attached to the consent document).
- ☐ Appendix E if research is being conducted at sites other than Auburn University or in cooperation with other entities. A permission letter from the site / program director must be included indicating their cooperation or involvement in the project. NOTE: If the proposed research is a multi-site project, involving investigators or participants at other academic institutions, hospitals or private research organizations, a letter of IRB approval from each entity is required prior to initiating the project.
- ☐ Appendix F - Written evidence of acceptance by the host country if research is conducted outside the United States.

FOR ORC OFFICE USE ONLY

DATE RECEIVED IN ORC: _____ **by** _____ **PROTOCOL #**
DATE OF IRB REVIEW: _____ **by** _____ **APPROVAL CATEGO**
DATE OF IRB APPROVAL: _____ **by** _____ **INTERV**
COMMENTS:

The Auburn University Institutional Review Board has approved this Document for use from
09/07/2016 to 08/23/2017
Protocol # 16-272 MR 1608

6. GENERAL RESEARCH PROJECT CHARACTERISTICS

6A. Research Methodology

Please check all descriptors that best apply to the research methodology.

Data Source(s): ☑ New Data ☐ Existing Data

Will recorded data directly or indirectly identify participants?
✔ Yes ☐ No

Data collection will involve the use of:

- ☐ Educational Tests (cognitive diagnostic, aptitude, etc.)
- ✔ Interview
- ☐ Observation
- ✔ Location or Tracking Measures
- ✔ Physical / Physiological Measures or Specimens (see Section 6E.)
- ✔ Surveys / Questionnaires
- ✔ Internet / Electronic
- ☐ Audio
- ☐ Video
- ☐ Photos
- ☐ Digital images
- ☐ Private records or files

Other: _____

6B. Participant Information

Please check all descriptors that apply to the target population.
☑ Males ☑ Females ☐ AU students

Vulnerable Populations
☐ Pregnant Women/Fetuses ☐ Prisoners ☐ Institutionalized
Children and/or Adolescents (under age 19 in AL)

Persons with:
☐ Economic Disadvantages ☐ Physical Disabilities
☐ Educational Disadvantages ☐ Intellectual Disabilities

Do you plan to compensate your participants? ☐ Yes ☑ No

6C. Risks to Participants

Please identify all risks that participants might encounter in this research.

- ☑ Breach of Confidentiality*
- ☐ Deception
- ☑ Psychological
- ☐ None
- ☐ Coercion
- ☑ Physical
- ☐ Social

Other:

*Note that if the investigator is using or accessing confidential or identifiable data, breach of confidentiality is always a risk.

6D. Corresponding Approval/Oversight

- Do you need IBC Approval for this study?
  ☐ Yes ☑ No

  If yes, BUA #_____ Expiration date_____

- Do you need IACUC Approval for this study?
  ☐ Yes ☑ No

  If yes, PRN #_____ Expiration date _____

- Does this study involve the Auburn University MRI Center?
  ☐ Yes ☑ No

  Which MRI(s) will be used for this project? (Check all that apply)
  ☐ 3T ☐ 7T

  Does any portion of this project require review by the MRI Safety Advisory Council?
  ☐ Yes ☑ No

  Signature of MRI Center Representative: _____
  Required for all projects involving the AU MRI Center

  Appropriate MRI Center Representatives:
  Dr. Thomas S. Denney, Director AU MRI Center
  Dr. Ron Beyers, MR Safety Officer

7. PROJECT ASSURANCES Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 12-week intervention.

A. PRINCIPAL INVESTIGATOR'S ASSSURANCES

1. I certify that all information provided in this application is complete and correct.
2. I understand that, as Principal Investigator, I have ultimate responsibility for the conduct of this study, the ethical performance this project, the protection of the rights and welfare of human subjects, and strict adherence to any stipulations imposed by the Auburn University IRB.
3. I certify that all individuals involved with the conduct of this project are qualified to carry out their specified roles and responsibilities and are in compliance with Auburn University policies regarding the collection and analysis of the research data.
4. I agree to comply with all Auburn policies and procedures, as well as with all applicable federal, state, and local laws regarding the protection of human subjects, including, but not limited to the following:
    a. Conducting the project by qualified personnel according to the approved protocol
    b. Implementing no changes in the approved protocol or consent form without prior approval from the Office of Research Compliance
    c. Obtaining the legally effective informed consent from each participant or their legally responsible representative prior to their participation in this project using only the currently approved, stamped consent form
    d. Promptly reporting significant adverse events and/or effects to the Office of Research Compliance in writing within 5 working days of the occurrence.
5. If I will be unavailable to direct this research personally, I will arrange for a co-investigator to assume direct responsibility in my absence. This person has been named as co-investigator in this application, or I will advise ORC, by letter, in advance of such arrangements.
6. I agree to conduct this study only during the period approved by the Auburn University IRB.
7. I will prepare and submit a renewal request and supply all supporting documents to the Office of Research Compliance before the approval period has expired if it is necessary to continue the research project beyond the time period approved by the Auburn University IRB.
8. I will prepare and submit a final report upon completion of this research project.

My signature indicates that I have read, understand and agree to conduct this research project in accordance with the assurances listed above.

Mynor G. Rodriguez		
Printed name of Principal Investigator	**Principal Investigator's Signature**	**Date**

B. FACULTY ADVISOR/SPONSOR'S ASSURANCES

1. I have read the protocol submitted for this project for content, clarity, and methodology.
2. By my signature as faculty advisor/sponsor on this research application, I certify that the student or guest investigator is knowledgeable about the regulations and policies governing research with human subjects and has sufficient training and experience to conduct this particular study in accord with the approved protocol.
3. I agree to meet with the investigator on a regular basis to monitor study progress. Should problems arise during the course of the study, I agree to be available, personally, to supervise the investigator in solving them.
4. I assure that the investigator will promptly report significant incidents and/or adverse events and/or effects to the ORC in writing within 5 working days of the occurrence.
5. If I will be unavailable, I will arrange for an alternate faculty sponsor to assume responsibility during my absence, and I will advise the ORC by letter of such arrangements. If the investigator is unable to fulfill requirements for submission of renewals, modifications or the final report, I will assume that responsibility.

Danielle Wadsworth		
Printed name of Faculty Advisor / Sponsor	**Faculty Advisor's Signature**	**Date**

C. DEPARTMENT HEAD'S ASSSURANCE

By my signature as department head, I certify that I will cooperate with the administration in the application and enforcement of all Auburn University policies and procedures, as well as all applicable federal, state, and local laws regarding the protection and ethical treatment of human participants by researchers in my department.

Mary Rudisill		
Printed name of Department Head	**Department Head's Signature**	**Date**

8. PROJECT OVERVIEW: Prepare an abstract that includes:
(350 word maximum, in language understandable to someone who is not familiar with your area of study**):**

a) A summary of relevant research findings leading to this research proposal:
(*Cite sources; include a "Reference List" as* ***Appendix A.)***
b) A brief description of the methodology, including design, population, and variables of interest

Sedentary behavior is emerging as a risk factor for hypokinetic diseases independent of participation in regular exercise. Breaks in sedentary behavior such as short durations of walking or exercise has demonstrated positive changes in physiological variables during short duration interventions. The proposed design will aim to determine the effect of two different walking programs (intermittent vs. single bout) on physiological and psychological parameters in 75 physically inactive adults.

I. 75 female and male participants between 25-60 years old will be recruited to participate in this study. Qualified and consenting participants will then complete baseline data assessments in their first visit to the labs. The initial evaluation will include: Weight, height, iDEXA, VO2max (aerobic fitness), and demographics. Participants will complete a series of questionnaires that assess self-regulation, self-efficacy, and fatigue. After completion of questionnaires, a finger prick will be performed to analyze Hemoglobin A1c (HbA1c) levels. They will also wear an Accelerometer for 7 days. Based on gender and body composition, participants will then be randomly assigned to one of the 3 groups to complete one the following conditions over the course of 12 weeks: 1) Intermittent physical activity based on micro-bouts of 5 minutes walking at light to moderate intensity during given days, 2) Continuous physical activity based on a single bout of walking at light to moderate intensity on a given day and 3) wait list control group who will have the option to perform one or the other program after the initial 12 weeks. At 24 weeks all three groups will return to the lab to complete baseline measures again.
II. The following variables will be measured: Weight, Height, age, body composition, HbA1c, VO2max, exercise adherence, physical activity/sedentary behavior, self regulation, self-efficacy, and fatigue.
III. The hypothesis is that participants will respond better to intermittent breaks of exercise at a light to moderate intensity in terms of physiological and psychological variables.
IV. The results of this experiment will have direct application on people who work in fields which require minimum effort and highly related to sedentary behavior.
V. The study includes a 24-week program: 12-week physical activity program and then a follow up phase of another 12 weeks. Each participant will come to the School of Kinesiology labs for a total of 6 times. The first time will be the baseline followed by the orientation session one week later. Then at week 5, week 9, week 13, and week 24 for the final assessment.
VI. This study is based on free-living conditions, therefore, participants will be asked to work on your own environment. Meaning that the exercise sessions will be perform on their own time and space, they do not have to come to the lab for each session.

9. PURPOSE.
a. Clearly state the purpose of this project and all research questions, or aims.

To examine the effect of two different exercise programs on exercise adherence, self-regulation, self-efficacy, fatigue, physical activity/sedentary behavior, VO2, HbA1c, and body composition in previously sedentary individuals during a 12-week intervention and retention phase, 12 weeks after completing the intervention.

b. How will the results of this project be used? (e.g., Presentation? Publication? Thesis? Dissertation?)

This is a dissertation study, that will lead to presentations and publications

10. KEY PERSONNEL. Describe responsibilities. Include information on research training or certifications related to this project. CITI is required. Be as specific as possible. (Include additional personnel in an attachment.) *All key personnel must attach CITI certificates of completion.*

Principle Investigator Mynor G. Rodriguez Title: Doctoral Candidate E-mail address mgr0018@auburn.edu

Dept / Affiliation: Kinesiology

Roles / Responsibilities:

3ULQFLSDO LQYHVWLJDWRU VWXG\ GHVLJQ SURMHFW GHYHORSPHQW SDUWLFLSDQW UHFUXLWPHQW KDQGOH WKH FRQVHQW SURFHVV DQG FRQVHQW IRUPV SDUWLFLSDQW VFUHHQLQJ GDWD FROOHFWLRQ GDWD UHYLHZ

Individual: Title: Professor E-mail address wadswdd@auburn.edu

Dept / Affiliation: School of Kinesiology

Roles / Responsibilities:

Project oversite; participant recruitment, handle the consent process and consent forms, participant screening, data collection, data review/analysis,data interpretation, overall project oversite of the study.
Danielle wadsworth has completed 1) CITI training, 2) CPR

Individual: Title: E-mail address

Dept / Affiliation:

Roles / Responsibilities:

Individual: Title: E-mail address

Dept / Affiliation:

Roles / Responsibilities:

Individual: Title: E-mail address

Dept / Affiliation:

Roles / Responsibilities:

Individual: Title: E-mail address

Dept / Affiliation:

Roles / Responsibilities:

11. LOCATION OF RESEARCH. List all locations where data collection will take place. (School systems, organizations, businesses, buildings and room numbers, servers for web surveys, etc.) Be as specific as possible. Attach permission letters in Appendix E.
(See sample letters at http://www.auburn.edu/research/vpr/ohs/sample.htm)

301 Wire Road, Kinesiology Building: Epidemiology Lab (Room 144), Prevention and performance Lab (Room 146), Fitness optimization Lab (142), TigerFit Lab (Room 126), iDEXA (Room 125)

12. PARTICIPANTS.

a. Describe the participant population you have chosen for this project including inclusion or exclusion criteria for participant selection.

☐ Check here if using existing data, describe the population from whom data was collected, & include the # of data files.

1) Male and female between the ages of 25-60 who are currently employed
2) Level of daily activity mostly sedentary (more than 50% time sitting at work)
3) Sedentary. Do not meet the recommendations for physical activity. At least 3 times per week 30 or more minutes at moderate to vigorous intensity for the past 6 months.
4) Low risk for medical complications as determined by the Physical Activity Readiness Questionnaire (PARQ) and not pregnant.
5) Cannot be pregnant.
6) Able to complete a walking program. Walking from 20 minutes at the beginning to 40 minutes at the end of the program.
7) Agree to commit the study
8) Have access to a computer and internet connection.

b. Describe, step-by-step, in layman's terms, all procedures you will use to recruit participants. *Include in Appendix B a copy of all e-mails, flyers, advertisements, recruiting scripts, invitations, etc., that will be used to invite people to participate. (See sample documents at http://www.auburn.edu/research/vpr/ohs/sample.htm.)*

Participants will be recruited by word of mouth, e-mail, flyers, and sending a total of 5 social network blasts from the Auburn Community. The script will provide a brief overview of the study with all details provided with review of the informed consent. See Appendix B. No deceptive language will be used in recruiting participants, and any potential question regarding the study will be honestly answered to the best of our ability.

c. What is the minimum number of participants you need to validate the study? 75

How many participants do you expect to recruit? 100

Is there a limit on the number of participants you will include in the study? ☑ No ☐ Yes – the # is _____

d. Describe the type, amount and method of compensation and/or incentives for participants.

(If no compensation will be given, check here: ☐)

Select the type of compensation: ☐ Monetary ☐ Incentives

☐ Raffle or Drawing incentive (Include the chances of winning.)
☐ Extra Credit (State the value)
☑ Other

Description:

3DUWLFLSDQWV ZLOO UHFHLYH WKLHU SHUVRQDO LQIRUPDWLRQ IURP WKH VWXG\ ZKLFK LQFOXGHV '(;$ VFDQV DQDO\VLV +E$ F DQG RYHUDOO UHVXOWV RI WKHLU SDUWLFLSDWLRQ O\QRU 5RGULJXH] DQG 'U :DGZRUWK ZLOO EH LQ FKDUJH RI H[SODLQLQJ DOO RYHUDOO VWXG\ UHVXOWV WR HDFK SDUWLFLSDQW IRU WKH UHJXODU ZHHN LQWHUYHQWLRQ DQG WKH IRU WKH IROORZ XS SKDVH LQFOXGLQJ $ &DQG '(;$ UHVXOWV

13. PROJECT DESIGN & METHODS.

a. Describe, step-by-step, all procedures and methods that will be used to consent participants. If a waiver is being requested, check each waiver you are requesting, describe how the project meets the criteria for the waiver.

☐ Waiver of Consent (including using existing data)

☐ Waiver of Documentation of Consent (use of Information Letter)

☐ Waiver of Parental Permission (for college students)

Before any testing, familiarization, or data collection, potential participants will be provided with the approved informed consent document and have any of their questions answered by the principal investigator Mynor Rodriguez or Dr. Danielle Wadsworth. If the potential participant decides to volunteer for the study, she/he will be asked to sign the informed consent and then complete the PAR-Q as a screening tool. Recruits who do not meet the study inclusion criteria will have their PAR-Q and informed consent returned to them and will be not allowed to participate in the study. Participants with self-reported medical issues, potential drug interactions with testing variables, or PAR-Q answers indicating an increased risk associated with physical activity will be dismissed. Potential participants will also not be allowed to participate in the study if they are currently engaging in enough physical activity to meet exercise recommendations. If the participant does not meet the inclusion criteria, the PAR-Q will be returned upon dismissal. If after explaining the requirements to the study, the participant does not agree to commit, the participant is not allowed to participate in the project, if they do not meet this inclusion criteria the PAR-Q is returned upon dismissal. If the particpant is pregnant she will not participate in the study.

b. Describe the research design and methods you will use to address your purpose. Include a clear description of when, where and how you will collect all data for this project. Include specific information about the participants' time and effort commitment. (*NOTE: Use language that would be understandable to someone who is not familiar with your area of study. Without a complete description of all procedures, the Auburn University IRB will not be able to review this protocol. If additional space is needed for this section, save the information as a .PDF file and insert after page 7 of this form.*)

The mixed design research includes the baseline/orientation phase,12 weeks of intervention, the post-test, and a follow up test that will performed on week 24 when they return for the retention evaluation. For the baseline, participants arrive to the Epidemiology & Obesity Prevention Lab, School of Kinesiology, consenting procedures described in 13a will occur during the orientation day and basic demographic data will be collected (height, weight, age, and race). Participants will complete all 3 questionnaires for Self-regulation, Self-Efficacy, and Fatigue. Immediately, a fingerstick will be performed to collect a small amount of blood (5 microliters (µL)) through A1CNOW System to determine HbA1c levels. For this test participants will come to the lab with at least 3 hours of fasting, then a finger prick will be performed to collect 5 microliters (µL) of blood and the sample immediately will be analyzed using the A1CNOW System to dertermine HbA1C levels. After that, body composition will be assessed with an iDXA total body scan. Then the aerobic fitness through VO2 assessment is determined, on this, participants will perform a Bruce Protocol. During this test, the participant will walk/jog using determined speeds and inclines (appendix), as well identify on a scale of 1 to 10 the level of exertion and continue the test until maximum fatigue tolerance. Participants will be given a 3 days food log to be completed. Participants will be provided with an accelerometer to be worn around their waist with an elastic band to measure physical activity and obtain information about exercise adherence. Participants will return to the lab 7 days later and will be given a MovBand a wrist-worn activity monitor that measures daily physical activity as steps taken per day for the entire 12 weeks intervention. Immediately after completion of the baseline participants will be randomly assigned based on gender and BMI to one of the three groups: 1) Intermittent Physical Activity, 2) Continuous Physical Activity, and 3) Control Group.

1) Intermittent PA: 20-40 minutes of light to moderate walking activity broken up into four to seven bouts of five minutes. Participants will start with 4 breaks of 5 minutes each three days per week during the first 2 weeks. This will be performed at a light to moderate intensity or heart rate (HR) between 30-60% of maximum predicted heart rate and/or 3-6 on the Rate of Perceived Exertion (RPE) scale. After the first two weeks frequency and intensity of the breaks will increase biweekly until the number of breaks per day equals 40 minutes (8 breaks X 5 minutes each) and a moderate intensity (40-60% HR or 4-6 RPE).The program will also aim to establish self-regulation skills and enhance self-efficacy via mobile health facilitation.

Continued on Attached Sheet.

13. PROJECT DESIGN & METHODS. *Continued*

c. List all data collection instruments used in this project, in the order they appear in Appendix C.
(e.g., surveys and questionnaires in the format that will be presented to participants, educational tests, data collection sheets, interview questions, audio/video taping methods etc.)

Informed consent
PAR-Q screening
iDEXA for body composition
GSE 550 Scale for weight and hight
Woodway treadmill to analyze VO2
A1CNOW System for HbA1C
Accelerometer to measure physical activity
Questionnaires for demographics, physical activity, self-regulation, self-efficacy, and fatigue.
MovBand for the entire intervention.
Semi-strutured interview

d. Data analysis: Explain how the data will be analyzed.

Using an Analysis of Covariance (ANCOVA), a general linear model that blends ANOVA and linear regression. A regression for physiological variables will be performed to see specific changes on those elements. A Post-Hoc analysis will determine where the changes occur.

14. RISKS & DISCOMFORTS: List and describe all of the risks that participants might encounter in this research. *If you are using deception in this study, please justify the use of deception and be sure to attach a copy of the debriefing form you plan to use in Appendix D. (Examples of possible risks are in section #6D on page 2)*

1. The most extreme potential risk during the high intensity exercise even for short periods of time in this research is death. However, the American College of Sports and Medicine cites a survey that determined the risk of death to be 0.5 per 10,000 individuals, with the risk among healthy individuals, such as in this study, to be even lower. Other risks of exercise include nausea, fainting, dehydration, dizziness, muscle strain/pull, heart arrhythmia, and abnormal blood pressure response.

2. Muscle soreness is a possibility during the moderate intensity condition; this risk is greater among sedentary people.

3. Collecting blood samples. There is minimal risk associated with drawing blood from a finger prick. The risks include pain at the site of puncture; possible bruising and swelling around the injection site; rarely an infection; and, uncommonly, faintness from the procedure. This risk will be minimized by the use of sterile conditions during the procedure.

4. A small amount of radiation from iDEXA scan.

5. Since we will be using human subjects and will not be collecting data anonymously, breach of confidentially is always a risk.

15. PRECAUTIONS. Identify and describe all precautions you have taken to eliminate or reduce risks as listed in #14. If the participants can be classified as a "vulnerable" population, please describe additional safeguards that you will use to assure the ethical treatment of these individuals. ***Provide a copy of any emergency plans/procedures and medical referral lists in Appendix D. (Samples can be found online at http://www.auburn.edu/research/vpr/ohs/sample.htm#precautions)***

1. Some of the testing sessions in this research will be composed of short periods of moderate intensity exercise which may be uncomfortable. However, each trial will be conducted in a controlled laboratory setting, and monitored by CPR certified researchers. Heart rate will be measured during the VO2max as is standard protocol to ensure a linear increase with exercise intensity. Also, our pre-screening via PAR-Q will reduce the risk of injury during exercise.

2. All methods of data collection are commonplace in the exercise science literature and in Dr. Wadsworth's Lab. Participants will be screened for the health factors that would increase the risk associated with exercise. Participants will be able to freely terminate any test session whenever they wish.
3. All finger pricks will be taken by a trained and certified phlebotomist using aseptic technique to reduce the risk associated with collecting small blood samples.
4. Even though data will not be collected anonymously, it will be recorded anonymously, with the code list linking the participants kept confidential in a locked filling cabinet until the end of the study when it will be destroyed.

If using the Internet or other electronic means to collect data, what confidentiality or security precautions are in place to protect (or not collect) identifiable data? Include protections used during both the collection and transfer of data.

All devices used will be initialized and a specific code per every participant will be set.

16. BENEFITS.
    a. List all realistic direct benefits participants can expect by participating in this specific study.
    (Do not include "compensation" listed in #12d.) Check here if there are no direct benefits to participants. ☐

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    b. List all realistic benefits for the general population that may be generated from this study.

7KH UHVXOWV PD\ SURYLGH LQIRUPDWLRQ RQ KRZ D ORQJ WHUP LQWHUYHQWLRQ PD\ SURPRWH SURSHU KHDOWK LQ UHJDUG VHGHQWDU\ EHKDYLRU DQG H[HUFLVH DGKHUHQFH 5HVXOWV PD\ DOVR VKRZ WKH EHQHILWV LQ WHUPV RI LPSURYHPHQWV RQ DHURELF ILWQHVV ERG\ FRPSRVLWLRQ +E$ & VHOI UHJXODWRU\ VNLOOV VHOI HIILFDF\ DQG UHGXFWLRQ RQ SHUFHLYHG IDWLJXH

17. PROTECTION OF DATA.

a. Data are collected:

☐ Anonymously with no direct or indirect coding, link, or awareness of who participated in the study (Skip to e)

☐ Confidentially, but without a link of participant's data to any identifying information (collected as "confidential" but recorded and analyzed as "anonymous") (Skip to e)

☑ Confidentially with collection and protection of linkages to identifiable information

b. If data are collected with identifiers or as coded or linked to identifying information, describe the identifiers collected and how they are linked to the participant's data.

A code list will be generated and associated with the participants' data. After data collection and collation, the master list linking participant to numbered data will be destroyed.

c. Justify your need to code participants' data or link the data with identifying information.

Identification of participants is necessary to link information from the three conditions.

d. Describe how and where identifying data and/or code lists will be stored. (Building, room number?) Describe how the location where data is stored will be secured in your absence. For electronic data, describe security. If applicable, state specifically where any IRB-approved and participant-signed consent documents will be kept on campus for 3 years after the study ends.

$Q HOHFWURQLF FRS\ RI WKH FRGHG OLVW ZLOO EH VWRUHG DW WKH .LQHVLRORJ\ %XLOGLQJ RQ D SDVVZRUG SURWHFWHG GHVNWRS LQ O\QRU 5RGULJXH] RIILFH .LQHVLRORJ\ %XLOGLQJ # :LUH 5RDG 7KH RIILFH UHPDLQV ORFNHG ZKHQ QRW LQ XVH

e. Describe how and where the data will be stored (e.g., hard copy, audio cassette, electronic data, etc.), and how the location where data is stored is separated from identifying data and will be secured in your absence. For electronic data, describe security

+DUG FRSLHV RI WKH FRQVHQW IRUPV DQG GDWD ZLOO EH VWRUHG DW WKH .LQHVLRORJ\ %XLOGLQJ LQ D ORFNHG FDELQHW LQ O\QRU 5RGULJXH] RIILFH # :LUH 5RDG 7KH RIILFH UHPDLQV ORFNHG ZKHQ QRW LQ XVH (OHFWURQLF GDWD ZLOO EH VWRUHG RQ O\QRU 5RGULJXH] GHVN FRSXWHU PDLQWDLQHG E\ WKH $XEXUQ 2IILFH RI ,QIRUPDWLRQ 7HFKQRORJ\ LQ URRP .,1(EXLOGLQJ $ EDFN XS FRS\ RI WKH GDWD ZLOO EH VWRUHG RQ D IODVK GULYH DOVR ORFDWHG LQ WKH .LQHVLRORJ\ %XLOGLQJ URRP .,1(7KLV URRP UHPDLQV ORFNHG ZKHQ QRW LQ XVH

f. Who will have access to participants' data?
(*The faculty advisor should have full access and be able to produce the data in the case of a federal or institutional audit.*)

Only the research personnel identified in this IRB will have access to the data. Mynor Rodriguez and Danielle Wadsworth will be the only people with full access to the master code list.

g. When is the latest date that identifying information or links will be retained and how will that information or links be destroyed?
(Check here if only anonymous data will be retained ☐)

The informed consent will be kept for three years (as required). The master list will be destroyed once all data have been collected and collated. The master list linking participants to study number will be shredded. Informed consent will be shredded 3 years after the completion of the study.

AUBURN UNIVERSITY
COLLEGE OF EDUCATION
School of Kinesiology

Informed Consent for a Research Study Entitled

"Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 12-week intervention."

Project Overview: You are invited to participate in a research study that will examine the effect of two different exercise programs on physiological and psychological variables. We are recruiting participants to complete a 12-week intervention. There are 3 groups: 2 groups will perform 2 different exercise programs and one group will serve as the control group. You will be randomly assigned to one of these conditions: intermittent physical activity, continuous physical activity, and control group.

Purpose: The purpose of this study is to examine the effect of two different exercise programs on exercise adherence, self-regulation, self-efficacy, fatigue, physical activity/sedentary behavior, VO2, Hemoglobin A1c (HbA1c), and body composition in previously sedentary individuals during a 12-week intervention and retention phase, 12 weeks after completing the intervention.

Participation Requirements: To be eligible, you must be:

1) Male and female between the ages of 25-60 who are employed.

2) Level of daily activity mostly sedentary (more than 50% time sitting at work)

3) Sedentary. Do not meet the recommendations for physical activity. At least 3 times per week 30 or more minutes at moderate to vigorous intensity for the past 6 months.

4) Low risk for medical complications as determined by the Physical Activity Readiness Questionnaire (PARQ; must answer "no" to all questions)

5) Cannot be pregnant.

6) Able to complete a walking program (approximately 20-40 minutes)

7) Agree to commit the study.

8) Have access to a computer and internet connection.

You must meet all of the requirements to be eligible for participation in this study.

301 Wire Rd., Auburn, AL 36849-5323; Telephone: 334-844-4483; Fax: 334-844-1467

www.auburn.edu

What will be involved if you participate? If you decide to participate in this research study, you will be asked to make the agreement to participate in a 24-week program. You will come to the School of Kinesiology labs for a total of 6 times. The first time will be the baseline followed by the orientation session one week later. Then at week 5, week 9, week 13, and week 24 for the final assessment. This study is based on free-living conditions, therefore, you will be asked to work on your own environment. Meaning that the exercise sessions will be performed on your own time and space, you do not have to come to the lab for each session. The exercise program is performed on your own, so you are asked to dedicate 20-40 minutes, 3-5 times per week for 12 weeks.

Orientation/baseline Session – During the orientation/baseline session you will complete the consent documents, the PAR-Q medical screening (question based to answer yes/no to the stated medical conditions) and demographic measures. You will also complete an iDEXA scan (Dual-energy X-ray Absorptiometry) which measures body composition and an aerobic test on the treadmill. Also, you need to complete few questionnaires and a finger prick performed to obtain a small amount of blood. A finger prick will be performed to collect a small amount of blood (5 microliters (µL)) through A1CNOW System to determine HbA1c (glycated hemoglobin) levels. This is an indication of how your body processes glucose. Dr. Wadsworth or Mynor Rodriquez will be present for all consenting procedures. If ineligible for participation for any reason (participation requirements or PAR-Q) all forms will be returned to the subject and no record will be kept by the researchers. Descriptive data will be obtained [age, height, weight, waist, physical activity level, and iDEXA (body composition)]. To assess your VO_{2max} (maximum oxygen consumption or aerobic capacity), you will also be orientated to the treadmill. You will be asked to walk/jog on the treadmill to test your aerobic capacity and to get familiar with the Rating Perceived Exertion scale (RPE). You will be asked to walk/jog to your Maximum Fatigue Tolerance. We will also give you an accelerometer to be worn around your waist to measure your physical activity. You will wear the accelerometer during the baseline week, then on week 5, week 9, week 13, and finally when you come back at week 24 for the retention evaluation.

One week later you will return to the lab and be assigned to one of the 3 groups, based on your BMI and gender, and will be given specifics on the physical activity program. 1) Intermittent PA: 20-40 minutes of light to moderate walking activity broken up into four to eight bouts of five minutes. Participants will start with 4 breaks of 5 minutes each three days per week during the first 2 weeks. This will be performed at a light to moderate intensity or heart rate (HR) between 30-60% of maximum predicted heart rate and/or 3-6 on the Rate of Perceived Exertion (RPE) scale. After the first two weeks frequency and intensity of the breaks will increase biweekly until the number of breaks per day equals 40 minutes (8 breaks X 5 minutes each) and a moderate intensity (40-60% HR or 4-6 RPE).The program will also aim to establish self-regulation skills and enhance self-efficacy via mobile health facilitation. 2) Continuous PA: 20-40 minutes single bout of walking activity at light to moderate intensity. Participants will start with 20 minutes of continuous walking three days per week during the first 2 weeks at light to moderate intensity or heart rate (HR) between 30-60% of maximum predicted heart rate or 3-6 on the RPE scale. Then applying the FITT-VP principles, biweekly adjustments will increase the time per day until 40 minutes of continuous exercise at a moderate intensity is achieved. The program will also aim to establish self-regulation skills and enhance self-efficacy via mobile health facilitation. 3) Wait list control group: At week 5, week 9 week 13, and week 24 participants will return to the lab for testing. After week 13, if you are in the control group you will be offered your choice of which exercise program (intermittent or continuous) to participate in. All groups will be given a food log to complete several times during the intervention.

You will be given with a MovBand, a wrist-worn activity monitor that measures daily physical

activity as steps taken per day for the entire 12 weeks intervention. You will have access to an online account and you must login once a week to download the accumulated data and charge the device. Also you will need to log your physical activity per week.

For the remaining point of assessments at week 5, week 9, week 13 and week 24 you will come back to the lab to complete: Self-Regulation, Self-Efficacy, and Fatigue questionnaires. Also you have to wear an accelerometer, complete a physical activity log and a food log during those given weeks. You will be asked to perform an iDEXA, aerobic fitness test, and a finger prick test only at the baseline, post-test and retention phase. A semi-structured interview will occur at week 13 or post-test to determine your program experience. .

Total time for the baseline and orientation session is approximately 90 minutes.

Debrief session – You will return to the lab to complete the assessments at weeks 5, 9 and at week 13. At week 13, you will need to return the MovBand. At this time, we will explain your results and you will complete a short semi-structured interview of approximately 20 minutes detailing your experience with the study. The total time commitment for the entire intervention assessments is about 4 hours.

Potential risks:

1. While performing any exercise there is a chance of muscle strains, sprains, pulls, and even death. The American College of Sports Medicine estimates the risk of sudden cardiac death 1 per 36.5 million hours of exertion.
2. There is a small amount of radiation from iDEXA scan. The amount of radiation from an iDexa scan is the equivalent of walking outside in direct sunlight for 10 minutes.
3. Muscle soreness is a possibility after your walking sessions; this risk is greater among sedentary people.
4. There is minimal risk associated with drawing blood from a finger prick. The risks include pain at the site of puncture; possible bruising and swelling around the injection site; rarely an infection; and, uncommonly, faintness from the procedure. This risk will be minimized by the use of sterile conditions during the procedure.

NOTE*: In the unlikely event that you sustain an injury from participation in this study, the investigators have no current plans to provide funds for any medical expenses or other costs you may incur.*

Precautions:

1. Some of the testing and intervention sessions in this research will be composed by short periods of moderate intensity exercise which may be uncomfortable. However, each trial will be conducted in a controlled laboratory setting, monitored by CPR certified researchers. Also, our pre-screening via the PAR-Q will reduce the risk of injury during exercise. Participants will get training if they are not familiar with using the treadmill.

2. All methods of data collection are commonplace in the exercise science literature and in Dr. Wadsworth Lab. Participants will be screened for the health factors that would increase the risk associated with exercise. Participants will also be able to freely terminate any test or exercise session whenever they wish.

3. All finger pricks will be taken by a trained and certified phlebotomist using aseptic technique to reduce the risk associated with collecting small blood samples.

4. All iDEXA scans are conducted by trained staff. The amount of radiation from an iDexa scan is the equivalent of walking outside in direct sunlight for 10 minutes.

Initials_____

Benefits and Compensation:

Mynor Rodriguez and Dr. Wadsworth will provide you with all of your results including: iDexa scans, HbA1C, aerobic fitness, exercise adherence, sedentary behavior changes, and overall physical activity results after completion of intervention. You will be given a handout and suggestions for maintaining your physical activity. We will not give any medical referrals based on your results.

Your participation is completely voluntary. If you change your mind about participating, you can withdraw at any time during the study. If you choose to withdraw, you can request to have your data withdrawn. Your decision about whether or not to participate or stop participating will not jeopardize your future relations with Auburn University, the School of Kinesiology, or the Epidemiology Lab.

Your privacy will be protected. Any information obtained in connection with this study will be maintained confidentially. Information obtained through your participation may be published or presented at a professional meeting.

If you have questions about this study, *please ask them now or* contact **Mynor Rodriguez** at **mgr0018@auburn.edu** or **Danielle Wadsworth** at **wadswdd@auburn.edu**. A copy of this document will be given to you to keep.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

_____ _____

Participant's signature Date Investigator obtaining consent Date

_____ _____

Printed Name Printed Name

_____

Co-Investigator Date

_____

Printed Name

AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMAN SUBJECTS

RESEARCH PROTOCOL REVIEW FORM

FULL BOARD or EXPEDITED

For Information or help contact **THE OFFICE OF RESEARCH COMPLIANCE (ORC)**, 115 Ramsay Hall, Auburn University
Phone: 334-844-5966 **e-mail:** IRBAdmin@auburn.edu **Web Address:** http://www.auburn.edu/research/vpr/ohs/index.htm

Revised 2.1.2014 **Submit completed form to IRBsubmit@auburn.edu or 115 Ramsay Hall, Auburn University 36849.**

Form must be populated using Adobe Acrobat / Pro 9 or greater standalone program (do not fill out in browser). Hand written forms will not be accepted.

1. PROPOSED START DATE of STUDY: 08-16-2016

PROPOSED REVIEW CATEGORY (Check one): ☐ **FULL BOARD** ☑ **EXPEDITED**

SUBMISSION STATUS (Check one): ☑ **NEW** ☐ **REVISIONS (to address IRB Review Comments)**

2. PROJECT TITLE: Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 12-week intervention.

3. Mynor G. Rodriguez	Doctoral Candidate	Kinesiology	mgr0018@auburn.edu
PRINCIPAL INVESTIGATOR	**TITLE**	**DEPT**	**AU E-MAIL**
301 Wire Road, Auburn University, 36849		334-275-5394	mynorgrh@gmail.com
MAILING ADDRESS		**PHONE**	**ALTERNATE E-MAIL**

4. FUNDING SUPPORT: ☑ N/A ☐ Internal ☐ External Agency: _____ ☐ Pending ☐ Received

For federal funding, list agency and grant number (if available). _____

5a. List any contractors, sub-contractors, other entities associated with this project:

_____

b. List any other IRBs associated with this project (including Reviewed, Deferred, Determination, etc.):

_____

PROTOCOL PACKET CHECKLIST

All protocols must include the following items:

☑ **Research Protocol Review Form** (All signatures included and all sections completed)
(Examples of appended documents are found on the OHSR website: http://www.auburn.edu/research/vpr/ohs/sample.htm)

☑ **CITI Training Certificates** for all Key Personnel.

☑ **Consent Form or Information Letter** and any Releases (audio, video or photo) that the participant will sign.

☐ **Appendix A**, "Reference List"

☑ **Appendix B** if e-mails, flyers, advertisements, generalized announcements or scripts, etc., are used to recruit participants.

☑ **Appendix C** if data collection sheets, surveys, tests, other recording instruments, interview scripts, etc. will be used for data collection. Be sure to attach them in the order in which they are listed in # 13c.

☐ **Appendix D** if you will be using a debriefing form or include emergency plans/procedures and medical referral lists (A referral list may be attached to the consent document).

☐ **Appendix E** if research is being conducted at sites other than Auburn University or in cooperation with other entities. A **permission letter** from the site / program director must be included indicating their cooperation or involvement in the project. NOTE: If the proposed research is a multi-site project, involving investigators or participants at other academic institutions, hospitals or private research organizations, a letter of **IRB approval** from each entity is required prior to initiating the project.

☐ **Appendix F** - Written evidence of acceptance by the host country if research is conducted outside the United States.

FOR ORC OFFICE USE ONLY

DATE RECEIVED IN ORC: _____ by _____ **PROTOCOL #** _____
DATE OF IRB REVIEW: _____ by _____ **APPROVAL CATEGORY:** _____
DATE OF IRB APPROVAL: _____ by _____ **INTERVAL FOR CONTINUING REVIEW:** _____
COMMENTS:

6. GENERAL RESEARCH PROJECT CHARACTERISTICS

6A. Research Methodology

Please check all descriptors that best apply to the research methodology.

Data Source(s): ☑ New Data ☐ Existing Data

Will recorded data directly or indirectly identify participants? ☑ Yes ☐ No

Data collection will involve the use of:

- Educational Tests (cognitive diagnostic, aptitude, etc.)
- ✓ Interview
- Observation
- ✓ Location or Tracking Measures
- ✓ Physical / Physiological Measures or Specimens (see Section 6E.)
- ✓ Surveys / Questionnaires
- ✓ Internet / Electronic
- Audio
- Video
- Photos
- Digital images
- Private records or files

Other: _____

6B. Participant Information

Please check all descriptors that apply to the target population.

☑ Males ☑ Females ☐ AU students

Vulnerable Populations

☐ Pregnant Women/Fetuses ☐ Prisoners ☐ Institutionalized

☐ Children and/or Adolescents (under age 19 in AL)

Persons with:

☐ Economic Disadvantages ☐ Physical Disabilities

☐ Educational Disadvantages ☐ Intellectual Disabilities

Do you plan to compensate your participants? ☐ Yes ☑ No

6C. Risks to Participants

Please identify all risks that participants might encounter in this research.

☑ Breach of Confidentiality* ☐ Coercion

☐ Deception ☑ Physical

☑ Psychological ☐ Social

☐ None

☐ Other:

*Note that if the investigator is using or accessing confidential or identifiable data, breach of confidentiality is always a risk.

6D. Corresponding Approval/Oversight

- **Do you need IBC Approval for this study?**
  ☐ Yes ☑ No

  If yes, BUA #_____ Expiration date _____

- **Do you need IACUC Approval for this study?**
  ☐ Yes ☑ No

  If yes, PRN #_____ Expiration date _____

- **Does this study involve the Auburn University MRI Center?**
  ☐ Yes ☑ No

  Which MRI(s) will be used for this project? (Check all that apply)
  ☐ 3T ☐ 7T

  Does any portion of this project require review by the MRI Safety Advisory Council?
  ☐ Yes ☑ No

  Signature of MRI Center Representative: _____
  Required for all projects involving the AU MRI Center

  Appropriate MRI Center Representatives:
  Dr. Thomas S. Denney, Director AU MRI Center
  Dr. Ron Beyers, MR Safety Officer

7. PROJECT ASSURANCES Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 12-week intervention.

A. PRINCIPAL INVESTIGATOR'S ASSSURANCES

1. I certify that all information provided in this application is complete and correct.
2. I understand that, as Principal Investigator, I have ultimate responsibility for the conduct of this study, the ethical performance this project, the protection of the rights and welfare of human subjects, and strict adherence to any stipulations imposed by the Auburn University IRB.
3. I certify that all individuals involved with the conduct of this project are qualified to carry out their specified roles and responsibilities and are in compliance with Auburn University policies regarding the collection and analysis of the research data.
4. I agree to comply with all Auburn policies and procedures, as well as with all applicable federal, state, and local laws regarding the protection of human subjects, including, but not limited to the following:
    a. Conducting the project by qualified personnel according to the approved protocol
    b. Implementing no changes in the approved protocol or consent form without prior approval from the Office of Research Compliance
    c. Obtaining the legally effective informed consent from each participant or their legally responsible representative prior to their participation in this project using only the currently approved, stamped consent form
    d. Promptly reporting significant adverse events and/or effects to the Office of Research Compliance in writing within 5 working days of the occurrence.
5. If I will be unavailable to direct this research personally, I will arrange for a co-investigator to assume direct responsibility in my absence. This person has been named as co-investigator in this application, or I will advise ORC, by letter, in advance of such arrangements.
6. I agree to conduct this study only during the period approved by the Auburn University IRB.
7. I will prepare and submit a renewal request and supply all supporting documents to the Office of Research Compliance before the approval period has expired if it is necessary to continue the research project beyond the time period approved by the Auburn University IRB.
8. I will prepare and submit a final report upon completion of this research project.

My signature indicates that I have read, understand and agree to conduct this research project in accordance with the assurances listed above.

Mynor G. Rodriguez	[signature]	7/1/2016
Printed name of Principal Investigator	**Principal Investigator's Signature**	**Date**

B. FACULTY ADVISOR/SPONSOR'S ASSURANCES

1. I have read the protocol submitted for this project for content, clarity, and methodology.
2. By my signature as faculty advisor/sponsor on this research application, I certify that the student or guest investigator is knowledgeable about the regulations and policies governing research with human subjects and has sufficient training and experience to conduct this particular study in accord with the approved protocol.
3. I agree to meet with the investigator on a regular basis to monitor study progress. Should problems arise during the course of the study, I agree to be available, personally, to supervise the investigator in solving them.
4. I assure that the investigator will promptly report significant incidents and/or adverse events and/or effects to the ORC in writing within 5 working days of the occurrence.
5. If I will be unavailable, I will arrange for an alternate faculty sponsor to assume responsibility during my absence, and I will advise the ORC by letter of such arrangements. If the investigator is unable to fulfill requirements for submission of renewals, modifications or the final report, I will assume that responsibility.

Danielle Wadsworth	Danielle Wadsworth	7/1/2016
Printed name of Faculty Advisor / Sponsor	**Faculty Advisor's Signature**	**Date**

C. DEPARTMENT HEAD'S ASSSURANCE

By my signature as department head, I certify that I will cooperate with the administration in the application and enforcement of all Auburn University policies and procedures, as well as all applicable federal, state, and local laws regarding the protection and ethical treatment of human participants by researchers in my department.

Mary Rudisill	[signature]	7-1-2016
Printed name of Department Head	**Department Head's Signature**	**Date**

for PR Rudisill

8. **PROJECT OVERVIEW: Prepare an abstract that includes:**
(**350** word maximum, in language understandable to someone who is not familiar with your area of study):

a) **A summary of relevant research findings leading to this research proposal:**
(Cite sources; include a "Reference List" as Appendix A.)
b) **A brief description of the methodology, including design, population, and variables of interest**

Sedentary behavior is emerging as a risk factor for hypokinetic diseases independent of participation in regular exercise. Breaks in sedentary behavior such as short durations of walking or exercise has demonstrated positive changes in physiological variables during short duration interventions. The proposed design will aim to determine the effect of two different walking programs (intermittent vs. single bout) on physiological and psychological parameters in 75 physically inactive adults.

I. 75 female and male participants between 25-60 years old will be recruited to participate in this study. Qualified and consenting participants will then complete baseline data assessments in their first visit to the labs. The initial evaluation will include: Weight, height, iDEXA, and demographics. Participants will complete a series of questionnaires that assess self-regulation, self-efficacy, and fatigue. After completion of questionnaires, a finger prick will be performed to analyze Hemoglobin A1c (HbA1c) levels. They will also wear an Accelerometer for 7 days. Based on gender and body composition, participants will then be randomly assigned to one of the 3 groups to complete one the following conditions over the course of 12 weeks: 1) Intermittent physical activity based on micro-bouts of 5 minutes walking at light to moderate intensity during given days, 2) Continuous physical activity based on a single bout of walking at light to moderate intensity on a given day and 3) wait list control group who will have the option to perform one or the other program after the initial 12 weeks. At 24 weeks all three groups will return to the lab to complete baseline measures again.
II. The following variables will be measured: Weight, Height, age, body composition, HbA1c, aerobic fitness, exercise adherence, physical activity/sedentary behavior, self regulation, self-efficacy, and fatigue.
III. The hypothesis is that participants will respond better to intermittent breaks of exercise at a light to moderate intensity in terms of physiological and psychological variables.
IV. The results of this experiment will have direct application on people who work in fields which require minimum effort and highly related to sedentary behavior.

9. **PURPOSE.**
a. **Clearly state the purpose of this project and all research questions, or aims.**

To examine the effect of two different exercise programs on exercise adherence, self-regulation, self-efficacy, fatigue, physical activity/sedentary behavior, VO2, HbA1c, and body composition in previously sedentary individuals during a 12-week intervention and retention phase, 12 weeks after completing the intervention.

b. **How will the results of this project be used? (e.g., Presentation? Publication? Thesis? Dissertation?)**

This is a dissertation study, that will lead to presentations and publications

10. **KEY PERSONNEL.** Describe responsibilities. Include information on research training or certifications related to this project. **CITI is required. Be as specific as possible.** (Include additional personnel in an attachment.) *All key personnel must attach CITI certificates of completion.*

Principle Investigator Mynor G. Rodriguez **Title:** Doctoral Candidate **E-mail address** mgr0018@auburn.edu

Dept / Affiliation: Kinesiology

Roles / Responsibilities:

Principal investigator, study design, project development, participant recruitment, participant screening, data collection, data review and analysis, and data interpretation.
Mynor Rodriguez has completed 1) CITI training, 2) CPR

Individual: Danielle Wadsworth **Title:** Professor **E-mail address** wadswdd@auburn.edu

Dept / Affiliation: School of Kinesiology

Roles / Responsibilities:

Project supervisor, participant recruitment, participant screening, data collection, data review/analysis,data interpretation.

Danielle wadsworth has completed 1) CITI training, 2) CPR

Individual: _____ **Title:** _____ **E-mail address** _____

Dept / Affiliation: _____

Roles / Responsibilities:

Individual: _____ **Title:** _____ **E-mail address** _____

Dept / Affiliation: _____

Roles / Responsibilities:

Individual: _____ **Title:** _____ **E-mail address** _____

Dept / Affiliation: _____

Roles / Responsibilities:

Individual: _____ **Title:** _____ **E-mail address** _____

Dept / Affiliation: _____

Roles / Responsibilities:

11. **LOCATION OF RESEARCH. List all locations where data collection will take place.** (School systems, organizations, businesses, buildings and room numbers, servers for web surveys, etc.) **Be as specific as possible. Attach permission letters in** Appendix E.
(See sample letters at http://www.auburn.edu/research/vpr/ohs/sample.htm)

301 Wire Road, Kinesiology Building: Epidemiology Lab (Room 144), Prevention and performance Lab (Room 146), Fitness optimization Lab (142), TigerFit Lab (Room 126), iDEXA (Room 125)

12. PARTICIPANTS.

a. Describe the participant population you have chosen for this project including inclusion or exclusion criteria for participant selection.

☐ **Check here if using existing data, describe the population from whom data was collected, & include the # of data files.**

1) Male and female between the ages of 25-60 who are currently employed
2) Level of daily activity mostly sedentary (more than 50% time sitting at work)
3) Do not meet the recommendations for physical activity. At least 3 times per week 30 or more minutes at moderate to vigorous intensity for the past 6 months.
4) Low risk for medical complications as determined by the Physical Activity Readiness Questionnaire (PARQ) and not pregnant.
5) Cannot be pregnant.
6) Able to complete a walking program
7) Agree to commit the study

b. Describe, step-by-step, in layman's terms, all procedures you will use to recruit participants. *Include in Appendix B a copy of all e-mails, flyers, advertisements, recruiting scripts, invitations, etc., that will be used to invite people to participate. (See sample documents at http://www.auburn.edu/research/vpr/ohs/sample.htm.)*

Participants will be recruited by word of mouth, e-mail, flyers, and sending a total of 5 social network blasts from the Auburn Community. The script will provide a brief overview of the study with all details provided with review of the informed consent. See Appendix B. No deceptive language will be used in recruiting participants, and any potential question regarding the study will be honestly answered to the best of our ability.

c. What is the minimum number of participants you need to validate the study? 75

How many participants do you expect to recruit? 100

Is there a limit on the number of participants you will include in the study? ☑ **No** ☐ **Yes – the # is** _____

d. Describe the type, amount and method of compensation and/or incentives for participants.

(If no compensation will be given, check here: ☐)

Select the type of compensation: ☐ Monetary ☐ Incentives

- ☐ Raffle or Drawing incentive (Include the chances of winning.)
- ☐ Extra Credit (State the value)
- ☑ Other

Description:

Participants will receive thier personal information from the study which includes: DEXA scans analysis, HbA1c, and overall results of their participation.

13. **PROJECT DESIGN & METHODS.**

a. **Describe, step-by-step, all procedures and methods that will be used to consent participants. If a waiver is being requested, check each waiver you are requesting, describe how the project meets the criteria for the waiver.**

- ☐ **Waiver of Consent (including using existing data)**
- ☐ **Waiver of Documentation of Consent (use of Information Letter)**
- ☐ **Waiver of Parental Permission (for college students)**

Before any testing, familiarization, or data collection, potential participants will be provided with the approved informed consent document and have any of their questions answered by the principal investigator Mynor Rodriguez or Dr. Danielle Wadsworth. If the potential participant decides to volunteer for the study, she/he will be asked to sign the informed consent and then complete the PAR-Q as a screening tool. Recruits who do not meet the study inclusion criteria will have their PAR-Q and informed consent returned to them and will be not allowed to participate in the study. Participants with self-reported medical issues, potential drug interactions with testing variables, or PAR-Q answers indicating an increased risk associated with physical activity will be dismissed. Potential participants will also not be allowed to participate in the study if they are currently engaging in enough physical activity to meet exercise recommendations. If the participant does not meet the inclusion criteria, the PAR-Q will be returned upon dismissal. If after explaining the requirements to the study, the participant does not agree to commit, the participant is not allowed to participate in the project, if they do not meet this inclusion criteria the PAR-Q is returned upon dismissal. If the particpant is pregnant she will not participate in the study.

b. **Describe the research design and methods you will use to address your purpose. Include a clear description of when, where and how you will collect all data for this project.** Include specific information about the participants' time and effort commitment. (*NOTE: Use language that would be understandable to someone who is not familiar with your area of study. Without a complete description of all procedures, the Auburn University IRB will not be able to review this protocol. If additional space is needed for this section, save the information as a .PDF file and insert after page 7 of this form.*)

The mixed design research includes the baseline/orientation phase,12 weeks of intervention, the post-test, and a follow up test that will performed on week 24 when they return for the retention evaluation. For the baseline, participants arrive to the Epidemiology & Obesity Prevention Lab, School of Kinesiology, consenting procedures described in 13a will occur during the orientation day and basic demographic data will be collected (height, weight, age, and race). Participants will complete all 3 questionnaires for Self-regulation, Self-Efficacy, and Fatigue. Immediately, a fingerstick will be performed to collect a small amount of blood (5 microliters (µL)) through A1CNOW System to determine HbA1c levels. For this test participants will come to the lab with at least 3 hours of fasting, then a finger prick will be performed to collect 5 microliters (µL) of blood and the sample immediately will be analyzed using the A1CNOW System to dertermine HbA1C levels. After that, body composition will be assessed with an iDXA total body scan. Then the aerobic fitness through VO2 assessment is determined, on this, participants will perform a Bruce Protocol. During this test, the participant will walk/jog using determined speeds and inclines (appendix), as well identify on a scale of 1 to 10 the level of exertion and continue the test until maximum fatigue tolerance. Participants will be given a 3 days food log to be completed. Participants will be provided with an accelerometer to be worn around their waist with an elastic band to measure physical activity and obtain information about exercise adherence. Participants will return to the lab 7 days later and will be given a MovBand a wrist-worn activity monitor that measures daily physical activity as steps taken per day for the entire 12 weeks intervention. Immediately after completion of the baseline participants will be randomly assigned based on gender and BMI to one of the three groups: 1) Intermittent Physical Activity, 2) Continuous Physical Activity, and 3) Control Group.

1) Intermittent PA: 20-40 minutes of light to moderate walking activity broken up into four to seven bouts of five minutes. Participants will start with 4 breaks of 5 minutes each three days per week during the first 2 weeks. This will be performed at a light to moderate intensity or heart rate (HR) between 30-60% of maximum predicted heart rate and/or 3-6 on the Rate of Perceived Exertion (RPE) scale. After the first two weeks frequency and intensity of the breaks will increase biweekly until the number of breaks per day equals 40 minutes (8 breaks X 5 minutes each) and a moderate intensity (40-60% HR or 4-6 RPE).The program will also aim to establish self-regulation skills and enhance self-efficacy via mobile health facilitation.

Continued on Attached Sheet.

....Continuation 13B

2) Continuous PA: 20-40 minutes single bout of walking activity at light to moderate intensity. Participants will start with 20 minutes of continuous walking three days per week during the first 2 weeks at light to moderate intensity or heart rate (HR) between 30-60% of maximum predicted heart rate or 3-6 on the RPE scale. Then applying the FITT-VP principles, biweekly adjustments will increase the time per day until 40 minutes of continuous exercise at a moderate intensity is achieved. The program will also aim to establish self-regulation skills and enhance self-efficacy via mobile health facilitation.

3) Wait list control group: At week 5, week 9 week 13, and week 24 participants will return to the lab for testing. After week 13, the control group will choose which exercise program (intermittent or continuous) to participate in.

All participants will perform the intervention on their own environment. This intervention is based on a free-living conditions environment. They will have access to the exercise prescription and will be given with all learning material to improve awareness on all self-regulatory and self-efficacy strategies, sedentary behavior, physical activity, and health.

For the remaining point of assessments at week 5, week 9, week 13 and week 24 participants will return to the lab to complete: Self-Regulation, Self-Efficacy, and Fatigue questionnaires. Also they will wear an accelerometer, complete a physical activity log and a food log.

Body composition, aerobic fitness, and HbA1c assessments will be performed only at the baseline, post-test and retention phase. A semi-structured interview will occur at week 13 (Appendix).

A MovBand will be used for the entire 12-week intervention. Participants will be in charge of download the data every week to a general data base. To do this, they will be given with a username and password to login, charge and download the recorded information in that particular week.

13. **PROJECT DESIGN & METHODS.** *Continued*

c. **List all data collection instruments used in this project, in the order they appear in** Appendix C.
(e.g., surveys and questionnaires **in the format that will be presented to participants**, educational tests, data collection sheets, interview questions, audio/video taping methods etc.)

Informed consent
PAR-Q screening
iDEXA for body composition
GSE 550 Scale for weight and hight
Woodway treadmill to analyze VO2
A1CNOW System for HbA1C
Accelerometer to measure physical activity
Questionnaires for demographics, physical activity, self-regulation, self-efficacy, and fatigue.
MovBand for the entire intervention.
Semi-strutured interview

d. **Data analysis: Explain how the data will be analyzed.**

Using an Analysis of Covariance (ANCOVA), a general linear model that blends ANOVA and linear regression. A regression for physiological variables will be performed to see specific changes on those elements. A Post-Hoc analysis will determine where the changes occur.

14. **RISKS & DISCOMFORTS: List and describe all of the risks that participants might encounter in this research.** ***If you are using deception in this study, please justify the use of deception and be sure to attach a copy of the debriefing form you plan to use in Appendix D.*** *(Examples of possible risks are in section #6D on page 2)*

1. The most extreme potential risk during the high intensity exercise even for short periods of time in this research is death. However, the American College of Sports and Medicine cites a survey that determined the risk of death to be 0.5 per 10,000 individuals, with the risk among healthy individuals, such as in this study, to be even lower. Other risks of exercise include nausea, fainting, dehydration, dizziness, muscle strain/pull, heart arrhythmia, and abnormal blood pressure response.

2. Muscle soreness is a possibility during the moderate intensity condition; this risk is greater among sedentary people.

3. Collecting blood samples. There is minimal risk associated with drawing blood from a finger prick. The risks include pain at the site of puncture; possible bruising and swelling around the injection site; rarely an infection; and, uncommonly, faintness from the procedure. This risk will be minimized by the use of sterile conditions during the procedure.

4. A small amount of radiation from iDEXA scan.

5. Since we will be using human subjects and will not be collecting data anonymously, breach of confidentially is always a risk.

15. **PRECAUTIONS.** Identify and describe all precautions you have taken to eliminate or reduce risks as listed in #14. If the participants can be classified as a "vulnerable" population, please describe additional safeguards that you will use to assure the ethical treatment of these individuals. ***Provide a copy of any emergency plans/procedures and medical referral lists in Appendix D. (Samples can be found online at http://www.auburn.edu/research/vpr/ohs/sample.htm#precautions)***

1. Some of the testing sessions in this research will be composed of short periods of moderate intensity exercise which may be uncomfortable. However, each trial will be conducted in a controlled laboratory setting, and monitored by CPR certified researchers. Heart rate will be measured during the exercise condition to ensure heart response. Also, our pre-screening via PAR-Q will reduce the risk of injury during exercise.

2. All methods of data collection are commonplace in the exercise science literature and in Dr. Wadsworth's Lab. Participants will be screened for the health factors that would increase the risk associated with exercise. Participants will be able to freely terminate any test session whenever they wish.
3. All finger pricks will be taken by a trained and certified phlebotomist using aseptic technique to reduce the risk associated with collecting small blood samples.
4. Even though data will not be collected anonymously, it will be recorded anonymously, with the code list linking the participants kept confidential in a locked filling cabinet until the end of the study when it will be destroyed.

If using the Internet or other electronic means to collect data, what confidentiality or security precautions are in place to protect (or not collect) identifiable data? Include protections used during both the collection and transfer of data.

All devices used will be initialized and a specific code per every participant will be set.

16. **BENEFITS.**

a. **List all realistic direct benefits participants can expect by participating in this specific study.**
(Do not include "compensation" listed in #12d.) Check here if there are no direct benefits to participants. ☐

Participants will receive their personal data including: iDexa scans, HbA1C, aerobic fitness, exercise adherence, sedentary behavior changes, overall physical activity results after completion of intervention.

b. **List all realistic benefits for the general population that may be generated from this study.**

The results will provide information on how a long term intervention may promote proper health in regard sedentary behavior and exercise adherence. Results will also show the benefits in terms of improvements on aerobic fitness, body composition, HbA1C, self-regulatory skills, self-efficacy, and reduction on perceived fatigue.

17. **PROTECTION OF DATA.**

a. **Data are collected:**

☐ **Anonymously with no direct or indirect coding, link, or awareness of who participated in the study (Skip to e)**

☐ **Confidentially, but without a link of participant's data to any identifying information (collected as "confidential" but recorded and analyzed as "anonymous") (Skip to e)**

☑ **Confidentially with collection and protection of linkages to identifiable information**

b. **If data are collected with identifiers or as coded or linked to identifying information, describe the identifiers collected and how they are linked to the participant's data.**

A code list will be generated and associated with the participants' data. After data collection and collation, the master list linking participant to numbered data will be destroyed.

c. **Justify your need to code participants' data or link the data with identifying information.**

Identification of participants is necessary to link information from the three conditions.

d. **Describe how and where identifying data and/or code lists will be stored.** (Building, room number?) **Describe how the location where data is stored will be secured in your absence. For electronic data, describe security. If applicable, state specifically where any IRB-approved and participant-signed consent documents will be kept on campus for 3 years after the study ends.**

An electronic copy of the coded list will be stored at the Kinesiology Building on a password protected laptop in Mynor Rodriguez' office Kinesiology Building 126B @ 301 Wire Road. The office remains locked when not in use.

e. **Describe how and where the data will be stored** (e.g., hard copy, audio cassette, electronic data, etc.)**, and how the location where data is stored is separated from identifying data and will be secured in your absence. For electronic data, describe security**

Hard copies of the consent forms and data will be stored at the Kinesiology Building in a locked cabinet in Mynor Rodriguez' office 126B @ 301 Wire Road. The office remains locked when not in use. Electronic data will be stored on Mynor Rodriguez' desk computer maintained by the Auburn Office of Information Technology in room 126B KINE building. A back-up copy of the data will be stored on a flash-drive, also located in the Kinesiology Building room 126B KINE. This room remains locked when not in use.

f. **Who will have access to participants' data?**
(*The faculty advisor should have full access and be able to produce the data in the case of a federal or institutional audit.*)

Only the research personnel identified in this IRB will have access to the data. Mynor Rodriguez and Danielle Wadsworth will be the only people with full access to the master code list.

g. **When is the latest date that identifying information or links will be retained and how will that information or links be destroyed?**
(Check here if only anonymous data will be retained ☐)

The informed consent will be kept for three years (as required). The master list will be destroyed once all data have been collected and collated. The master list linking participants to study number will be shredded. Informed consent will be shredded 3 years after the completion of the study.

AUBURN UNIVERSITY
COLLEGE OF EDUCATION
School of Kinesiology

Informed Consent for a Research Study Entitled

"Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 12-week intervention."

Project Overview: You are invited to participate in a research study that will examine the effect of two different exercise programs on physiological and psychological variables. We are recruiting participants to complete a 12-week intervention. There are 3 groups: 2 groups will perform 2 different exercise programs and one group will serve as the control group. You will be randomly assigned to one of these conditions: intermittent physical activity, continuous physical activity, and control group.

Purpose: The purpose of this study is to examine the effect of two different exercise programs on exercise adherence, self-regulation, self-efficacy, fatigue, physical activity/sedentary behavior, VO2, Hemoglobin A1c (HbA1c), and body composition in previously sedentary individuals during a 12-week intervention and retention phase, 12 weeks after completing the intervention.

Participation Requirements: To be eligible, you must be:

1) Male and female between the ages of 25-60 who are employed.

2) Level of daily activity mostly sedentary (more than 50% time sitting at work)

3) Do not meet the recommendations for physical activity. At least 3 times per week 30 or more minutes at moderate to vigorous intensity for the past 6 months.

4) Low risk for medical complications as determined by the Physical Activity Readiness Questionnaire (PARQ) and not pregnant.

5) Cannot be pregnant.

6) Able to complete a walking program

7) Agree to commit the study.

You must meet all of the requirements to be eligible for participation in this study.

301 Wire Rd., Auburn, AL 36849-5323; Telephone: 334-844-4483; Fax: 334-844-1467

What will be involved if you participate? If you decide to participate in this research study, you will be asked to make the agreement to participate in a 24-week program. You will come to the School of Kinesiology labs for a total of 6 times. The first time will be the baseline followed by the orientation session one week later. Then at week 5, week 9, week 13, and week 24 for the final assessment. This study is based on free-living conditions, therefore, you will be asked to work on your own environment. Meaning that the exercise sessions will be perform on your own time and space, you do not have to come to the lab for each session.

Orientation/baseline Session – During the orientation/baseline session you will: complete the consent documents, the Par-Q medical screening and demographic measures. You will also complete an iDEXA scan which measures body composition and an aerobic test on the treadmill. Also, you need to complete few questionnaires and a finger prick performed to obtain a small amount of blood. A finger prick will be performed to collect a small amount of blood (5 microliters (μL)) through A1CNOW System to determine HbA1c levels. Dr. Wadsworth or Mynor Rodriquez will be present for all consenting procedures. If ineligible for participation for any reason (participation requirements or PAR-Q) all forms will be returned to the subject and no record will be kept by the researchers. Descriptive data will be obtained [age, height, weight, waist, physical activity level, and iDEXA (body composition)]. You will also be orientated to the treadmill. You will be asked to walk/jog on the treadmill to test your aerobic capacity and to get familiar with the Rating Perceived Exertion scale (RPE). You will be asked to walk/jog to your Maximum Fatigue Tolerance. We will also give you an accelerometer to be worn around your waist to measure your physical activity. You will wear the accelerometer during the baseline week, then on week 5, week 9, week 13, and finally when you come back at week 24 for the retention evaluation.

One week later you will return to the lab and be assigned to one of the 3 groups, based on your BMI and gender, and bring you all details related to your specific program. 1) Intermittent PA: 20-40 minutes of light to moderate walking activity broken up into four to eight bouts of five minutes. Participants will start with 4 breaks of 5 minutes each three days per week during the first 2 weeks. This will be performed at a light to moderate intensity or heart rate (HR) between 30-60% of maximum predicted heart rate and/or 3-6 on the Rate of Perceived Exertion (RPE) scale. After the first two weeks frequency and intensity of the breaks will increase biweekly until the number of breaks per day equals 40 minutes (8 breaks X 5 minutes each) and a moderate intensity (40-60% HR or 4-6 RPE).The program will also aim to establish self-regulation skills and enhance self-efficacy via mobile health facilitation. 2) Continuous PA: 20-40 minutes single bout of walking activity at light to moderate intensity. Participants will start with 20 minutes of continuous walking three days per week during the first 2 weeks at light to moderate intensity or heart rate (HR) between 30-60% of maximum predicted heart rate or 3-6 on the RPE scale. Then applying the FITT-VP principles, biweekly adjustments will increase the time per day until 40 minutes of continuous exercise at a moderate intensity is achieved. The program will also aim to establish self-regulation skills and enhance self-efficacy via mobile health facilitation. 3) Wait list control group: At week 5, week 9 week 13, and week 24 participants will return to the lab for testing. After week 13, the control group will choose which exercise program (intermittent or continuous) to participate in. You will be given a food log to complete several times during the intervention.

Initials_____

You will be given with a MovBand, a wrist-worn activity monitor that measures daily physical activity as steps taken per day for the entire 12 weeks intervention. You will have access to an online account and you must login once a week to download the accumulated data and charge the device. Also you will need to log your physical activity per week.

For the remaining point of assessments at week 5, week 9, week 13 and week 24 you will come back to the lab to complete: Self-Regulation, Self-Efficacy, and Fatigue questionnaires. Also you have to wear an accelerometer, complete a physical activity log and a food log during those given weeks. You will be asked to perform an iDEXA, aerobic fitness test, and a finger prick test only at the baseline, post-test and retention phase. A semi-structured interview will occur at week 13 or post-test to determine your program experience. .

Total time for the baseline and orientation session is approximately 90 minutes.

Debrief session – You will return to the lab to all those given weeks to complete the assessments and at week 13 you will need to return the MovBand. At this time we will go over your results and have a short semi-structured interview. Approximately 20 minutes each time. For a total time commitment of 2.5 hours.

Potential risks:

1. While performing any exercise there is a chance of muscle strains, sprains, pulls, and even death. The American College of Sports Medicine estimates the risk of sudden cardiac death 1 per 36.5 million hours of exertion.
2. There is a small amount of radiation from iDEXA scan.
3. Muscle soreness is a possibility after your walking sessions; this risk is greater among sedentary people.
4. There is minimal risk associated with drawing blood from a finger prick. The risks include pain at the site of puncture; possible bruising and swelling around the injection site; rarely an infection; and, uncommonly, faintness from the procedure. This risk will be minimized by the use of sterile conditions during the procedure.

NOTE: ***It is important for you to realize that you are responsible for any costs incurred in the event of an injury and you are responsible for any costs associated with medical treatment.***

Precautions:

1. Some of the testing and intervention sessions in this research will be composed by short periods of moderate intensity exercise which may be uncomfortable. However, each trial will be conducted in a controlled laboratory setting, monitored by CPR certified researchers. Also, our pre-screening via the PAR-Q will reduce the risk of injury during exercise. Participants will get training if they are not familiar with using the treadmill.

2. All methods of data collection are commonplace in the exercise science literature and in Dr. Wadsworth Lab. Participants will be screened for the health factors that would increase the risk associated with exercise. Participants will also be able to freely terminate any test or exercise session whenever they wish.

3. All finger pricks will be taken by a trained and certified phlebotomist using aseptic technique to reduce the risk associated with collecting small blood samples.

4. All iDexa scans are conducted by trained staff. The amount of radiation from an iDexa scan is the equivalent of walking outside in direct sunlight for 10 minutes.

Benefits and Compensation:

You will be provided with all of your results including: iDexa scans, HbA1C, aerobic fitness, exercise adherence, sedentary behavior changes, and overall physical activity results after completion of intervention.

Your participation is completely voluntary. If you change your mind about participating, you can withdraw at any time during the study. If you choose to withdraw, you can request to have your data withdrawn. Your decision about whether or not to participate or stop participating will not jeopardize your future relations with Auburn University, the School of Kinesiology, or the Epidemiology Lab.

Your privacy will be protected. Any information obtained in connection with this study will be maintained confidentially. Information obtained through your participation may be published or presented at a professional meeting.

If you have questions about this study, *please ask them now or* contact **Mynor Rodriguez** at **mgr0018@auburn.edu** or **Danielle Wadsworth** at **wadswdd@auburn.edu**. A copy of this document will be given to you to keep.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

_____	_____
Participant's signature Date	Investigator obtaining consent Date
_____	_____
Printed Name	Printed Name
	_____
	Co-Investigator Date
	_____
	Printed Name

Appendix B: Recruitment Script

"Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 10-week intervention."

Purpose:

You are invited to participate in a research study that will investigate the effect of two different exercise programs on exercise adherence, self-regulation, self-efficacy, fatigue, physical activity/sedentary behavior, Hemoglobin A1c (HbA1c), VO_2 and body composition in sedentary individuals during a 10-week intervention. To conduct this experiment, we are looking to recruit healthy females and males whose daily activity is mostly sedentary and do not exercise.

Participant Qualifications:

- Females and males
- Age 25 - 60
- Healthy (as determined by screening PAR-Q document).
- Level of daily activity mostly sedentary
- Agree and able to complete a 10-week walking program
- Sedentary. Do not currently engaged in any structured physical activity program.
- Females cannot be pregnant.
- Have access to a computer and internet connection to access the account, to charge, and to download the MOVband data.

Requirements:

If you decide to participate you will be asked to read and sign an informed consent and complete a Physical Activity Readiness Questionnaire (PAR-Q) to determine if you are healthy enough to participate in this program. Testing will include: body composition measurements using an iDXA scan, Physical Activity questionnaire, aerobic testing determined by performing a Bruce Protocol (walking test), and 3 questionnaires. Also, for the baseline and at week 13 a finger prick will be performed to collect a small amount of blood (5 microliters (μL)) through A1CNOW System to determine HbA1c levels. You will be provided with an accelerometer to be worn around your waist for about one week. Also, you will be given with a MOVband a wrist-worn activity monitor that you will wear for the entire 10-week intervention. For 10 weeks, you will be given an exercise prescription (walking program, group 1: intermittent physical activity or short breaks of physical activity, group 2: continuous physical activity. Both programs performed 20 to 40 minutes, 3 to 5 times per week, during 10 weeks) or assigned to the control group. If you are assigned to the control group, you will receive the intervention in 10 weeks. You need to

return to our lab on weeks 6, 11, and 12 to perform further evaluations with a total time commitment of around 4 hours

Benefits:

You will receive a free screening and all your data including: iDXA scans, and all results from the different variables assessed. You will receive a 10-week exercise program along with strategies to understand and adhere to a healthier lifestyle.

YOUR PARTICIPATION IS COMPLETELY VOLUNTARY!

If you choose to participate, you have the right to stop at any time. Your choice of whether or not to participate in this study will in no way effect your relationship with the researchers or the Department of Kinesiology. Recorded data will be available only by participant number.

Contact Information: Please contact Mynor Rodriguez via e-mail at mgr0018@auburn.edu or Danielle Wadsworth at wadswdd@auburn.edu or telephone at 334-844-1836 for more information.

Appendix C: Media Recruitment

Social Media/email
Recruitment Script

"Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 10-week intervention."

You are invited to participate in a research study that will investigate the effect of two different exercise programs on exercise adherence, self-regulation, self-efficacy, fatigue, physical activity/sedentary behavior, Hemoglobin A1c (HbA1c), VO_2 and body composition in sedentary individuals during a 10-week intervention. To conduct this experiment, we are looking to recruit healthy females (not pregnant) and males (25-60 years old) whose daily activity is mostly sedentary and do not exercise. If you decide to participate you will be asked to read and sign an informed consent and complete a Physical Activity Readiness Questionnaire (PAR-Q) to determine if you are healthy enough to participate in this program. Testing will include: body composition measurements using an iDXA scan, Physical Activity questionnaire, aerobic testing determined by performing a Bruce Protocol (walking test), and 3 questionnaires. Also, a finger prick will be performed to collect a small amount of blood (5 microliters (µL)) through A1CNOW System to determine HbA1c levels. You will be provided with an accelerometer to be worn around your waist for about one week. You need to return to our lab on weeks 6,11, and 12, to perform further evaluations with a total time commitment of around 4 hours. Also, you will be given with a MOVband a wrist-worn activity monitor that you will wear for the entire 10-week intervention (you need access to a computer and internet connection to login the MOVband). For 10 weeks, you will be given an exercise prescription (walking program, group 1: intermittent physical activity or short breaks of physical activity, group 2: continuous physical activity. Both programs performed 20 to 40 minutes, 3 to 5 times per week, during 10 weeks) or assigned to the control group. If you are assigned to the control group, you will receive the intervention after 10 weeks. You will receive a free screening and all your data including: iDXA scans, and all results from the different variables assessed. You will receive a 10-week exercise program along with strategies to understand and adhere to a healthier lifestyle. Please contact Mynor Rodriguez via e-mail at mgr0018@auburn.edu or Danielle Wadsworth at wadswdd@auburn.edu or telephone at 334-844-1836 for more information.

Appendix D: Surveys

PAR Q Medical Questionnaire*

Please read each question carefully and answer honestly. If you do not understand the question, please ask the investigator for clarification. Check the appropriate answer.

No	**Yes**	
____	____	1. Are you under 25 years old or over the age of 60 years?
____	____	2. Do you presently smoke or have been a regular smoker?
____	____	3. Has your doctor ever said you have heart trouble?
____	____	4. Do you have a family history of early cardiovascular death before the age of 50?
____	____	5. Have you ever had a heart murmur, rheumatic fever or respiratory problems?
____	____	6. Have you ever been told that you have a fast resting heart rate?
____	____	7. Have you ever been told by your doctor or nurse that your blood pressure is too high?
____	____	8. Have you ever been told that your cholesterol is too high?
____	____	9. Have you been told that you have a kidney disorder?
____	____	10. Have you been told that you have diabetes or that your blood sugar is too high?
____	____	11. Have you been told that your electrocardiogram (EKG), 12 lead EKG or stress test is not normal?
____	____	12. Do you have any rashes or reactions that result from hot or cold exposures (hot or cold urticarial)?
____	____	13. Have you been hospitalized in the past year?
____	____	14. Are you taking prescription medications?

If so, what?

_____

** Note that taking certain medications may cause you to be excluded from participation in this

study including those that cause increases in heart rate, or other drugs [i.e. drugs that are prescribed or over the counter that interfere with balance, respiratory function (e.g. COPD, shortness of breath), or blood sugar (e.g. insulin, glucagon)] that may increase the risk of participation.

___ ___ 15. Do you have any orthopedic issues that would interfere with your participation in this study?

___ ___ 16. Do you have any reason to believe that your participation in this investigative effort may put your health or well-being at risk? If so, please state reason.
_____

____ ____ 17. Are you pregnant?

_____

Signature of subject _____ Date _____

*Adapted from British Columbia Department of Health and Michigan Heart Association.

Appendix E: Questionnaires

Self-Regulation questionnaire

People use various techniques to help them exercise on a regular basis. Recalling your exercise activities performed in the last four (4) weeks, please answer the following questions regarding techniques you may have used to help you exercise. If you did not exercise during this time period, select “never”.

On the scale provided next to each item, circle the number that best represents how often you used the specified technique in the past four (4) weeks.

	Never	**Rarely**	**Some times**	**Often**	**Very Often**	
I mentally kept track of my exercise activities.	1	2	3	4	5	Self Monitoring
I mentally noted specific things that helped me exercise.	1	2	3	4	5	
I recorded my exercise activities in a written record.	1	2	3	4	5	
I recorded my exercise activities in a written record including duration or intensity of exercise performed.	1	2	3	4	5	
I kept a written record of specific methods used to enhance my ability to perform exercise.	1	2	3	4	5	
I established short term goals (daily or weekly) related to how often I exercise.	1	2	3	4	5	Goal Setting
I established long term goals (monthly or longer) related to how often I exercise.	1	2	3	4	5	
I established goals for exercise time or distance (e.g. swim 20 min, run 3 miles).	1	2	3	4	5	
I established exercise goals that focused on my health (e.g. improved fitness).	1	2	3	4	5	

	Never	Rarely	Some times	Often	Very Often	
I established exercise goals that focused on my appearance (e.g. lose weight, tone body).	1	2	3	4	5	Goal Setting
I established a written commitment with others to exercise.	1	2	3	4	5	
I established an oral commitment with others to exercise.	1	2	3	4	5	
I mentally set exercise goals.	1	2	3	4	5	
I wrote down my exercise goals.	1	2	3	4	5	
I exercise with someone to help me exercise regularly.	1	2	3	4	5	Social Support
I exercised with a pet to help me exercise regularly.	1	2	3	4	5	
I talked to someone while I exercised to help me exercise regularly.	1	2	3	4	5	
I received verbal praise from someone for exercising.	1	2	3	4	5	
I received a reward from someone for exercising.	1	2	3	4	5	
I asked someone to remind me to exercise.	1	2	3	4	5	
I asked someone to assume some of my responsibilities.	1	2	3	4	5	
I asked someone for advice or demonstration of exercise activities.	1	2	3	4	5	
I asked an exercise expert/health professional for advice or demonstration of exercise activities	1	2	3	4	5	

	Never	Rarely	Some times	Often	Very Often	
I rewarded myself for exercising (e.g. snack, watch TV, movies, buy gift, etc.).	1	2	3	4	5	Reinforcements
I rewarded myself for reaching health goals related to exercise (e.g. improved fitness).	1	2	3	4	5	
I rewarded myself for reaching appearance goals related to exercise (e.g. lose weight, tone body).	1	2	3	4	5	
I punished myself for not exercising (e.g. withhold reward if I don't exercise).	1	2	3	4	5	
When I exercised, I focused on how good I felt.	1	2	3	4	5	
After I exercised, I focused on how good I felt.	1	2	3	4	5	
I reminded myself of positive health benefits of exercise (e.g. lose weight, tone body).	1	2	3	4	5	
I reminded myself of negative health consequences of not exercising (e.g. heart disease).	1	2	3	4	5	
I remind myself of negative appearance consequences (weight gain).	1	2	3	4	5	

	Never	Rarely	Some times	Often	Very Often	
I mentally schedule my time periods to exercise.	1	2	3	4	5	Time Management
I wrote down specific time periods to exercise.	1	2	3	4	5	
I rearranged my schedule of other activities to ensure I had time to exercise.	1	2	3	4	5	
If I had conflicts with my scheduled time periods for exercise, I chose exercise.	1	2	3	4	5	
I mentally noted barriers which influenced my ability to exercise.	1	2	3	4	5	Relapse Prevention
I mentally planned ways to overcome barriers to my exercise activities.	1	2	3	4	5	
I wrote down barriers which influenced my ability to exercise.	1	2	3	4	5	
I wrote down ways to overcome barriers to my exercise activities.	1	2	3	4	5	
I asked others to identify barriers to my exercise activities.	1	2	3	4	5	
I purposely planned ways to exercise when I was on trips away from home.	1	2	3	4	5	
I purposely planned ways to exercise during bad weather.	1	2	3	4	5	

Self-Efficacy questionnaire

		Sure I could not do it		**Maybe I can do it**		**Sure I could do it**	**Does not apply**
Factor 1 Resisting Relapse							
1	Stick to your exercise program when your family is demanding more time from you	1	2	3	4	5	(8)
2	Stick to your exercise program when you have household chores to attend to	1	2	3	4	5	(8)
3	Stick to your exercise program when you have excessive demands at work	1	2	3	4	5	(8)
4	Stick to your exercise program when social obligations are very time consuming	1	2	3	4	5	(8)
5	Read or study less in order to exercise more	1	2	3	4	5	(8)
Factor 2 Making time for exercise							
6	Get up early, even on weekends, to exercise.	1	2	3	4	5	(8)
7	Get up earlier to exercise	1	2	3	4	5	(8)
8	Stick to your exercise program after a long, tiring day at work	1	2	3	4	5	(8)

9	Exercise even though you are feeling depressed.	1	2	3	4	5	(8)
10	Set aside time for a physical activity program; that is, walking, jogging, swimming, biking, or other continuous activities for at least 30 minutes, 3 times per week.	1	2	3	4	5	(8)
11	Continue to exercise with others even though they seem too fast or too slow to you	1	2	3	4	5	(8)
12	Stick to your exercise program when undergoing a stressful life change (e.g., divorce, death in the family, moving).	1	2	3	4	5	(8)

Appendix F: Physical Activity Log

Subject#___

Activity and Accelerometer Log

Device and Activity Log

Wear the devices for seven (7) consecutive days. If you are unable to wear the device for seven (7) consecutive days, add additional days at the end of the week. Please fill out the log daily. An example entry is provided. If you take the accelerometer off for more than 5 minutes, such as showering, record when you take it off and put it back on, and any activity you performed while not wearing.

Questions? Just call or text: 334-844-1836 or email: wadswdd@aubum.edu

Example	Time On:	Time Off:	Activity while not wearing:	Location:	
	6:00 am	7:00 am	Showered and changed after walking in a.m.	Home	
	7:30	9:30 pm			
	Exercise performed: walked				

Day 1	Time On:	Time Off:	Activity while not wearing:	Location:
	Exercise performed:			

Day 2	Time On:	Time Off:	Activity while not wearing:	Location:
	Exercise performed:			

Day 3	Time On:	Time Off:	Activity while not wearing:	Location:
	Exercise performed:			

Day 4	Time On:	Time Off:	Activity while not wearing:	Location:
	Exercise performed:			

Day 5	Time On:	Time Off:	Activity while not wearing:	Location:
	Exercise performed:			

Day 6	Time On:	Time Off:	Activity while not wearing:	Location:
	Exercise performed:			

Day 7	Time On:	Time Off:	Activity while not wearing:	Location:
	Exercise performed:			

Appendix G: Data Collection Script

Intermittent versus continuous walking: Effects on physiological and psychological variables in sedentary employees during a 10-week intervention.

Data Collection Worksheet

Subject #		Movband #	
Date:		Accelerometer #	
DOB:	Height:		
Variable	Baseline	Week 6	Post test
Weight			
Waist			
BMI			
Body fat%			
Abdominal fat %			
Gynoid fat %			
Android fat %			
BMD			
VO2			
Self-regulation			
Self-efficacy			
Sedentary behavior			
Exercise adherence			
A1c			

Appendix H: Walking prescription

Walking prescription					
	W 1	**W 2-3**	**W 4-5**	**W 6-7**	**W 8-10**
Group 1	MOVband plus the recommendation of 10,00 step per day				
F	4 breaks/day/3 days/week	6 breaks/day/3 days/week	6 breaks/day/4 days/week	6 breaks/day/5 days/week	8 breaks/day/5 days/week
I	30-60%	40-60%	40-60%	40-60%	40-60%
T	5 minutes x 4	5 minutes x 6	5 minutes x 6	5 minutes x 6	5 minutes x 8
T	Walking	Walking	Walking	Walking	Walking
Group 2	MOVband plus the recommendation of 10,00 step per day				
F	3 /week	3/week	4/week	5/week	5/week
I	30-60%	40-60%	40-60%	40-60%	40-60%
T	20 minutes	30 minutes	30 minutes	30 minutes	40 minutes
T	Walking	Walking	Walking	Walking	Walking
Group 3	MOVband plus the recommendation of 10,00 step per day				

Appendix I: Text Messages

A. Text message system targeting self-regulation and self-efficacy

Messaging system		
	Self-Efficacy	**Self-Regulation**
Week 1		
Week 2		
Week 3	a. Make an inventory of your past experience with exercise. List all positive and negative you can recall. b. Analyze your capabilities: strengths and weaknesses c. What barriers may stop you for doing exercise d. What are possible solutions to overcome those barriers and become a frequent exerciser?	e. Park you vehicle further, take the stairs, and walk to your friend's office. Walk when you getting your lunch. Stand up from your chair frequently f. Find a friend, family member that is physically active and hang out hit that person. g. When we sit or remain inactive for long periods our system slows down its functioning and the rick of develop a chronic disease increase exponentially.
Week 3	h. Do you know that daily physical activity may improve your quality of life? Decrease anxiety, stress, decrease the overall risk of develop a chronic disease like diabetes, cardiovascular disease, obesity. i. Physical inactivity is really dangerous for your quality of life and overall health. Keep moving every day.	j. What is the easiest way for you to keep up with your exercise recommendation? k. Think in small goals for aerobic fitness and physical activity, share them with your friend, family, coworkers. Write them down and highlight them. Put them in a visible place in which you spend most of your sitting time. l. At this point your body may start experiencing small changes. You may fell tired. You may feel that you can't continue with your exercise. That is normal, just try to keep going. You are close to overcome that feeling.
Week 4	m. Write down your goals for exercise and share them with your friends, coworkers, and family. Show them you can do it! n. Make a plan for your exercise. How are you going to keep up with exercise while following your exercise prescription?	o. Make an inventory of your regular behavior related to exercise, sitting time, and inactive time, time watching TV, and eating behavior. How can modify them to make them better?
Week 5	p. Find physically active people. Look for what they do. What can you use from them to increase your physical activity behavior? q. What kind of activities you like the most when doing physical activity? Can you start performing them?	r. If you add physical activity to your daily schedule, very soon you will start feeling more energy to face everyday tasks. s. Park your vehicle further, take the stairs, and walk with your dog (if you have one) daily. Leave your lunch in your vehicle, so you must walk back and forth to get it!

Week 6	t. When we do exercise, sometimes we experiment positive changes, some negatives temporary outcomes may appear like soreness, join pain, tiredness, etc. It is part of the process. u. Make physical activity part of your schedule. Think in exercise as a medicine. Follow the prescription!	v. How can you confront negative situations that affect your exercise routine? w. If something unexpected comes up and it feels like the perfect excuse to do not do exercise, are you able to make a plan B? Can you set up your exercise prescription as the same as medicine prescription?
Week 9	x. Is there something that is not allowing you to follow your prescription? How can you overcome it? y. Keep doing exercise you are making a huge progress. You are on your wheels!	
Week 10	z. Share your goals with your peer and see who may need help around you. You are making the difference. Help someone to keep up with exercise. aa. Stay active, sit less, stand up often, and walk longer.	