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The majority of US adults fall short of the physical activity recommendations. The most common barriers to starting and maintaining an exercise program are a lack of time, social support, convenience, self-efficacy, and intrinsic motivation. The purpose of *Work-It Circuit* was to examine the impact of a 12-week worksite circuit training program on the health, fitness, and self-efficacy of previously underactive adults. Eligible participants were employees at a university in the southwest who fell short of the physical activity recommendations over the past six months.

The circuit training program addressed common barriers through time-efficient workouts, used self-efficacy and motivational strategies based on behavioral theories, and provided peer and instructor support with an aim to enhance exercise self-efficacy and intrinsic motivation. The program featured two full-body circuit workouts per week, with each workout lasting 19-27 minutes. Participants also interacted with each other and a personal trainer daily through simultaneous exercise sessions and in a group chat platform.

This project was a single group, pre-test/post-test, mixed methods study. Fifteen of 16 participants completed the *Work-It Circuit* program and 82% of the exercise sessions were completed. Results showed improvements in systolic blood pressure, $F(1,13) = 10.18$, $p = .003$, chest press 10-repetition maximum (10RM), $F(1,13) = 123.91$, $p < .001$, leg press 10RM, $F(1,13) = 45.95$, $p < .001$, global health, $F(1,13) = 5.29$, $p = .021$, overall physical activity, $F(1,13) = 9.46$, $p = .003$, and self-efficacy, $F(1,13) = 11.36$, $p = .001$. There were non-significant improvements in intrinsic motivation and diastolic blood pressure. No significant changes were observed in other fitness

measures. In post-program open-ended questions, participants most commonly noted the social aspect as being enjoyable while desiring more exercise program variety and flexibility. The results indicate that a time-efficient, workplace circuit training program with theory-based strategies is efficacious and could create long-term program adherence in previously underactive adults.

WORK-IT CIRCUIT: IMPROVING HEALTH, FITNESS, AND SELF-EFFICACY THROUGH A WORKSITE EXERCISE PROGRAM

by

Sean R. Preuss

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Approved by

_____
Committee Chair

To my parents, Roger and Susanna, for your unwavering support and unrelenting love since the beginning. Without your support and love, this would not be possible. Although a “thank you” is not nearly enough, *thank you*.

APPROVAL PAGE

This dissertation, written by Sean R. Preuss, has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

Committee Chair _____

Committee Members _____

_____

_____
Date of Acceptance by Committee

_____
Date of Final Oral Examination

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CHAPTER I

PROJECT OVERVIEW

Exercise is a proven approach for improving health, fitness, and longevity, but most adults are not regularly exercising enough. Regular exercise reduces the risk of many common chronic diseases and mental health conditions (Durstine et al., 2012; Haskell et al., 2007). Exercise also enhances muscle size and strength, aerobic fitness, and body composition (Buch et al., 2017). To obtain these benefits, the US Department of Health and Human Services recommends that adults participate in at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic activity each week (Physical Activity Guidelines Advisory Committee, 2018). In addition, the guidelines call for at least two weekly strength-building exercise sessions. Only 20.6% of adults meet both of these guidelines (Harris et al., 2011). When adults begin exercise programs, about half quit within six months (Larson et al., 2018).

The lack of regular exercise is due to a few factors. A few of the most common barriers cited by people who quit exercise programs are lacking time or having time-related barriers (Larson et al., 2018; Trost et al., 2002). Other reasons include a lack of social support, convenience, self-efficacy, and relying on external motivations (Kinnafick, Thogersen-Ntounani, & Duda, 2014; Trost et al., 2002). To keep people in a program long enough to obtain health benefits, factors such as support, time commitment, convenience, and motivation type should be carefully considered.

The objective of this study was to develop a worksite exercise program for underactive adults that addressed the common exercise barriers. A time-efficient exercise program was implemented, with behavioral theory-based approaches aimed at improving self-efficacy, intrinsic motivation, and social support. Adults with high exercise self-efficacy, intrinsic motivation, and support are more likely to remain in a long-term exercise program (Larson et al., 2018; Trost et al., 2002).

Background Literature

Most adults do not exercise enough to obtain health benefits (Alkhatib, 2015; Harris et al., 2011). Regular exercise is critical as it reduces the risk of developing cardiovascular disease, diabetes, obesity, and several types of cancer (Haskell et al., 2007). To obtain the health-related benefits of exercise, the Department of Health and Human Services recommends at least 75 minutes of vigorous aerobic exercise or 150 minutes of moderate aerobic exercise each week along with two or more resistance training workouts (Physical Activity Guidelines Advisory Committee, 2018). Only 20.6% of American adults report meeting these recommendations, although more objective measures indicate it might be less than 10% (Harris et al., 2011; Tucker et al., 2011).

Finding effective strategies to engage underactive individuals in exercise is only part of the existing need; maintaining exercise is another critical area to address. About half of people who start exercising quit within six months (Larson et al., 2018). Despite experiencing emotional and mental benefits, people who quit exercise programs may struggle with finding time to exercise, have difficulty prioritizing exercise with family and other responsibilities, and desire a trainer or workout partner but do not have access to one (Larson et al., 2018). For people who maintain exercise programs, key factors are

high exercise self-efficacy, support from others (e.g. family, a trainer) to exercise, and having environmental factors that make exercise convenient (Trost et al., 2002).

Exercising while at work could help make regular exercise feasible due to supplying resources that address the previously noted factors. Exercising at work does not require additional travel, which adds convenience, and the workplace provides an opportunity to receive support from coworkers (McCoy et al., 2014). Worksite gyms are also common for mid-sized and large employers, with 21.7 to 43.3% of larger companies having them (Linnan et al., 2019).

Circuit Training

Circuit training is an option that could have additional value for those who do not regularly exercise. It includes 1-3 circuits with about 10 exercises per circuit, 12-15 repetitions per set, and 30 seconds or less of rest between exercises (Buch et al., 2017). An exercise session featuring one circuit requires only 15-20 minutes (Heden et al., 2011), making circuit training an efficient form of exercise. Traditionally, resistance training is recommended for muscle hypertrophy and strength gain whereas blood pressure, blood flow, cholesterol, VO2max, and blood vessel function improvements are attributed to aerobic exercise (Waller, Miller, & Hannon, 2011). Circuit training provides all of the previously stated benefits (Buch et al., 2017; Paoli et al., 2013; Waller et al., 2011). Therefore, circuit training provides a comprehensive and appealing option for underactive working adults, who cite time as the biggest obstacle to exercise.

One study did assess the ability of a workplace circuit training program to improve health and fitness in office workers (Yoon et al., 2016). Employees performed 10 weeks of twice-weekly circuit training, with each session lasting 30 minutes. Following the program, BMI, lean body mass, body fat, waist circumference, systolic and

diastolic blood pressure, and hemoglobin A1c all improved. This program showed a twice-weekly circuit training program at work improves health and fitness. However, the research team did not assess changes in exercise self-efficacy or intrinsic motivation.

Another feature not used in the 10-week workplace circuit training program was training until momentary muscular fatigue. Momentary muscular fatigue, or "muscle failure," occurs at the point in a resistance training set when the trainee can no longer move the resistance on the concentric phase ("lifting phase") of a repetition due to accumulated fatigue (Steele et al., 2012). Training until this point adds a minimal amount of extra time while enhancing cardiovascular benefits, such as increasing arterial diameter, overall blood flow, and the quantity of mitochondria in muscle cells.

Promoting Exercise Adherence

While circuit training and training to the point of muscle failure help reduce exercise time requirements, other barriers exist. Self-efficacy is the most consistent psychological predictor of exercise maintenance (Trost et al., 2002). Gaining self-efficacy increases the number of activities a person will partake in and the likelihood a person will effectively cope when facing obstacles (Bandura, 1977). Self-efficacy development is a key focus in several behavior change theories, including the Social Cognitive Theory, Transtheoretical Model, and overlaps with perceived competence in the Self-Determination Theory (SDT) and perceived behavior control in the Theory of Planned Behavior (Ajzen, 1991; McAuley & Blissmer, 2000; Ryan & Deci, 2000). Mastery experience, or the effective performance of activities related to the target behavior, is the most effective method for enhancing self-efficacy (Bandura, 1977; McAuley & Blissmer, 2000). Another effective approach for building self-efficacy is vicarious experience, or seeing people succeed in relevant situations (Bandura, 1977).

Intrinsic motivation development is another factor preceding exercise maintenance. Intrinsic motivation is the desire to participate in an activity for the primary reason of enjoyment (Ryan & Deci, 2000). The SDT provides a framework that focuses on building intrinsic motivation (Ryan & Deci, 2000). The theory states that there are three basic psychological needs that must be met to achieve intrinsic motivation: autonomy, competence, and relatedness (Silva et al., 2008). Competence, similar to self-efficacy and perceived behavior control, is one's belief that he or she can effectively execute the targeted behavior. In exercise studies, examples of promoting competence are goal setting and providing praise (Kinnafick et al., 2014). Autonomy is feeling one has control and the ability to make decisions regarding the behavior. This is supported through enabling participants to schedule their workouts and by teaching self-regulation skills (Kinnafick et al., 2014). Relatedness is a sense of connection to others involved with the target behavior. Examples of creating relatedness are allowing participants to be in contact during and outside of exercise sessions (Kinnafick et al., 2014). Addressing the three basic psychological needs should answer common exercise barriers by providing social support (relatedness), enhancing self-efficacy (competence and autonomy), and creating internal motivation (a result of meeting all three needs). Motivation also overlaps with intention, another factor connected with behavior adoption and adherence (Ajzen, 1991). Therefore, efforts to increase motivation will also likely enhance the intention to exercise.

Previous research shows evidence of various effective approaches for enhancing health, fitness, and exercise adherence. Circuit training is effective in an amount that doesn't require people to meet the physical activity recommendations. Approaches from various behavioral theories demonstrate the ability to enhance self-efficacy, intrinsic

motivation, and intention, all of which signify a higher likelihood of exercise maintenance. However, a combination of behavioral strategies with a time-efficient circuit training program in the workplace creates a novel strategy that could lead to long-term maintenance.

Purpose and Aims

The purpose of this project was to determine the influence of a circuit training program with behavioral strategies on underactive adults' health, fitness, exercise-related self-efficacy, and intrinsic motivation for exercise.

Aim #1: Determine the influence of a 12-week circuit training program on health and fitness of underactive adults.

Aim #2: Determine the influence of a 12-week circuit training program on exercise-related self-efficacy and intrinsic motivation in underactive adults.

Methods

This program featured 12 weeks of circuit training for underactive university employees at a private southwest university. In addition to twice-weekly circuit training, strategies promoting self-efficacy, intrinsic motivation, and support were implemented. Assessments of health, body composition, fitness, motivation, intention, and exercise self-efficacy were performed before, during, and after the program.

Participants

Eligible employees were men and women who did not consistently fulfill the weekly activity recommendations of the Department of Health and Human Services over the previous six months (Physical Activity Guidelines Advisory Committee, 2018). The Physical Activity Stages of Change questionnaire (Marcus et al., 1992) was used to determine each participant's recent exercise history. The participant chose a statement

matching their current activity level. Those who met the activity recommendations for at least six months or failed ACSM's exercise preparticipation health screening guidelines were excluded (Riebe et al., 2015).

The sample featured 16 employees (12 women, four men). Participants' ages ranged from 23-56 years old (M = 35.2, SD = 8.9 years). The participants had an average baseline BMI of 28.8 kg/m^2 (SD = 5.9). Participants identified their racial/ethnic backgrounds as white (6), multiracial (4), black or African American (3), Hispanic (2), or American Indian/Alaskan Native (1).

Measures and Data Collection

Changes in health and fitness were determined through a series of assessments. Activity level, intrinsic motivation, self-efficacy, and physical activity intention were assessed through surveys that were completed before, during, and after the *Work-It Circuit* program. BMI, waist-to-hip ratio, and blood pressure were taken before, during, and after the program. Participants completed muscle endurance and cardiorespiratory assessments before and after the program. Attendance was also taken.

PROMIS Scale v1.2: Global Health. Participants completed the PROMIS Scale v1.2: Global Health. The Global Health measure features 10 items, providing self-assessed scores of global, physical, and mental health. The scale is a valid and reliable measure of physical, mental, and social health (PROMIS, 2017).

Resting Blood Pressure. Resting blood pressure is an important health measure as it predicts mortality and the onset of cardiovascular disease and diabetes mellitus (Vlachopoulos et al., 2010). Blood pressure was taken following five minutes of rest in a seated position. An automatic cuff was used on the upper arm, around the brachial artery. An automatic cuff was implemented to reduce the risk of operator error

while decreasing the time needed to assess blood pressure (Climie et al., 2011). The automatic cuff is a reliable measure and is valid with manual blood pressure measures at the brachial and radial arteries (Climie et al., 2011).

Body Composition. Health and body composition were measured by body mass index (BMI) and waist-to-hip ratio (WHR) assessments. BMI is calculated by dividing a person's weight (kgs) by height squared (m). WHR is measured by taking the average of two measurements at the waist, then dividing that by the average of two measurements at the hips (Sampaio et al., 2007). BMI and WHR are effective predictors of myocardial infarction and mortality risks (Flegal et al., 2005; Yusuf et al., 2005).

Rockport Walk Test. The Rockport walk test was performed on a treadmill. Each participant had up to five minutes to find a pace that he or she felt could be maintained for a 15-20-minute walk. After finding the speed, the treadmill was stopped and restarted to begin the test. At the end of the test, the overall time was recorded, and a 15-second heart rate was taken. These data were used to calculate an estimate of VO2 peak (Pober et al., 2002). The Rockport test (on a treadmill or flat ground) is a valid test for predicting VO2 peak in adults (Pober et al., 2002) and has high test-retest reliability (Hagerman et al., 2001). Also, the pre- and post-program one-mile walk times were compared. One-mile walk times are valid and reliable predictors of VO2 max in adults between 30 and 69 years old (Kline et al., 1987).

10-Repetition Maximum Tests. The final fitness assessment was a 10-repetition maximum (10-RM) test, performed with the leg press and chest press machines. The 10-RM test measures muscle endurance. The test started with a light warm-up, including a set with light weights. The participant then selected a weight he or she believed can be lifted 10 times. If more than 10 repetitions were performed, the

participant rested three minutes, then attempted a heavier weight. Subsequent sets were performed with progressively heavier weights, with 5-10 minutes of rest between sets. This was repeated until a 10-repetition maximum was achieved. The 10-RM test is a valid test for representing upper and lower body strength (Knutzen, Brilla, & Caine, 1999).

Self-Efficacy Scale. A five-item scale was used to assess self-efficacy (Marcus et al., 1992). The scale measured a person's confidence to continue exercising in various situations, including while on vacation, facing different emotions, and when lacking time. The items are valid and reliable for assessing self-efficacy for exercising during different moods and time constraints (Marcus et al., 1992).

Intrinsic Motivation Inventory. Participants also took the Intrinsic Motivation Inventory (IMI). The IMI is a reliable and valid measure of the degree of intrinsic motivation (McAuley, Duncan, & Tammen, 1987). The inventory assesses a person's intrinsic motivation and self-regulation related to an activity. In this study, two subscales were used: interest/enjoyment and value/usefulness. Each subscale has seven items, rated on a seven-point scale from "not at all true" to "very true." For each subscale, the scores of all items are then totaled for one overall score.

Physical Activity Intention. Physical activity intention was assessed using a three-item measure asking to what extent participants agreed with statements saying they intend to perform regular physical activity, circuit training, and exercise on their own in the future (Ghahremani, Niknami, & Nazari, 2012). The responses ranged on a five-point scale, from "very unlikely" to "very likely." The intention measure has high test-retest reliability (Dairo, Collett, & Dawes, 2018).

Godin Leisure-Time Exercise Questionnaire. This questionnaire assesses participants' overall activity levels. Participants report their average frequency of mild, moderate, and strenuous exercise sessions over a typical seven-day period. The frequency of weekly workouts in each intensity level is multiplied by a number that represents the estimated metabolic equivalents (METs). The METs for each intensity level are summed to provide an overall activity score. The survey is a reliable tool for estimating exercise volume and intensity (Godin & Shephard, 1985).

Open-Ended Questions. For the purposes of program evaluation, participants completed an open-ended survey with the following four questions:

1. What aspects of the program did you enjoy? Please explain.
2. If you were to continue this program, what changes would you make to enhance your enjoyment of it? Please explain.
3. How likely are you to continue circuit training or strength training in the future on your own time? Explain your response.
4. What else would you like to say about the program that the previous questions did not ask about?

Procedures

Following IRB approval, a one-week pilot trial was then conducted with three participants, who were recruited through word of mouth. Recruitment for the main study took place in August and September, with the intervention occurring from September through December. Participants were recruited through three university-wide emails, flyers, and meetings with individual university departments. The emails and flyers shared the research purpose, study outline, and inclusion criteria. Meetings were held to

elaborate on the research objectives, responsibilities of participants in the study, potential benefits, inclusion criteria, and the initial steps for participation.

The exercise sessions took place on the first floor of the university's only building. Employees had two blocks of time during each workday that they could choose to attend. Each block lasted 60 to 90 minutes and covered before, during, or after work hours on different days.

Circuit Training Program. Participants were asked to participate in two workouts per week on nonconsecutive days. The workout program was structured to encourage maximal efficiency. Each session featured 10 exercises, which targeted all major muscle groups. All workouts were also supervised by an ACSM-certified personal trainer. More details are included in Appendix E.

Behavioral Strategies. Multiple strategies were used to increase self-efficacy, intrinsic motivation, and intention to exercise based on the Self-Determination Theory (SDT) framework and self-efficacy research. Verbal support and the achievement of individualized goals were used to develop self-efficacy and competence. To promote autonomy, participants scheduled their own sessions and chose two exercises per session. Simultaneous exercise sessions and daily conversation in the Zoom chat were used to create relatedness. Appendix F lists all behavioral strategies used and the corresponding constructs.

Data Analysis

A repeated measures ANOVA was used to compare pre-, mid-, and post-program measures of the Godin Leisure-Time Exercise Questionnaire, Global Health scale, resting blood pressure, BMI, WHR, self-efficacy scale, IMI, and physical activity intention. Follow-up paired t-tests were performed to identify significant changes

between the three measurement times. A paired t-test was also performed to compare pre- and post-program measures from the Rockport Walk Test and both 10-RM tests. Open-ended survey responses were coded and analyzed.

Results

Fifteen of the 16 participants (93.8%) completed the *Work-It Circuit Program,* with one participant dropping out due to a health issue that was unrelated to exercise. Participants attended 82% of the sessions, an average of 19.4 of the 24 sessions. The rest of the results are shown in the following sections, broken down by aim.

Aim 1: Health and Fitness

Participants experienced a significant reduction in systolic blood pressure and waist-to-hip ratio (WHR). Significant increases were observed in 10-repetition maximums (10-RM) for the chest press and leg press. The chest press and leg press 10-RMs increased by 19.5 and 15.9%. All participants gained strength in both tests. Cardiorespiratory fitness and diastolic blood pressure did not significantly change. These results are shown in Table 1.

BMI did not significantly change over the study. A sub-analysis of those with a BMI of 30.0 or greater (n = 5) showed a nonsignificant decrease from pre- to post-study (32.32 ± 1.68 to 31.44 ± 1.39). Also, the effect size (η^2 = .772) is much stronger than the effect size of the entire study sample (η^2 = .286).

As noted in Table 2, the PROMIS Global Health Scale showed significant improvements in global health and physical health, whereas no changes took place in mental health. Global health and physical health increased significantly from pre- to mid-program. Global health also increased from pre- to post-program.

Table 1. Health and Fitness Test Results.

Measure	Pre M±SD	Mid M±SD	Post M±SD	F	η□²
Systolic BP	131.21[a] ± 24.43	127.00[b] ± 27.48	125.36[b] ± 23.72	10.18*	.629
Diastolic BP	79.00 ± 17.52	77.71 ± 16.42	76.50 ± 17.80	.77	.114
WHR	.82[a] ± .08	.81[b] ± .08	.81[b] ± .07	3.46	.366
BMI	27.64[a] ± 4.75	27.88[a] ± 4.60	27.41[b] ± 4.35	2.40	.286
CP 10-RM	84.46[a] ± 33.49		100.89[b] ± 35.35	123.91*	.905
LP 10-RM	238.65[a] ± 59.38		276.54[b] ± 72.26	45.95*	.793
1-Mile Time	16.48 ± 1.57		16.67 ± 1.95	.652	.052
Rockport	51.74 ± 10.26		49.84 ± 10.43	2.19	.154

*p < .05. Means with different letters (a,b,c) are significantly different.

Table 2. PROMIS Global Health Scale v1.2 Results.

Measure	Pre M±SD	Mid M±SD	Post M±SD	F	η□²
Global Health	40.07[a] ± 5.87	42.40[b] ± 5.30	42.67[b] ± 4.76	5.29*	.449
Physical Health	19.80[a] ± 3.71	21.47[b] ± 3.11	20.73[b] ± 3.26	3.03	.318
Mental Health	13.73 ± 2.15	14.07 ± 2.02	14.60 ± 1.84	1.85	.221

*p < .05. Means with different letters (a,b,c) are significantly different.

Aim 2: Intrinsic Motivation and Self-Efficacy

Exercise self-efficacy improved while there was a significant decrease with intention to perform circuit training. Exercise interest/enjoyment increased from pre- to mid-program with a small increase at the post-program measurement. Although the changes were not statistically significant, the effect size was large (η□² = .264). No changes were observed with the intention to exercise or overall exercise value. The results are shown in Table 3.

Table 3. Intrinsic Motivation, Intention, Self-Efficacy, and Godin Leisure Time Exercise Results.

Measure	Pre M±SD	Mid M±SD	Post M±SD	F	η□²
IMI Enjoyment	34.60 ± 8.54	37.93 ± 5.12	38.80 ± 4.59	2.33	.264
IMI Value	26.00 ± 2.07	27.13 ± 1.60	26.93 ± 2.15	1.48	.185
Exercise intention	4.73 ± .46	4.73 ± .59	4.60 ± .51	.49	.070
CT intention	4.80^{a} ± .41	4.93^{a} ± .26	4.27^{b} ± .59	8.30*	.561
Self-efficacy	17.67^{a} ± 4.08	20.67^{b} ± 3.18	22.13^{b} ± 4.53	11.36*	.636
Overall METS	19.43^{a} ± 16.08	34.43^{b} ± 13.79	34.71^{b} ± 13.96	14.82*	.712
Mod/Vig METS	11.50^{a} ± 12.32	26.50^{b} ± 10.82	23.79^{b} ± 11.68	12.68*	.679

*p < .05. Means with different letters (a,b,c) are significantly different.

Godin Leisure-Time Exercise Questionnaire

The Godin Leisure-Time Exercise Questionnaire showed a significant increase in overall physical activity METs and moderate-to-vigorous activity METs from pre- to mid-program and pre- to post-program. One participant's scores were removed from the calculations as the scores were more than three standard deviations from the pre- and mid-program means. The averages with the outlier removed are shown in Table 3.

Program Evaluation

Participants answered four open-ended questions at the end of the program, asking about program features they liked, would change, how likely they are to continue, and if there's any additional information they want to add. In terms of what they liked, the social aspect (7) was most commonly noted. The following are a few examples of the participants' comments on socializing:

> I enjoyed that we had a social aspect to the group to encourage and discuss challenges. I also enjoyed the weekly topics and how the whole group had discussions about the topic, even outside the chat.
>
> I enjoyed the camaraderie. It really felt like everyone was encouraging each other. Also, the program was flexible and it felt fun and not like work.

The other comments about enjoyable program features were focused on receiving professional help and educational resources (4), seeing progress (4), being accountable to a schedule (3), learning strength training (3), enjoying the challenge of the training (3), and the time efficiency of the workouts (2).

The majority of the participants (13) were confident they would continue, while two stated they would likely do something different. The desired changes were having more flexibility or variety with the workouts (10) and different workout times (3). The following comments are examples of the suggested workout program changes:

> I would implement more cardio. I personally love running so it would help push me to stay with the program, having two goals to accomplish.
>
> I would change the days I workout because the times available were very limited with the other commitments I have in my schedule.

Discussion and Implications

The fitness and health results align with the literature. *Work-It Circuit* sessions lasted 19-27 minutes with an overall attendance of 82%, both consistent with previous circuit training research (Buch et al., 2017; Yoon et al., 2016). Similar to previous studies, systolic blood pressure, strength, and general health all improved (Waller et al., 2011; Yoon et al., 2016).

Contrary to the literature, the *Work-It Circuit* program did not lead to improvements in BMI or cardiorespiratory fitness. As noted, the analysis with those who had a BMI at 30.0 or greater showed a nonsignificant increase with a large effect size. In previous research, circuit training reduced BMI when using a frequency of three sessions per week (Waller et al., 2011). This BMI reduction in this study indicates weight loss can be achieved with two sessions per week for obese individuals. The lack of BMI

change in the whole cohort could be due to one-third of the sample starting the study in the "healthy" weight range, falling between 18.5 and 24.9 kg/m^2. Those with a BMI of 30 kg/m^2 or more are more likely to carry extra body fat and, therefore, have a greater likelihood of losing weight in an exercise program. The lack of changes in BMI and cardiorespiratory fitness could be the lack of strict enforcement of the inter-set rest. While participants were encouraged to move quickly between exercises, inter-set rest was not timed and a few participants moved slowly through the exercise sessions. Also, improvements in cardiorespiratory fitness from circuit training programs occur in programs with more than 24 sessions (Buch et al., 2017).

Muscle endurance, as evidenced by the 10-RM tests for the leg press and chest press, increased for all participants. The effect sizes were largest for the muscle endurance changes, compared to all other tests. The large improvement is likely due to a few factors. Neurological adaptations during the first few weeks of strength training enhance strength/endurance results (Brown et al., 2017). Also, the 10-RM tests feature a similar repetition range to what was used in the *Work-It Circuit Program.*

Program retention indicates the effectiveness of behavior-based strategies. Previous research shows a retention rate around 50% for the first six months (Larson et al., 2018). Fifteen of the 16 participants (93.8%) completed the *Work-It Circuit Program*, despite all being inactive or underactive prior to the study. This retention rate could be due to a few factors. High exercise self-efficacy, social support, convenience, and time are common factors in exercise program maintenance (David et al., 2014; Larson et al., 2018; Trost et al., 2002). In this study, self-efficacy significantly increased. This could be due to the mastery and vicarious experiences, such as the achievement of weekly goals, peer support in the Zoom chat, and instructor praise of training milestones. The Zoom

chat and simultaneous workouts may be responsible for creating a sense of community, which was the most commonly noted enjoyable program feature. In regard to time, the program was efficient with a weekly commitment of 38-54 minutes.

Intention to circuit train significantly decreased from mid- to post-program with a large effect size. Paradoxically, 13 of the 15 participants said they planned to continue circuit training in the post-program open-ended questions. Despite the decrease, all participants still chose one of the highest two intention scores in the post-program survey. The decrease could be explained by proximity to the "holiday season, with Christmas and New Year's Day after the study's conclusion.

The Self-Determination Theory (SDT) states that fulfilling autonomy, competence, and relatedness should lead to intrinsic motivation (Silva et al., 2008). The increase in exercise interest/enjoyment, although not significant, indicates the application of the SDT may have been successful. Specifically, intrinsic motivation showed a trend for increasing with a large effect size (η^2 =.264). The strategies were effective in the first six weeks and participants maintained an elevated level of exercise enjoyment for the second half of the program. Relatedness and competence were likely improved, as shown by self-efficacy improvements and participants' comments on social support as an enjoyable program feature.

There were several limitations with the *Work-It Circuit* program. The sample size was small, falling short of the sample recommended by a power analysis. The study featured only one group, lacking a control group to identify the influence of confounding factors. Also, the sample was three-quarters female. While male university employees were recruited, many were too active to meet the inclusion criteria. Also, most of the on-campus employees are female. The participants' workouts all took place in the presence

of a certified personal trainer, who was also a coworker. This likely influenced workout attendance. Finally, the automatic blood pressure cuff was not calibrated, possibly influencing the accuracy of systolic and diastolic blood pressure ratings.

Future work will focus on developing a framework that can be customized for other worksites with the aim to increase long-term exercise participation. The workplace provides a unique opportunity for exercise participation as it can address many of the common exercise barriers. *Work-It Circuit* showed that less than an hour of weekly exercise along with an-onsite exercise facility and coworker support are effective for improving health, fitness, and self-efficacy in underactive adults. Future directions include continuing with the framework of peer support through simultaneous workouts and an ongoing community discussion application. Other successful program features to continue with are having professional help at the start to teach exercise form, performing periodic fitness assessments, having convenient access to a facility, and implementing a time-efficient exercise program. Feedback from participants indicates more flexibility is needed with the exercises and session time options. As a whole, this program modeled an opportunity for increasing exercise participation for underactive adults by using existing resources to address common exercise barriers.

CHAPTER II

DISSEMINATION

The results from the *Work-It Circuit* program were shared with the university's wellness committee in a presentation in January of 2020 (slideshow in Appendix H). The wellness committee creates and facilitates ongoing wellness initiatives for university employees. In addition to the results, recommendations were made to the committee with the aim of creating a long-term exercise program for current on-campus employees. To achieve long-term exercise maintenance for employees, the recommended strategies focused on providing social support, building self-efficacy, and increasing intrinsic motivation while also taking advantage of the convenience of on-campus facilities. The strategies were grounded in behavioral research theories, including the Self-Determination Theory and Self-Efficacy Theory.

Work-It Circuit **Presentation:**

Presented to the University's Wellness Committee, January, 2020

Title Slide

About three in four American adults fall short of the physical activity guidelines for Americans. Most adults are underactive, or completely inactive, despite the widespread understanding that exercise is beneficial for health and fitness. The most common reasons for not being able to stick with an exercise program are a lack of the following: time, convenience, confidence in being able to exercise, exercise enjoyment, and support.

Work-It Circuit was created to address these common reasons for not exercising. Specifically, *Work-It Circuit* aimed to improve health and fitness with employees who did not previously obtain regular exercise. The program also aimed to improve self-efficacy and intrinsic motivation in these individuals, considering these are key underlying factors in those who maintain exercise programs.

Study Details

Work-It Circuit featured two circuit strength training workouts per week, each lasting around 20-25 minutes, for a total of 12 weeks. This took place in the building gym, near the west-side elevators. Participants led their own workouts with minimal coaching from me. The participants chose their own workout times, based on 13 hours of preset times that I was in the gym, and most participants exercised at the same time as others in the program. On a daily basis, participants were supported by each other and me through a group Zoom chat. The Zoom chat was also used for a weekly topic of the week, when resources were shared to educate participants on previously requested fitness topics.

Slide with Images

A series of assessments were conducted before, in the middle of, and after the 12 weeks of training. At all three points, participants were assessed by their weight, blood pressure, hip and waist circumference, overall physical activity level, exercise enjoyment, exercise confidence, and blood pressure. Before and after the training, participants completed fitness tests. These tests were cardiorespiratory fitness on a treadmill and tests assessing muscle endurance on the chest press and leg press machines.

Results

Work-It Circuit showed several promising results. Fifteen of the 16 participants completed the study. Those 15 adults completed 82% of the workouts. Participants increased muscle endurance by 19.5 and 15.9% in the upper and lower body, with increases ranging from 9-40%. Systolic blood pressure decreased from 131 to 125 mmHg. Participants also gained self-efficacy and intrinsic motivation towards exercise.

At the end of *Work-It Circuit,* the participants also shared what they enjoyed and would change about the program. The most enjoyable aspects were the social aspect (7), receiving professional guidance and education (4), seeing progress (4), learning strength training (3), being challenged (3), and being accountable to a schedule (3). The biggest requests for changes were having more flexibility and variety with the workout program (10) and having more options for workout session times (3).

What's Next

Considering the goal of this wellness committee is to improve the health of this university's employees, I would like to work with the committee on creating an ongoing program that helps underactive employees engage in an exercise program. Based on the results of the program and participants' feedback, here are a few suggestions for a program.

To maximize accountability and having a schedule, we can have participants schedule their weekly workouts in advance with a Google Calendar. This Calendar can be overseen by the wellness team. The wellness team has an accountability system, with the team looking after other employees that are participating in fitness challenges. The same system can be applied here. The accountability coaches can help new

participants get started on the workout program. Also, the accountability coaches can contact their partners on a weekly basis to see how the workouts went.

The participants mentioned “seeing progress” as an enjoyable feature of *Work-It Circuit.* I recommend conducting monthly or bi-monthly (every other month) assessments. I can continue doing this, taking weight, blood pressure, and circumference measurements in my office during the first week of the month.

Finally, receiving education and help from a professional was noted as an enjoyable feature of *Work-It Circuit.* Since there are two personal trainers on the wellness team, we have three people (including me) who can teach exercises, answer questions, and provide educational resources when requested. We can have a chat where participants can seek insights and help.

Follow-Up

Less than two months after my presentation, the director of the wellness team announced a continuation of *Work-It Circuit* through email. The email provided details of the program, along with a survey to complete for those who want to participate. This version of *Work-It Circuit* was scheduled to start in the spring or summer of 2020. However, working from home during due to concerns related to COVID-19 has led to a delay in this program.

The new version of the program will include a few features of the study, along with added program flexibility. Features that are carried over from the study are the ability to exercise simultaneously with others, accountability with peers and supervisors (wellness committee members), the ability to choose one’s own workout times, assistance from a certified personal trainer, and periodic health/fitness assessments (blood pressure, waist-to-hip ratio, BMI, and other circumference measurements). The

participants of the new version have the opportunity to choose the support they want, with options being a continuous Zoom chat with others, access to a Google Calendar to share their own exercise days and times with others, and choosing which personal trainer they would like to have fitness assessments with. Another option that adds flexibility is the ability to choose one's own workout, instead of needing to follow the study's circuit workout sequence.

The wellness team is adding the incentive of earning points through Vitality. Vitality is an employee wellness app that rewards health-promoting efforts with points. These points, when reaching specific totals, can be converted to gift cards with popular retailers (Amazon.com, Target, etc.). Participants of the new *Work-It Circuit* will receive points for each workout, additional points for completing two or more workouts in a week, and also for completing fitness assessments with a personal trainer.

Finally, I will continue to support the program by aiding participants. When new members want help with creating a workout program, I will meet with them for the first time. Also, I will serve as one of two personal trainer options for performing fitness assessments. Considering the added flexibility plus continuation of success *Work-It Circuit* study features, I expect the program will be effective with starting and maintaining many employees in an exercise program.

CHAPTER III

ACTION PLAN

Considering about three of every four American adults are underactive, new initiatives are needed to increase exercise participation. My goal is to help Americans exercise while at work, minimizing the inconvenience of added time and travel for exercise. In pursuit of this goal, I have started at my employer, a university in the southwest. Using existing university features (wellness committee, monthly “Lunch and Learn” lecture, and monthly company newsletter), I have collaborated with the university to create a perpetual circuit training program that employees can use over the long-term to obtain health and fitness benefits while at work. This program will implement peer accountability, autonomy with choosing session times and exercises, assistance at the start from a certified personal trainer, and assessments taken by the personal trainer. Google Calendar will be used to show every participant’s session day and time and participants will have the opportunity to choose from one of two personal trainer options.

After launching the new employee exercise program at my employer, participation and retention will be monitored for three months. If participation improves and retention is high, I will start promoting to other local workplaces. I have several personal connections to another local business. The business is a Fortune 500 company with over 35,000 employees worldwide. Their headquarters is located in Phoenix, AZ. I will meet and pitch the program to the company’s human resources department. Their

company has a history of encouraging employee wellness efforts, including having softball company games along with a gym and athletic facilities on campus. If the program is successful in terms of participation and retention at this company, I will pitch to other local mid-sized businesses.

Outside of the university and the Fortune 500 company, my target dissemination mediums are published research and newsletter articles. I plan to publish in an open source journal, specifically *Exercise Medicine* or *Journal of Exercise Science & Fitness.* I am pursuing open source journal publication to make the research easily accessible, especially when sharing with exercise professionals. I have personal connections with three personal training companies (with over 75 locations combined) who mostly focus on helping underactive individuals obtain regular exercise using brief circuit training sessions. These sessions are similar to the exercise sessions implemented in *Work-It Circuit*. All three of these companies have newsletters or blogs focused on exercise research. I personally ghost write for one of these newsletters. This company has 62 locations and over 20,000 newsletter subscribers. All three companies benefit from sharing my research as their promotion in the newsletter communicates serve to build credibility for their service. The newsletter content will likely focus on the exercise program (including the total weekly exercise time and exercises used) and health and fitness changes. I will also share changes in exercise self-efficacy and qualitative themes with the company CEOs via email as they may find value in the strategies used, should exercise self-efficacy improve. These strategies could be used by employees in their facility with an aim to improve client retention. Between the newsletters, blogs, and university employees, I anticipate reaching over 22,000 people with the research results.

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APPENDIX A

CURRENT EXERCISE STAGE (INCLUSION CRITERIA)

Current Exercise Stage

“Regular exercise” is any planned physical activity (e.g. brisk walking, aerobics, jogging, bicycling, swimming, rowing, etc.) performed to increase physical fitness. This should be at a moderate effort for at least 150 minutes per week, or at a vigorous effort for at least 75 minutes a week. In addition, this includes at least two strength training sessions a week.

Do you exercise regularly according to that definition?

1. No, and I do NOT intend to start exercising regularly in the next six months.
2. No, but I intend to start exercising regularly in the next six months.
3. No, but I intend to start exercising regularly in the next 30 days.
4. Yes, I have been exercising regularly for LESS than six months.
5. Yes, I have been exercising regularly for MORE than six months.

APPENDIX B

IMI SCALES

Circle the number that represents your feelings regarding the statement. The meaning for each number is below:

- **1 = not true at all**
- **4 = somewhat true**
- **7 = very true**

Interest/Enjoyment of Exercise Program

1. I enjoyed doing this activity very much.

1 2 3 4 5 6 7

2. This activity was fun to do.

1 2 3 4 5 6 7

3. I thought this was a boring activity.

1 2 3 4 5 6 7

4. This activity did not hold my attention at all.

1 2 3 4 5 6 7

5. I would describe this activity as being very interesting.

1 2 3 4 5 6 7

6. I thought this activity was quite enjoyable.

1 2 3 4 5 6 7

7. While I was doing this activity, I was thinking about how much I enjoyed it.

1 2 3 4 5 6 7

Value/Usefulness of Exercise Program

1. I believe this activity could be of some value to me.

1 2 3 4 5 6 7

2. I would be willing to do this again because it has some value to me.

1 2 3 4 5 6 7

3. I think this is an important activity.

1 2 3 4 5 6 7

APPENDIX C

SELF-EFFICACY MEASURE

Self-Efficacy Measure

(Marcus & Forsyth, 2009) (*RQES*, 1992; *HFJ* 2009)

Physical activity or exercise includes activities such as walking briskly, jogging, bicycling, swimming, or any other activity in which the exertion is at least as intense as these activities.

Circle the number that indicates how confident you are that you could be physically active in each of the following situations. The meaning for each number is below:

- 1 = not at all confident
- 2 = slightly confident
- 3 = moderately confident
- 4 = very confident
- 5 = extremely confident

Circle one number for each of the situations below to represent your confidence for being physically active in that circumstance:

1. When I am tired	1	2	3	4	5
2. When I am in a bad mood	1	2	3	4	5
3. When I feel I don't have time	1	2	3	4	5
4. When I am on vacation	1	2	3	4	5
5. When it is raining or snowing	1	2	3	4	5

Using a scale of: 0% to 100%, complete the following statement:

I am _____% confident I can regularly perform a workout for 20+ minutes, 2x per week.

_____

APPENDIX D

PHYSICAL ACTIVITY INTENTION SCALE

Physical Activity Intention

Circle the answer that best represents your feelings.

	Very Unlikely	Unlikely		Likely	Very Likely
I intend to perform regular physical activity in the future.	1	2	3	4	5
I intend to perform regular circuit training for at least 20 minutes, twice per week, in the future.	1	2	3	4	5
I intend to continue exercising on my own in the future.	1	2	3	4	5

APPENDIX E

CIRCUIT TRAINING PROGRAM

Format:

- 2-4 people exercise at one time.
- One circuit per workout.
- 10 exercises: 8 being the same for every workout, 2 others chosen by participant in each workout.
- Each exercise performed until momentary muscular fatigue.
- Weights increased when reaching 15 repetitions.
- Two workouts per week on nonconsecutive days.
- Rest: 30 seconds or less between exercises.
- Equipment: selectorized machines and a cable machine.

Exercise Order:

1. Leg curl
2. Leg press
3. Sumo bodyweight squats
4. Chest press
5. Pulldown (neutral grip)
6. Shoulder press
7. Cable biceps curls
8. Abdominal crunch

Options for Final Two Exercises:

- Leg extension
- Reverse fly
- Push-ups
- Rope pushdowns

APPENDIX F

BEHAVIORAL STRATEGIES

Behavioral Theories and Constructs:

- Self-efficacy:
    - Mastery experience (ME)
    - Vicarious experience (VE)
- Self-Determination Theory:
    - Autonomy (AU)
    - Competence (CO)
    - Relatedness (RE)

Strategies Used (with Related Constructs):

- During each week, participants will set goals for the following week. The goals will be listed on the workout card. The participants will be coached on creating simple and realistic goals. This will be aimed at creating "successes," enabling the participants to feel progressively accomplished (ME, CO).
- Participants with the same standing appointment times will be asked to create names for their groups (RE).
- Participants will have the same first eight exercises and will choose the final two exercises for themselves during each session (AU).
- Participants are given the right to adjust a pre-set resistance load in a workout, if desired (AU).
- Participants will choose their session days and times each week by replying to the Google Calendar invites of their choice (AU).
- Workouts will occur simultaneously in the same gym, giving participants the chance to support each other as they're training while also being supported by me as I instruct each person (RE).
- "Motivation Monday": In Zoom, a recent milestone or other progress by a participant will be shared by me every Monday (VE, RE).
- "Tuesday Topics": participants will be asked (in Zoom) what exercise/fitness-related topics they'd like to learn more about. Some topics will be addressed as future educational material (articles) with research-based information. This provides more personal choice and expands education in fitness, along with providing an incentive to continue with the program (AU, CO).
- "Weekly Wins": participants will be asked in Zoom on Fridays to share personal "victories" from the past week related to training. Examples are reaching new weight loads, attending a session despite having personal obstacles, or completing a session despite not being in the mood to exercise (ME, VE, CO).

APPENDIX G

POST-PROGRAM OPEN-ENDED QUESTIONS

Post-Training Questions

Please answer the following questions and explain your answers.

1. What aspects of the program did you enjoy? Please explain.

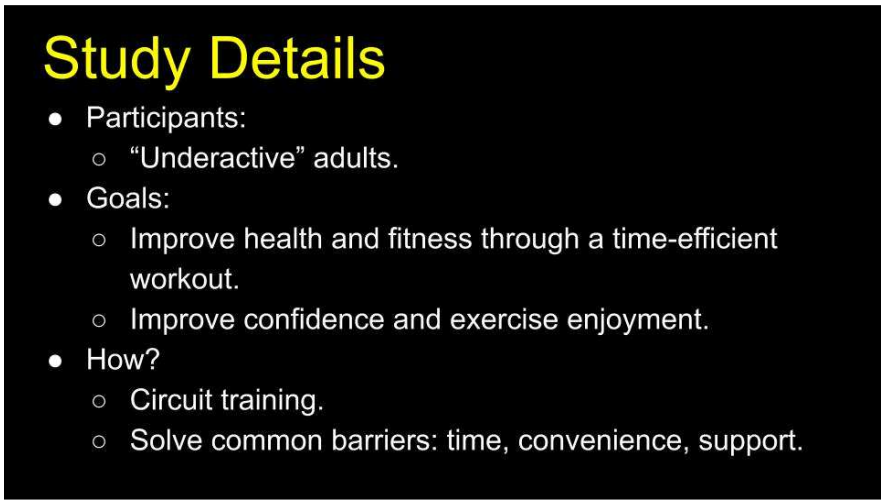
2. If you were to continue this program, what changes would you make to enhance your enjoyment of it? Please explain.

3. How likely are you to continue circuit training or strength training in the future on your own time? Explain your response.

4. What else would you like to say about the program that the previous questions did not ask about?

APPENDIX H

DISSEMINATION PRESENTATION SLIDESHOW



Results

1. 15/16 participants completed.
2. 82% of workouts attended.
3. 19.5 and 15.9% increases in muscle endurance.
4. Systolic blood pressure: 126 to 121 mmHg.
5. Enhanced exercise self-efficacy.
6. Insights gained from participants.

What's Next

My suggestions:

- Schedule sessions with wellness team.
- Accountability partners.
- New participants: have a mentor to help learn exercises, weights, and settings.
- Monthly assessments?
- My help is available with whatever program you create.