Black women are F.I.R.E.- Fitting in resistance exercise: A culturally tailored and theory-based exercise intervention for young adult women

by

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Abstract

BACKGROUND: Black women have the lowest rates of physical activity (PA) in the United States coupled with high prevalence of cardiometabolic risk factors. Resistance exercise (RE) has been shown to mitigate these health risks, however its effects and feasibility to increase exercise adherence in young Black women has been understudied. Concepts from the Social Cognitive Theory (SCT) and the Self-Determination Theory (SDT) have been associated with exercise adherence, but have not been used in conjunction with culturally-tailored strategies in this population to improve exercise adherence, physical and psychological outcomes. **PURPOSE**: This study examined the effects of a culturally tailored and theory-based RE intervention on adherence to RE, cardiometabolic disease risk factors, body composition, strength, behavioral aspects from the SCT (self-regulatory strategies and self-efficacy) and SDT concepts (competence, autonomy, relatedness, source of self-regulation) in young Black women over 24 weeks between a motivational exercise group (MEG) and a standard exercise group (SEG). **METHODS:** Thirty young, inactive Black women were randomized into MEG or SEG and received in-person RE training from a Black woman trainer in a fitness center in a predominantly Black neighborhood. Women in MEG discussed weekly topics about self-regulation and barriers and motivators for exercise in Black women while also working on improving competence and autonomy for RE. These discussions were followed up with text messages twice per week. Women in SEG only received one-on-one training. Cardiometabolic risk factors [total cholesterol, triglycerides, high-density lipoproteins (HDL), low-density lipoprotein (LDL), glucose, and waist circumference], body composition, and muscular strength were measured. Psychological outcomes included self-regulation, the basic psychological needs (competence, autonomy, relatedness), sources of motivation (amotivation, external, introjected,

identified, integrated, and intrinsic motivation), and self-efficacy. All outcomes were assessed at pre-test, post-test, and a 3-month follow-up. RE adherence was measured for supervised and unsupervised RE sessions. **RESULTS**: Women in MEG (n = 14, mean age: 23.29±3.77 years) completed 93.9% of supervised sessions compared to 88.8% in SEG (n = 13, mean age: 26.15±3.29 years), and 14.3% completed at least 2 or more days of RE unsupervised versus 15.4% in SEG. Mixed ANOVAs showed no group by time interactions for physical or psychological outcomes, but there was a main effect of time. Bonferroni post-hoc analyses showed women in MEG significantly increased lean body mass ($p < .001$), decreased body fat percentage ($p = .005$), increased upper ($p = .002$) and lower body strength ($p < .001$) from pre-test to post-test, and upper and lower body muscular strength remained significantly higher than baseline at 3-month follow up ($p < .001$). Women in SEG exhibited increases in lean body mass at post-test ($p = .023$), upper body strength at 3-month follow-up ($p < .001$), and lower body strength at post-test and 3-month follow-up ($p < .001$). Bonferroni post-hoc analyses following the main effect of time revealed that women in both groups experienced increases in autonomy and competence at post-test ($p < .001$), but ultimately decreased from post-test to 3-month follow-up (MEG: $p = .008$, $p < .001$; SEG: $p = .003$, $p = .002$). Relatedness increased significantly for MEG ($p = .001$) and SEG ($p < .001$) from pre- to post-test, but showed a decrease from post-test to 3-month follow-up for MEG ($p = .025$). Significant increases in MEG and SEG occurred for identified regulation ($p < .001$; $p = .004$), integrated regulation ($p < .001$; $p = .027$), and intrinsic motivation ($p < .001$; $p < .001$) from pre- to post-test visits. For MEG, values were significantly higher at 3-month follow-up in comparison to pre-test for identified regulation ($p < .001$), integrated regulation ($p = .002$), and intrinsic motivation ($p < .001$). For SEG, only intrinsic motivation remained higher at 3-month follow-up in comparison to pre-test

values (p = .034). Introjected regulation continually increased over the three timepoints for MEG (pre-test to 3-month follow-up: p = .003; post-test to 3-month follow-up: p = .006). Self-efficacy increased for MEG test (p < .001) and SEG (p = .014) from pre- to post-test, and decreased in MEG from post-test to 3-month follow-up (p = .011). Self-regulation increased in both groups at post-test (p < .001), and remained significantly higher at 3-month follow-up from baseline for MEG (p = .002) and SEG (p = .017). **CONCLUSION:** Ten weeks of surface level culturally-tailored RE can improve lean body mass, body fat percentage, and muscular strength in Black women. Additionally, those who successfully participated in more than 1 day of RE during the unsupervised period of the study increased basic psychological needs, and forms of autonomous and intrinsic motivation 12 weeks beyond in-person training. Deeper level cultural tailoring failed to significantly improve adherence. However, better methods are needed to improve adherence to RE during unsupervised training periods for young Black women.

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List of Abbreviations

PA- physical activity

U.S.- United States

CVD- cardiovascular disease

RE- resistance exercise

CMD- cardiometabolic disease

SCT- Social Cognitive Theory

SDT- Self-Determination Theory

MEG- motivational exercise group

SEG- standard exercise group

PAR-Q- Physical Activity Readiness Questionnaire

BPNES- Basic Psychological Needs in Exercise Scale

BREQ-3- Behavior Regulation Exercise Questionnaire-3

PASR-12- Physical Activity Self-Regulation 12

SBP- systolic blood pressure

DBP- diastolic blood pressure

TC- total cholesterol

TG- triglycerides

HDL-C- high-density lipoprotein

LDL-C- low-density lipoprotein

BMI- body mass index

3RM- 3-repetition maximum

Chapter 1: Introduction

Physical Activity and Cardiometabolic Health

Physical activity (PA) rates in the United States (U.S.) are troubling as only 30.0% of adults are meeting the aerobic PA guidelines only, 3.6% are meeting the muscle strengthening guidelines only, and (24.1%) are concurrently meeting the guidelines for both types of activity (1). Men are more likely to meet PA guidelines (27.6%) compared to women (20.8%), and across biological sex, Black women are less active (13.1%) than White (24.0%), and Hispanic women (17.1%) (1). Regular participation in PA or exercise promotes health benefits such as reduced risk for cardiovascular disease (CVD), metabolic disease, hypertension, dyslipidemia, stroke, some cancers, all-cause mortality, and improvement in cognition, sleep, and body composition (2). While both aerobic and muscle-strengthening exercise have positive effects on health (2), less Americans participate in resistance exercise (RE) (1), and many PA and exercise interventions in Black women focus on aerobic activities only (3-6). Resistance exercise, a type of muscle-strengthening PA, elicits positive impacts on cardiometabolic disease (CMD) risk factors (7), body composition (8), and physical strength (9). Women have previously expressed concerns with performing RE such as developing “manly” figures, feeling unwelcomed by men in strength areas, and lack of encouragement (10). However, positive sentiments about RE have also been expressed by women who have referred to it as enjoyable (11-13) and reporting it makes them “feel strong” (Jones-2024-in review). Thereby, implementing RE interventions in Black women may be an underutilized strategy to increase sustained PA and exercise participation to prevent negative health outcomes.

Black adults exhibit higher rates of obesity (49.9%) compared with the national average (41.9%), with Black women exhibiting higher rates (57.9%) than Black men (40.4%), White women (39.6%), Hispanic women (45.7%), and Asian women (14.5%) (14) Obesity increases the risk for cardiovascular disease, type 2 diabetes, hypertension, cancer, and mortality (15). Currently, Black adults have worse CMD risk profiles than White adults based on summed scores of the presence of risk factors for CMD ranging from optimum, average, or poor (16). Black adults were 14.7% likely to have "poor" CMD risk profiles compared to 11.1% of Hispanic, and 9.3% of White adults.

Young adults are also a vulnerable population regarding risks for developing CMD risk factors nationally (17) and internationally (18). Rates for obesity (19), diabetes (20), and hypertension (21, 22) have increased in young adults over the past 20 years. Disparities in CMD outcomes also exist in this population as young Black adults exhibit poorer CMD health measures than other racial or ethnic groups (17). For example, in comparison to young White adults, young Black adults have higher rates of obesity (44.1% versus 33.4%), hypertension (16.9% versus 8.9%), prediabetes (30.3% versus 22.2%), and diabetes (6.1% versus 3.4%). Young Black adults are also more likely than young White adults to have two or more lifestyle risk factors that exacerbate these conditions such as insufficient PA, bad eating habits, and poor sleep quality (56.4% versus 20.1%, respectively). Young adults are uniquely positioned between adolescence and middle-age where they make many of their own decisions including participating, or not, in health behaviors, such as PA that can shape their future health outcomes (23). The combination of inadequate PA and increased chances of developing CMD risk factors warrants the need for targeted interventions in young Black women to prevent and mitigate the onset of negative health conditions.

Overview of PA and Exercise Interventions in Black Women

Previous systematic reviews assessing PA and exercise in Black women revealed that the dominant type of PA and exercise interventions are aerobic-based such a walking (24-27) and group aerobic classes (28-31). Additionally, middle- and older-aged women were most likely to be participants and few studies included long-term follow-up measures and outcomes (4-6). Researchers have used culturally sensitive approaches, such as incorporating participants' cultural characteristics, values, and norms, to strengthen the connection between the participant and the study and increase the chances of sustaining a new behavior (32). This included deep-level strategies such as focusing on barriers to PA or exercise commonly experienced by Black people (25, 33-36), and including friends or romantic partners (13, 27, 37), and surface-level strategies including ethnicity-matched instructors (28, 31, 38) and adapting educational materials for this demographic. More recent studies have incorporated evidence-based strategies from theoretical frameworks (6), which represents an improvement from studies conducted 10-20 years ago (4, 5).

Resistance Exercise in Women

Recent studies have provided evidence that young women who exercise regularly prefer RE as their primary mode of exercise (39) (Jones 2024-in review). However few Black women participate in RE (1). Novelty of exercises tends to increase an individual's desire to perform and master a new skillset or activity which can lead to increased interest and enjoyment and overall intrinsic motivation (40). Feedback from women who completed resistance exercises stated it was "*...such a new experience for me. I really enjoyed it,*" (11) and one older Black woman shared her experience with RE stating, "*...cause I have never, I'm talking about have NEVER lifted weights… I mean I have walked…but weights…this was BRAND new to me. But I liked it!*"

(13). The drive to increase competency or mastery of a skill has been associated with increased motivation to continue a behavior (40). Given that RE presents a new challenge to novice exercisers and drives the need to master the behavior, this mode of exercising is worthy of further investigation on adherence to exercise and the use of SDT constructs to strategically increase adherence.

Few studies in Black women have incorporated muscle-strengthening activities such as RE (41-43). Of these studies, positive outcomes have emerged such as reductions in fat mass (41, 43), HbA1C (41), and increased upper and lower body strength (41, 42). However, it is important to note that these results are based upon concurrent training including both resistance and aerobic exercise training simultaneously and do not include culturally tailored or theory-based strategies. Also, none of studies collected long-term follow up adherence data (41-43). Examination of long-term outcomes is important to identify sustainable solutions to increase PA and reduce CMD risk factors in this high-risk population (4, 6). Previous studies have shown the feasibility in teaching novice exercisers how to complete RE and have demonstrated long-term adherence without supervision of a professional trainer (44-46). Therefore, given the variability in PA and exercise outcomes in Black women using primarily aerobic activities (3-6), there is a critical need to examine the use of RE-based interventions as the primary mode of exercise to assess adherence and to further examine its effects on CMD risk factors and body composition in young, Black women.

Theory-based Strategies to Increase Exercise Adherence in Black Women

In a systematic review examining PA and exercise interventions in Black women by Jenkins et al., 22 of the 32 studies utilized a theoretical framework, which was primarily based on concepts from the Social Cognitive Theory (SCT) (6). Other theoretical frameworks have

been used less frequently, such as the Transtheoretical Model (used in conjunction with the SCT) (34, 35, 47-49), the Health Belief Model (50, 51), and the Social Ecological Model (30). The SCT was developed by Albert Bandura and is based on the belief that the action of a behavior is determined by personal/cognitive, behavioral, and environmental factors that influence one another (52) through a bidirectional relation titled reciprocal determinism. Bandura suggests that a behavior can be learned through observational learning and can be impacted by self-regulatory strategies and social support. Examples of self-regulatory strategies include goal setting, reinforcements, self-monitoring, self-evaluation, and incorporating social support, and have been significant factors in exercise adherence (31, 53-58). These strategies have been used to promote exercise adherence in Black women, but successful short-term results have varied, and long-term results were not measured (25, 31, 36, 59). In addition to self-regulation, the SCT proposes the concept of self-efficacy, which is defined as an individual's belief in their capability to have control over their actions. In previous exercise promotion studies, participants who had higher self-efficacy to exercise were more likely to perform the behavior (60, 61). However, despite the efforts to increase self-efficacy and introduce self-regulation strategies to inactive Black women, the impact of the use of SCT to increase PA or exercise remain unclear as conflicting results exist in the literature (6).

The Self-Determination Theory (SDT) is a less frequently used theoretical framework used in PA and exercise promotion, however, the theoretical tenets are associated with increasing PA, exercise behaviors, and adherence (62). The SDT was originally created by Deci and Ryan and suggests that motivation is steered by the level of self-determinism within an individual (40). Additionally, the fulfilment of three basic psychological needs (competence, autonomy, and relatedness) can increase self-determination or the feeling of being in control of one's own

actions. Deci and Ryan propose that motivation is on a continuum from amotivation (no motivation) to extrinsic motivation (external influences) to intrinsic motivation (inherent satisfaction) in which the type of motivation guides the reasoning and action of the behavior (63). The source of motivation aligns with the amount of control an individual has over their behavior, such that amotivation is associated with non-regulation and is likely that the person will not perform the targeted behavior. In contrast, intrinsic motivation is associated with the highest level of self-determinism signifying the individual has a strong feeling of self-control over a behavior and is more likely to adhere to performing it due to a sense of competence, autonomy or relatedness associated with completing the behavior (40, 62, 64).

Few studies have assessed the utility of the SCT and SDT together to increase exercise. However, a study by Silva et al., demonstrated favorable results using self-regulatory strategies to increase intrinsic motivation in women (65). In a 12-month exercise study, participants in an autonomy-supportive experimental group were encouraged to self-initiate their behaviors and choose activities that they enjoyed, and they were provided a menu of options to help support their behavior change (65). Although not measured, self-regulatory procedures such as goal setting, self-monitoring, and strategies to overcome barriers were also introduced. In response, the experimental group showed higher amounts of autonomous regulation (i.e. integrated or identified motivation) and intrinsic motivation than participants in the control group (65). Additionally, the experimental group exhibited significant increases in exercise (i.e., steps/day and self-reported moderate-to-vigorous PA), improved body composition (decreased fat mass and body fat percentage, increase in lean body mass), and exhibited higher adherence to the intervention sessions. Results from a cross-sectional analysis in college students who exercised also showed that students who exercised frequently had high levels of intrinsic motivation and

positive emotion for exercise and this was further increased with the addition of self-regulation. These results demonstrate the utility of combining self-regulatory strategies from the SCT with SDT to maximize exercise adherence.

Summary

Black women are disproportionately affected by physical inactivity which may contribute to higher rates of and susceptibility to obesity and other CMD risk factors (1, 16, 66). Although underrepresented in the literature, there has been increasing research exploring successful strategies to increase PA or exercise adherence in Black women (6). Despite the use of culturally-tailored and theory-based interventions using various approaches, PA and exercise outcomes show mixed results (6). This raises uncertainty in the best practices to increase PA and exercise behavior in Black women. Lastly, the RE studies conducted in Black women have all been concurrent training and did not measure or report long-term adherence data leaving uncertainty to the sustainability of the protocol.

Implementing culturally tailored PA or exercise interventions has become a more commonly used strategy for exercise promotion in this population. Evidence also supports that self-regulatory strategies and fulfilling the basic psychological needs of the SDT can have a positive impact on body composition (45) and exercise adherence (62), however long-term assessment in Black women is underreported in the literature. Additionally, RE has shown the potential to improve body composition (8, 44), increase short- and long-term exercise adherence (44-46, 67), and provides a challenging and enjoyable form of exercise (11, 13). Despite these positive outcomes, most of the exercise interventions in Black women utilize aerobic training as the primary mode of exercise. The combination of a culturally tailored and theory-based intervention has not been used to promote adherence to RE in Black women. Additionally, the

combination of concepts from the SCT and the SDT shows potential merit (54, 65), yet this remains an untapped approach in this demographic. Increasing a participant's autonomy, competence, and sense of relatedness can lead to increased intrinsic motivation, and this could be further strengthened with the addition of self-regulatory strategies.

Statement of Purpose

The purpose of this study was to examine the effect of a culturally tailored and theory-based RE intervention on resistance exercise adherence, CMD risk factors, body composition, and strength in young Black women over 24 weeks between a motivational exercise group (MEG) and a standard exercise group (SEG). Additionally, the effects of the intervention on psychosocial and behavioral aspects from the SCT (self-regulatory strategies and self-efficacy) and SDT (competence, autonomy, relatedness, source of self-regulation) was assessed between the two groups over the course of the study.

Research Questions and Hypotheses

Research Question 1: Determine whether there is a difference in short-term and long-term resistance exercise adherence between a MEG and SEG in response to a RE intervention in young Black women?

Hypothesis 1: Women in MEG will participate in more RE measured by the total number of days of full body RE at 12 and 24 weeks compared to women in the SEG.

Research Question 2: Determine whether there are differences in CMD risk factors, body composition, and strength between a MEG and SEG after 12 and 24 weeks of RE in young Black women?

Hypothesis 2: Women in MEG will experience greater improvements in CMD risk factors (blood pressure, lipid profile, glucose, and waist circumference), body composition and strength than women in the SEG at 12 and 24 weeks.

Research Question 3: Determine whether there are differences in psychosocial and behavioral outcomes between a MEG and SEG after 12 and 24 weeks of RE in young Black women?

Hypothesis 3: Women in the MEG who receive behavioral strategies will have a higher: competence, autonomy, relatedness (measured by the Basic Psychological Needs in Exercise Scale), degree of self-regulation (measured by the Behavioral Exercise Questionnaire-3), self-efficacy (measured by the Self-efficacy to Regulate Exercise scale), and self-regulatory strategies (measured by the Physical Activity Regulation 12-item questionnaire) than women in SEG at 12 and 24 weeks.

Limitations

The current study had limitations that should be addressed. Convenience sampling at and near a university campus can potentially limit generalizability of the results to other Black women. Results for long-term adherence measurements relied on self-report data and could potentially be over or under estimations of actual resistance exercise behaviors. Furthermore, only days of training were able to be assessed versus total volume of training. Finally, this study only aimed to recruit 30 participants and should be completed in a larger sample size.

Delimitations

The results from this study will be limited by certain confinements. Specifically, participants must identify as a Black woman between the ages of 18-34 years to be eligible for the study. Women must not be regular exercisers defined as performing exercise at least 30

minutes per day, three days per week, for the past three months, and cannot be pregnant or intending to become pregnant during the study's timeframe. Lastly, all women of the study were required to live, work, or be a student within the city limits of Auburn, AL to be eligible for membership at the chosen community fitness center.

Chapter 2: Review of the Literature

Physical Activity and Exercise

Physical activity can be defined as "bodily movement produced by the skeletal muscles that results in energy expenditure" (2, 68). The 2018 PA guidelines recommend adults participate in 150 minutes of moderate-intensity PA or 75 minutes of vigorous-intensity aerobic PA each week, as well as at least two days of muscle-strengthening activities including all major muscle groups (chest, back, arms, shoulders, legs, and abdomen) (2). These recommendations can be met through various domains of PA including occupational, transportation, household, or leisure-time PA. Physical activity differs from exercise in that exercise is a planned and repeated behavior with the goal of some form of self-improvement (68) and most closely aligns with the domain leisure-time PA. However, the terms PA and exercise are frequently used interchangeably in the literature despite their different meanings.

Participation in aerobic and muscle-strengthening activities decrease the chances of CMD risk factors (obesity, hypertension, insulin resistance, dyslipidemia), some cancers, all-cause mortality, and body composition (69). Regular exercise can also lead to brain health benefits such as improved cognition, quality of life, sleep, anxiety, depression, and depressive symptoms. Independently, aerobic activity can also increase cardiorespiratory fitness and muscle-strengthening activities can improve muscular fitness and risk of falls balance (2). Despite these benefits, merely 24.1% of adults in the U.S. are meeting the full aerobic and muscle-strengthening guidelines with a higher percentage of men (27.6%) than women (20.8%) (1). Additionally, more Americans are participating in aerobic PA than muscle-strengthening PA (30.0% versus 3.6%), resulting in a missed opportunity to receive the benefits of RE. Black women specifically have the lowest percentage of persons meeting the full PA recommendations

at 13.1% in comparison to White women (24.0%) and Hispanic or Latina women (17.1%). Black women are also less likely to meet the aerobic only PA recommendations (26.5%) compared to White women (30.6%) and also less likely to meet the muscle-strengthening only recommendations (3.3%) compared to White women (3.9%). Aerobic only and muscle-strengthening only percentages were similar to Hispanic or Latina women (26.6% and 2.3%, respectively) (1). These data underscore the need to discover and implement tailored strategies to increase PA and exercise in Black women to mitigate these disparities and the detrimental consequences associated with physical inactivity.

Cardiometabolic Disease Risks

There is strong evidence linking PA and exercise participation to reduce the risk of obesity, hypertension, type 2 diabetes, CVD, metabolic disease, stroke, heart failure, some cancers (bladder, breast, colon, endometrial, gastric, and renal), and all-cause mortality (69). Black women have the highest rates of obesity in the U.S (57.9%) in comparison to non-Hispanic White women (39.6%), Hispanic women (45.7%), and non-Hispanic Asian women (14.5%) (14). Examination of obesity by age group amongst Black women also demonstrates little variation in prevalence rates across adulthood reflected in the following percentages: 20-39 years- 56.7%; 40-59 years- 57.5%, ≥ 60 years- 57.5% (70). This trend is deviant from women from different racial and ethnic backgrounds in which obesity across the lifespan resembles a bell-shaped curve. Additionally, Black adults have increased prevalence for other cardiometabolic risk factors such as type 2 diabetes, hypertension, dyslipidemia, and obesity and have a greater number of compiled CMD risk factors than their racial counterparts (16, 17).

Risks factors for CMD are appearing earlier in life as noted by increased numbers of hospitalizations for myocardial infarctions and strokes in adults under the age of 50 years (71,

72). Amongst young adults, Black adults experience a greater amount of lifestyle risk factors for developing CMD such as having insufficient PA, poor diet, and poor sleep quality compared to other races (17). Prevalence rates of hypertension, diabetes, prediabetes, and obesity are all greater in Black adults versus young White adults. The combination of these medical and lifestyle risk factors places young Black adults in a critical position that warrants assistance to help alleviate some of these risk factors. Interjecting during this stage in life is pivotal as behaviors established during these years can affect health later in life (23).

Resistance Exercise

The benefits of RE are well-documented (2), yet fewer Americans participate in this type of exercise (1). Aerobic activities decrease fat mass (73-75), however, muscle-strengthening activities, such as RE, positively affect all parts of body composition such as decreases in fat mass (8, 44), increases in lean body mass (76-78), as well as improvement or maintenance of bone mineral density (77, 79). Although there have been some studies to question the efficacy of RE on fat mass (78), others have shown a positive impact. In fact, Wewege et al. conducted a meta-analysis assessing resistance training of body fat percentage, fat mass, and visceral fat (8). Results from 41 studies using resistance training showed overall reductions in body fat percentage by -1.46% (95% CI: -1.78 to -1.14, $p < 0.0001$), fat mass (-0.55 kg [95%CI: -0.75 to -0.34, $p < 0.0001$), and visceral fat (-0.49 [95% CI: -0.87 to -0.11, $p = 0.011$). For women only, decreases in body fat percentage were slightly greater with reductions by -1.53% (95% CI: -2.14 to -0.91, $p < 0.0001$) and fat mass by .35kg (95%CI -.60 to -.09, $p = .008$).

Beyond the physical benefits of RE, participants from interventions that incorporated RE stated participants enjoyed participating in a new type of exercise and RE provided a new challenge for them (11, 13). A systematic review assessing factors associated with RE further

support these results by concluding an increase in affective judgement or feelings of enjoyment expected and received from performing exercise was positively correlated with exercise adherence (12). Other studies not included in this review but implemented RE protocols showed consistent findings (11, 45, 80). Moreover, pilot data from two studies in young women who exercised regularly demonstrated that RE was their preferred mode of exercise (39) (Jones 2024-in review). Data from semi-structured interviews in young Black women who maintained exercise for six months or greater revealed they preferred to participate in RE for the physical challenge, the variations in types of exercises, and the goal to increase muscle mass (preferably in their lower body) (39). Addtionally, a survey in young adult women who exercise regularly for the past three months identified RE as their primary mode of exercise mainly to build muscle mass and strength and because it made them "feel strong" (Jones, 2024-in review). These studies also highlight that setting personal challenges and goals are primary motivators for peforming RE on a frequent and sustained basis. As intrinsic motivation has been frequently linked to exercise adherence (62, 64), evidence from the above studies support the inclusion of RE intervetions and it's potential to lead to long-term maintence.

Barriers to Physical Activity/Exercise in Black Women

Prior to developing strategies to increase PA and exercise in Black women, barriers specifically encountered by this population must be understood. Previous studies have explored Black women's experiences with PA and exercise and revealed common challenges including personal (24, 81-84), social/cultural (24, 81, 82, 85-87), and environmental barriers (81-84). Recently, a study in Black women between the ages of 18-60 reported lack of motivation as the leading cause for not participating in exercise (24), which is consistent with previous studies (81, 82). Other personal barriers included fatigue from work or standing for extended periods

throughout the day (81-83). This was accompanied by lack of time which was frequently attributed to other daily/weekly obligations such as family, school, work, household chores, and attending church (24). The presence of health issues such as hypertension, arthritis, and general pain during exercise was reported and some women believed exercise could further exacerbate their current health issues (81, 83, 84).

A common cultural barrier stated amongst Black women is the lack of experience or knowledge beyond physical education classes in public schools, and not being taught how to exercise (24, 81, 82, 85). Additionally, lack of role models was a barrier as women stated they did not see their own mothers exercising while growing up due to other priorities, work, and household responsibilities. Growing up, some women were told by older women of the family that exercising was "selfish" or "unladylike" (85). Other cultural barriers reported included hair maintenance as challenge stating their hair texture adds an additional burden and requires more time and money to maintain (53, 85). Body shape was another common barrier, as many Black women reported the desire to have a larger and more curvaceous body shape that could be negatively affected by participating in exercise (87). Lastly, environmental barriers included facility costs, weather (excessive heat or rain), and safety (81-84). The presence of misbehaved children, crime, unleashed dogs, and lack of lighting or sidewalks all contributed to lack of neighborhood safety. Understanding these unique barriers is essential in the process of developing strategies to promote exercise participation in interventions for Black women.

Theory-based Strategies for Behavior Change

Previous research has incorporated theoretical constructs to support and guide positive changes in exercise behavior for Black women (31, 35, 88). According to findings from two systematic reviews covering PA and exercise interventions in Black women, there has been a

positive shift in the use of theory-based strategies aiming to increase exercise adherence with the most frequently used theory being the SCT (4, 6).

The Social Cognitive Theory

The SCT is one of the most commonly used theoretical frameworks in exercise interventions as the tenets of self-regulation and self-efficacy have been strongly associated to regular exercise participation (31, 53, 54). The SCT by Albert Bandura proposes that behavior is in a constant triadic relationship with personal/cognitive factors and environmental factors (52). This bidirectional interaction is referred to as reciprocal determinism; meaning any of these three factors can influence one another and vice versa. Motivation to achieve a targeted behavior change can be influenced by the constructs of the SCT such as observational learning, self-efficacy, outcome expectations, and self-regulation strategies including social support. In observational learning via modeling, an individual may acquire knowledge and consequences of a behavior while lessening the amount of trial and error in the learning process (52, 89). However, retaining this behavior requires more than complete observation as an individual must also see the functional value of a behavior to sustain interest. If an individual can consistently participate in the behavior in the absence of the model, then retention of the behavior has been achieved, increasing the likelihood of participation in the activity (89). Later, Bandura incorporated self-efficacy into the SCT, which is an individual's belief in their capability to exercise control over a targeted behavior even in challenging conditions (90, 91). Self-efficacy can be positively influenced by an increase in knowledge and competence of a new skill or the internal challenge to improve inherent skills (91). Higher self-efficacy leads to increased effort and interest in a behavior along with sustainability (90). Additionally, those who are more

efficacious tend to continue setting higher goals and are more resilient when faced with challenges to complete the behavior.

After observing a behavior, an individual may develop outcome expectations like those of the model. The effect of the outcome will influence the individual's decision in completing the behavior, as a more positive outcome increases the likelihood of behavior adoption (52). An individual's own outcomes in response to completing the behavior can determine future participation. Bandura proposed that individuals have the cognitive ability to exercise control over their own actions using a set of self-regulatory strategies (52). These strategies include goal setting, self-monitoring, and reinforcements (90). Goal setting can include establishing proximal or smaller, progressive goals to overcome a challenge leading to the overall or distal goal. Self-monitoring provides a method for individuals to assess their behavior and to evaluate their progress towards reaching their goals (92). Reinforcements involve evaluating and responding to feedback from the action and outcomes of the behavior (positive or negative) and making strategic adjustments to increase the likelihood of sustaining the targeted behavior (52, 90). The knowledge and use of self-regulatory strategies strongly increase self-efficacy and motivation in the adoption and maintenance of a targeted behavior (93). In addition, social support is an integral facilitator of a behavior change by increasing an individual's perceived efficacy to engaging in a behavior. While establishing a social network is a strategic mechanism for sustaining a behavior, it should not overshadow or replace an individual's internal motivation (93).

The Self-Determination Theory

Theoretical concepts from the SDT have been related to increased exercise adherence and predictions of exercise behaviors (62). Although a recent meta-analysis about the SDT and health

behaviors reported this theory having a small effect on PA (94), other exercise studies have shown potential to improve physical health outcomes such as muscle-strengthening PA (95), body composition (96), and exercise adherence (67). The SDT was originated by Ryan and Deci in 1985 and proposes that human behavior is motivated by both intrinsic and extrinsic factors (40). Furthermore, for one to be self-motivated or self-determined to complete a targeted behavior, three basic psychological needs must be met which include competence, autonomy, and relatedness. If these psychological needs are fulfilled, then an individual's motivation will transition from external motivation to internal motivation, which increases the likelihood of completing that behavior more frequently.

Competence is one of the three basic psychological needs and refers to the sense of being able to understand and master a behavior. Ryan and Deci describe this concept as a feeling of satisfaction after effectively completing an action (40). The mastery of an action or behavior will increase inherent or intrinsic motivation, and this ongoing process can drive individuals to seek new challenges and "stretch one's abilities". The second basic psychological need is autonomy which is defined as the need to feel a sense of choice in one's actions or interactions with the environment. Whether an individual is in complete control over their own actions or not, self-determination or autonomy is fulfilled if they have a choice in the control of their outcomes. This freedom of choice in one's actions can increase intrinsic motivation opposed to having limited or no options, which can deter motivation. However, to make intelligent autonomous and self-determining decisions, one must also have the appropriate knowledge or skillset to navigate a particular environment or situation. The third psychological need, relatedness, refers to sense of connection and belonging (63, 97). Ryan and Deci explained that the feeling of being significant to others or being cared for is an integral part of maintaining intrinsic motivation. Although

relatedness is a key component of the SDT, it has been suggested that it is less influential on intrinsic motivation than competency and autonomy given that individuals can still be intrinsically motivated to complete a behavior alone (63). The fulfillment of these three basic psychological needs not only play a key role in motivation, but also the overall well-being of humans (97).

Within SDT, motivation falls on a continuum from amotivation, extrinsic motivation and intrinsic motivation. Amotivation is defined as the lack of intention to complete a behavior resulting in a lack of motivation (63). Extrinsic motivation is external factors that act or persuade someone to complete a behavior and are oftentimes driven by rewards, avoiding punishment, or social influences. In contrast, intrinsic motivation is the inherent feeling to complete a behavior out of interest to receive satisfaction or enjoyment (63, 97). Along this continuum, individuals undergo an internalization process in which they strive to transfer behaviors that are determined by external factors into behaviors that are self-determined and that align with their own values. This internalization process encompasses several forms of regulation beginning with no regulation and eventually ending with intrinsic regulations. Figure 1 below depicts the self-determination continuum of motivation and self-regulation.

Behavior	**Nonself-determined**					**Self-determined**
Type of Motivation	Amotivation	Extrinsic Motivation				Intrinsic Motivation
Type of Regulation	Non-regulation	External Regulation	Introjected Regulation	Identified Regulation	Integrated Regulation	Intrinsic Regulation

Source Of Motivation	Impersonal	External	Somewhat External	Somewhat Internal	Internal	Internal
Regulatory Processes	Non-valuing, lack of control	Compliance, rewards, punishment	Self-control, internal rewards, and punishments	Personal importance, conscious raising	Congruence, awareness	Interest, enjoyment

Figure 1: The Self-determination Continuum of Motivation and Self-regulation

Adapted from Ryan and Deci, 2000 (63)

Behaviors that are externally regulated are primarily performed to obtain an extrinsic reward and are controlled by outside factors such as financial rewards. Introjected regulation describes behavior controlled by feelings of shame, guilt, disapproval from oneself or others, and internal or external pressure (97). These stressors are sourced from external factors therefore remaining extrinsically motivated. As an individual transitions to identified regulation, they begin to recognize the value of a behavior and develop a personal obligation to complete it. Furthermore, as one reaches integrated regulation, their personal values and beliefs assimilate with their targeted behavior as it becomes a part of their identity. During this stage, extrinsic motivation has the least amount of control, and individuals have a higher sense of autonomy leading to more persistent acts of the behavior. Once an individual reaches intrinsic regulation, motivation is fully internalized and the decision to perform a behavior is completely self-determined potentially resulting in behavior adherence (63, 97).

Increases in autonomous and intrinsic motivation are associated with exercise adherence. In a systematic review conducted by, Teixiera et al., amongst a variety of exercises, the review demonstrated that identified regulation is a strong predictor of adoption and short-term

adherence, as intrinsic motivation is a stronger predictor of long-term exercise adherence (62). Additionally, perceived competence was the most frequently assessed and strongest association with PA out of the three basic psychological needs. Results related to autonomy produced more mixed results as 60% reported no association with exercise behavior. Relatedness was assessed the least and studies showed no significant association, although data trended towards a positive association (62). It is evident that increases in intrinsic motivation and competence can lead to increases in exercise adherence; however, findings related to autonomy and relatedness and their association with exercise adherence differ across studies (62). These findings demonstrate the need to assess various motivational strategies in exercise interventions and their effects on basic psychological needs and exercise adherence.

Social Cognitive Theory and the Self-Determination Theory

The use of theoretical frameworks, SCT and SDT, have been shown to increase PA and exercise outcomes in greater capacities than interventions that do not (98). Typically, in PA and exercise promotion intervention studies, theoretical frameworks are used as a single approach to increasing favorable PA or exercise outcomes. The use of self-regulatory strategies from the SCT and increased intrinsic motivation from the SDT have continually, but separately shown efficacy to improve exercise outcomes such as adherence (44, 45, 62, 67, 96). However, given the low PA rates in America (1), more rigorous strategies should be explored. The SCT has been the dominant theoretical framework used to increase PA and exercise outcomes; however, there is some evidence that the addition of the SDT may augment results for exercise participation. For instance, in a cross-sectional study conducted by Ahn et al. (2016) amongst university students, self-regulation ability showed a positive association with exercise participation levels which was further increased by high intrinsic motivation (99). Silva et al., showed improved outcomes for

exercise, autonomous motivation (identified and integrated regulation), and intrinsic motivation in the experimental group that was able to self-select exercises and utilized self-regulatory strategies throughout the 12-week intervention (65). Additionally, Ryan and Patrick, (2009) noted that competence can be positively affected by an individual's social environment and strategies such as reinforcements and offering meaningful feedback to participants could potentially increase the fulfillment of the basic psychological needs (100). Although some evidence exists, there remains a need to assess the effect combining SCT and SDT constructs on exercise adherence.

Culturally Tailored Strategies for Physical Activity and Exercise Promotion in Black Women

As prevalence rates for physical inactivity, obesity, and other CMD risk factors consistently remain high for Black women, many strategies have explored and implemented efforts to increase PA rates and exercise adherence. A commonly used strategy in Black participants involve using culturally relevant methods, which demonstrate an increased likelihood of long-term adherence to a behavior (32). Culturally relevant strategies include incorporating cultural characteristics, experiences, norms, values, social, or environmental components related to a targeted population. This term can further be divided into surface structure level or deep structure level and is believed to increase the receptivity and success of PA and exercise interventions (32). Surface structure level strategies include adapting or providing materials based upon observable or superficial qualities of the targeted population (e.g., having ethnicity-matched interventionists/trainers). Deep structure level strategies require the knowledge and inclusion of the targeted population's social norms, beliefs, historical and

environmental factors surrounding a given topic and can include strategies such as conducting the intervetion in a community center or church within a Black neighborhood.

Joseph et al. developed a conceptual framework consisting of both levels of culturally relevant or culturally tailored strategies designed to assist in implementation of PA interventions in African American women (53). This framework outlines three main components that should be taken into consideration prior to developing an intervention: 1) the developmental stage of life of the participants, 2) the lived cultural experiences and social norms, and 3) the method of intervention delivery. Developmental considerations include taking into account the age of your targeted population and acknowledging that cultural, social, and occupational norms may differ between young-, middle, or older-aged Black women (53). Cultural considerations include incorporating study staff and educational materials reflective of the targeted population and taking into consideration physical appearance norms, religious ties, self- and family values of Black women. Lastly, intervention delivery considerations suggest that delivery methods should align with age, preferences, and social behaviors of the intended population (53).

In addition to having Black interventionists/trainers (28, 38, 101), other culturally relevant strategies have included hosting interventions at churches (101) or in Black-owned community centers (30), incorporating prayer and scripture (28, 29, 102), designing printed or online material including photos of Black people (25, 33-35, 37), highlighting barriers associated with PA or exercise specifically encountered by Black people (33-36), and including friends or romantic partners for social support throughout the intervention (27, 37, 38). However, amongst these strategical, multi-component exercise promotion efforts in Black women, PA and exercise outcome results are mixed increasing the difficulty of determining which strategies are most successful in increasing exercise adherence (3, 6).

Exercise Interventions in Black Women

Culturally tailored and theory-based strategies have been used independently and together to increase exercise and PA outcomes in Black women. Some of these studies have shown improvements in PA and exercise outcomes, whereas others did not support the use of culturally tailored or theory-based strategies to increase PA or exercise (25, 31, 36). Additionally, studies have used strategies from the SCT such as social support (24, 27, 28, 38), self-efficacy (28), self-monitoring (27, 36, 59), goal setting (24, 59), reinforcements (24), as well as strategies from SDT such as autonomy in choice of exercises (28, 59). However, there are significant research gaps in the literature. First, although the studies have used SCT and SDT strategies, changes in theoretical constructs were not included. Furthermore, there is a lack of detailed methodology on the implementation of theoretical constructs. Additionally, most of the PA and exercise interventions in Black women used aerobic exercises as the primary mode of activity and did not complete long-term follow up (3-6). Taken together, these present significant research gaps on addressing the impact of culturally tailoring and theoretical components on RE in young Black women.

There have been few RE interventions for Black women identified in the literature. In a single-arm study by Spector et al. Black women (mean age: 51.6 years) breast cancer survivors completed a 16-week, home-based aerobic (walking) and RE (resistance bands) study (42). Additionally, weekly motivational interviewing techniques via telephone elicited participants' own motivations for engaging and maintaining exercise. Results from the International Physical Activity Questionnaire and actigraphy showed significant increases in total minutes of PA, moderate-to-vigorous PA, and cardiorespiratory fitness. Regarding muscular strength, significant increases were found for arm flexion ($p = 0.03$), arm extension ($p < 0.001$), and left and right leg

extension ($p < 0.001$ and $p = 0.005$). There were no significant changes in weight or body composition (42).

In a 12-week concurrent training study by Hornbuckle et al. researchers assessed the differences in the effect of a walking versus a walking plus RE intervention on cardiovascular disease risk factors in middle aged women (mean age: 49.0 years) (41). Women were asked to increase their daily steps to >10,000 steps/day (measured by a pedometer) and those in the concurrent group additionally completed supervised RE twice per week using machines. Results showed significantly increased steps/day in both groups, but neither reached the 10,000 step goal. The concurrent group had significant increases in upper and lower body strength, decreased waist circumference, gynoid fat mass, and total body fat mass. There were significant reductions for HbA1c, blood glucose, and fibrinogen over the course of the 12 weeks in the concurrent group versus the walking group that showed no changes (41).

Lastly, Ntshaba et al., completed a 6-week concurrent training intervention in South African Black women (43). Women were randomized to a concurrent training group of cycling and supervised RE (four times/week) or a control group who completed no exercise. At six weeks post-test, researchers observed a significant decrease in body fat percentage ($p = 0.004$), but no other significant changes in waist-to-hip ratio or the six-minute walk test (43).

Based upon the findings in the literature surrounding culturally tailored strategies to increase PA or exercise adherence in Black women, it is unclear which strategies are more successful than others. For instance, there have been studies that have successfully used the combination of culturally tailored strategies (Black trainers, list of barriers and strategies to overcome barriers) and self-regulatory strategies from the SCT such as goal setting, self-monitoring, reinforcements, social support in-person and via online applications/websites.

However, lack of inclusion of RE, a lack of measuring SCT and SDT constructs, and low rates of measuring long-term adherence data are common amongst previous studies. Of the studies that have included RE, they have all been concurrent training interventions, did not include culturally tailored or theory-based strategies, and did not conduct long-term data assessments. Furthermore, there is a lack of studies assessing outcomes for young Black women aged 18 to 34 years.

Adherence to Resistance Exercise Protocols

The measurement of exercise adherence is critical to inform future studies of successful strategies to aid maintenance to regular exercise. Oftentimes, adherence to an exercise intervention is calculated by the number of completed sessions divided by the number of prescribed sessions. For in-person studies, this can be assessed and monitored by the research staff; however, it is mostly self-reported in non-face-to-face studies (12). There have been few studies that have assessed long-term adherence to RE interventions (46) with some including of theory-based strategies (44, 45, 67) and assessment of long-term body composition results (44). Overall, studies conducted supervised training sessions ranging from 12-36 weeks. Strategies used during the studies consisted of providing video demonstrations (45), corrective feedback for exercises (45), social support (44), providing access to websites for educational and monitoring purposes (44, 45), and strategies to navigate barriers (45). Adherence to supervised RE ranged from 76.5%-96% and unsupervised or long-term adherence rates ranged from 40%-61%, suggesting a need to explore better support systems during self-guided exercise. Results from measured psychosocial variables revealed planning (45, 67), having coping plans (67), modifying routines (45), and seeking gym staff assistance (45) were strategies used to maintain exercise post-intervention. Participants in the study by Viljoen et al. reported a shift in motivation from less controlled motivation to more autonomous motivation from intervention to

post-intervention (46). For example, during the intervention, loyalty to research staff and social support from participants were the primary motivators, but wellness, physical and mental benefits of regular exercise became the primary motivators by post-intervention. Lastly, exercisers in the study by Kekalainen who completed RE twice and three times per week significantly increased their intrinsic motivation compared to those who completed RE once weekly and the control group (67). Also, those who maintained exercise post-intervention and completed RE twice per week had higher self-efficacy and intrinsic motivation for RE compared to non-continuers and once weekly continuers (67).

In conclusion, the connection developed between the training staff and participants appeared to positively impact supervised RE adherence (12, 13, 46). For unsupervised RE, the suggested leading factors associated with adherence protocols included the use of self-regulatory strategies (self-monitoring, reinforcements, goal-setting, and relapse prevention) (12, 44, 45, 80). Increases in intrinsic motivation, evoking a sense of enjoyment, perceived satisfaction, and an overall sense of positive well-being (physically and mentally) were also motivating factors associated with adherence to resistance exercise (12, 45, 46, 67).

Summary

Black women participate in less PA and have the highest rates of CMD risk factors in comparison to women of other ethnic/racial groups and compared to Black men, increasing their chances for CMD. As outlined in this literature review, taking a culturally tailored approach to exercise promotion in Black women can be a potential strategy to increase PA or exercise outcomes and enjoyment. However, results for PA and exercise outcomes in culturally tailored interventions for Black women remain unclear leaving the impact of the approach questionable. Additionally, although components from theories (mainly the SCT) are frequently utilized in

studies promoting exercise for Black women, several concerns still exist. First, oftentimes when constructs are measured in the studies, details related to how the constructs were operationally implemented in the study (i.e., time management strategies, reinforcements) were not available. Second, many studies included constructs from theories, but did not measure how the variables changed such as social support (27, 28, 38), self-efficacy (28), self-monitoring (27, 36, 59), and goal setting (59), and autonomy (59). Assessment of these constructs could determine which variables are most strongly associated with exercise motivation and adherence. Third, the individualized use of the SCT and SDT on exercise adherence has been explored, however the combination and measurement of constructs from both have been underutilized in exercise interventions. Merging constructs from each of these theories such as increasing competence, autonomy, and relatedness from the SDT with self-regulatory and social support strategies, could potentially increase an individuals' motivation to perform a behavior (100), which in return can result in long-term behavioral adherence.

Other underlying limitations that exist in most of the PA or exercise interventions for Black women include the exclusion of RE (24, 25, 27, 28, 31, 59), low reports of long-term adherence assessments and results (28), and a lack of focus on young adult women (25, 27, 33, 103). Resistance exercise has the potential to improve CMD risk factors, body composition, physical strength, enjoyment for exercise, and can potentially lead to long-term exercise adherence. However, only a few studies incorporating RE have been conducted in Black women and none included culturally tailored approaches, theory-based strategies, or long-term adherence assessments (41-43). Analysis of long-term behavior is essential to assess behavior adoption and retention and how the participants were able to maintain participation in RE. Therefore, the purpose of this study was to implement a culturally tailored and theory-based RE intervention for

Black women and to assess the impact on exercise adherence, psychosocial and behavioral factors, and physical variables such as CMD risk factors and body composition.

Chapter 3: Methodology

Study Design

This study utilized a randomized control trial design. The aim of this study was to assess the impact of a theoretically based, culturally tailored 24-week exercise intervention on exercise adherence, psychosocial and behavioral factors, CMD outcomes, body composition, and physical strength in young Black women. Baseline, 12-week post-testing, and 3-month follow-up procedures took place in a laboratory setting at Auburn University. The exercise intervention included a total body RE protocol and took place at a local community fitness facility twice per week for 12 weeks. Participants were randomized to either the motivation exercise group (MEG) that received theory-based, culturally tailored experiences or the standard exercise group (SEG) group. Those in MEG received health education, self-regulation techniques, discussed motivators for exercise in Black women and strategies to overcome barriers to exercise. Both groups received surface level tailoring including Black personnel providing RE training and the intervention occurred in a predominately Black community facility. Procedures for the current study were approved by the Auburn University Institutional Review Board for Research under protocol #18-323 AR 1809 (Appendix A) and registered at clinicaltrials.gov under the #NCT05733260.

Participants

This study aimed to recruit 30 participants through convenience sampling in Auburn, AL. Recruitment strategies included using a combination of digital and physical flyers, targeted emails, and personal contacts. Eligibility requirements were women who self-identified as Black, between the ages of 18-34, non-exercisers, low risk for beginning an exercise program, and were residents, students, or employees of Auburn, AL. Women who participated in three or more days

of exercise for the past three months or greater were excluded, in addition to women who were pregnant or planned to become pregnant during the timeframe of the study. Risk to begin an exercise program was assessed with the Physical Activity Readiness Questionnaire (PAR-Q) and participants must have answered "no" to all questions to qualify for participation. All participants received a free, life-term membership to a local gym within a recreation facility valued at $25. Participants also received an additional $25 at 3-month follow-up testing. All participants received and signed an informed consent that provided an overview of study procedures, risks, and benefits after the screening process and prior to commencing study procedures.

Measurements

Prior to collecting baseline measurements, all potential participants underwent a medical history screening process to ensure eligibility using the PAR-Q. This process was conducted via telephone and participants provided information regarding their age, race, and exercise status. Following screening, participants were invited to the Exercise Adherence and Obesity Prevention Laboratory in the Kinesiology building at Auburn University to complete baseline data collection. Baseline data collection included a series of questionnaires and physiological assessments. Questionnaires included a demographics survey, questionnaires to assess psychosocial constructs of the SDT (competence, autonomy, relatedness, and level of behavioral regulation), and the SCT constructs (self-regulation and self-efficacy). Participants underwent several physiological measurements including assessments of resting blood pressure, cholesterol, glucose, anthropometrics, body composition, and muscular strength.

Demographics

A demographics survey collected the following information: age, marital status, number of children/dependents, employment status, education, and gross income.

Psychosocial and Behavioral Measures

Satisfaction of the three basic psychological needs of the SDT were measured using the Basic Psychological Needs in Exercise Scale (BPNES), which assessed the participant's competence, autonomy, and relatedness regarding exercise. This questionnaire contained 12 statements, four per construct, and participants were instructed to select their level of agreement to each statement on a 5-point likert scale ranging from 1, "I don't agree at all", to 5, "I completely agree". Higher scores suggested greater satisfaction or fulfillment of that basic psychological need. This questionnaire has been previously validated in an adult population as a measurement of the three factors of the SDT for both men and women (104, 105).

The degree of self-determination was measured by the 24-item, Behavior Regulation Exercise Questionnaire-3 (BREQ-3). This version of the questionnaire included the addition of introjected and amotivation, as previous versions did not measure these items (106). The BREQ-3 provided a measurement of six domains of regulation (four questions per domain) including amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic motivation. Statements regarding participants' reasons for exercising were scored on a 5-point likert scale ranging from 0, "not true for me" to 4, "very true for me". Scores from each of the six sub-scales were averaged (106). Previous studies assessed confirmatory factor analysis and determined this 5-factor model a good fit (Satorra-Bentler χ^2 = 136.49 [125], p = .23) and standardized factor loadings were significant, and moderate to strong (M = 0.76, range 0.53-0.90, p's < 0.001). Additionally, internal consistency amongst all factors were acceptable indicated by Cronbach's alpha's (0.86-intrinsic; 0.73-identified; 0.80-introjected; 0.79-external; amotivation-0.83) (107). Wilson et al. later added the subscale

integration and a new item to introjection. Results support the addition of the new subscale with internal consistency that ranged from 0.83-0.96 (108).

The Self-efficacy to Regulate Exercise scale assessed participants' level of self-efficacy to participate in exercise regularly under challenging conditions. This questionnaire contained 18 statements in which participants rate their level of confidence to participate in exercise given the statement on a scale of 0 (cannot do at all) to 100 (highly certain can do) (109). Scores from all statements were summed as higher scores indicate higher self-efficacy to participate in exercise. The use of this scale has been assessed and deemed to be a valid and reliable tool for measuring self-efficacy (110).

Self-regulatory strategies to enable exercise were examined using the Physical Activity Self-Regulation 12-item questionnaire (PASR-12). This questionnaire assessed the use and frequency of strategies to assist in exercise adoption and adherence on a 5-point likert scale such as goal setting, self-monitoring, time-management, eliciting social support, reinforcements, and relapse prevention. The totals from each of the six strategical domains were summed as scores ranging from 12-60. Higher scores demonstrated more frequent use of self-regulatory strategies to participate in exercise. The use of the PASR-12 has been determined to be a valid assessment of self-regulation in adults as construct validity showed overall strong correlations between the original PASR-43 and the PASR-12 (r = 0.96) (111).

Cardiometabolic Outcomes

Resting blood pressure was measured using an oscillometric BP device by Omron. Measurements were taken twice with one minute of rest in between after at least five minutes of being seated. Measurements differing greater than 6 mmHg for systolic blood pressure (SBP) and 4 mmHg for diastolic blood pressure (DBP) required a third or fourth measurement. The two

closest measurements were averaged and used for analysis. Individuals with resting blood pressure measurements of > 200/110 mmHg were deemed ineligible for the current study as those values are contraindications for exercise (112). Values for total cholesterol (TC), triglycerides (TG), high-density lipoproteins (HDL-C), low-density lipoproteins (LDL-C), and fasting glucose were assessed via blood draws and the Cholestech LDX. Blood was drawn using a fingerstick and was performed by trained research personnel. Once blood flow initiated, blood was collected in a capillary tube and loaded onto a cassette into the Cholestech LDX for analysis. The accuracy of the Cholestech device to measure blood lipids have is high in comparison to venipuncture standard lipid panels (113).

Anthropometric and Body Composition Measurements

Anthropometric measurements included height, mass, and waist circumference. Height and mass were measured using a digital stadiometer and used to compute body mass index (BMI). Participants were instructed to remove their shoes and to stand erect with their head faced away from the stadiometer. Height was measured to the 0.1 cm and mass to the 0.1 kg. Waist circumference was measured twice using an elastic tape measurer placed around the narrowest part of the torso beneath the xiphoid process and above the umbilicus (112). If measurements differed by more than 0.1 cm, then a third measurement was taken. Results were used to estimate abdominal adiposity and potential for CMD. Recommended waist circumferences for women are <88 for optimal health.

Body composition was assessed using dual energy x-ray absorptiometry, also known as the iDEXA (GE Healthcare Lunar' Madison WI). Participants were instructed to arrive at the lab in a fasted state (≥ 8 hours of nutritional intake), and the test was performed by a certified lab technician. Participants were asked to remove all metal from the body to produce the most

accurate results. During the approximate 7-13-minute body scan, the iDEXA measured three components of the body including lean mass (kg), fat mass (kg), and bone mineral density (g/cm^2), (114). Body composition results obtained from the iDEXA have been comparable to results from hydrostatic weighing for abdominal obesity (115). Low percentages of coefficient of variances have been reported for total body composition for bone mineral content, lean mass, and fat mass (<1%) and regional body composition for bone mineral content, lean mass, and fat mass (~2.5%) indicating the usefulness and precision of the iDEXA for body composition assessments (116). Additionally, the specific iDEXA used in this study has been tested for intra-reliability for participant and correlation coefficients for were 0.998 for total body fat mass and total body lean mass (117).

Muscular Strength

To assess upper and lower body muscular strength, participants completed a 3-repetition maximum (3RM) for the bench press and back squat. For each of these tests, demonstrations of how to perform the exercise along with communicating proper lifting techniques were provided to the participants. Following, participants were instructed to warm up using initially with body weight for squats, then progressed to using a 45lb barbell and 18lb barbell for bench press for a total of 10 repetitions. Participants were instructed to grip the bar with their hands approximately should-width apart when the bar was in resting position on the support props. A complete range of motion was required to count as a valid repetition, which was a 90-degree angle between the femur and tibia. For the bench press, a valid repetition was counted when the bar was lowered down to their chest, then pressed upward and locked the elbows at the top positions. Study personnel continued to add weight at each attempt until the participant could only complete three

repetitions of the exercise with proper form and technique. About 3-5 minutes were given for rest in between the sets, and achievement of the 3RM aimed to be reached within five attempts.

Exercise Adherence

Exercise adherence to the intervention was calculated using the total number of completed sessions by the total number of sessions (20 sessions) during the supervised period. Exercise adherence post-intervention was determined by the self-reported number of days completing total body RE divided by the total number of recommended days during the unsupervised training period (22 days). While unsupervised, participants received surveys inquiring about the number of days they participated in RE. To minimize contact or influence exercise participation and frequency for women in SEG, this survey was only administered at 18 and 24 weeks. In congruence with the national PA guidelines, two or more days was considered complete adherence and one day was considered partial adherence. Zero days of exercise indicated no adherence.

Procedures

This study took place over 24 weeks starting after the baseline assessment (see Figure 2). All pre-test procedures, including completion of questionnaires/surveys, cardiometabolic, anthropometric, body composition, muscular strength assessments, and gym facility registration were completed during Week 0. A familiarization period occurred at Week 1 (two days) in which trainers demonstrated, taught, and corrected form and technique for all exercises. During Weeks 2-11, participants were randomized to either the MEG intervention group or the SEG comparison group and completed the RE intervention. Post-test was conducted during Week 12 and repeated data collection procedures from baseline with the addition of answering a few open-ended questions about their experience. Participants were instructed to complete exercise regimens

unsupervised from weeks 13-23. Final measures were reassessed at Week 24, similar to post-test procedures.

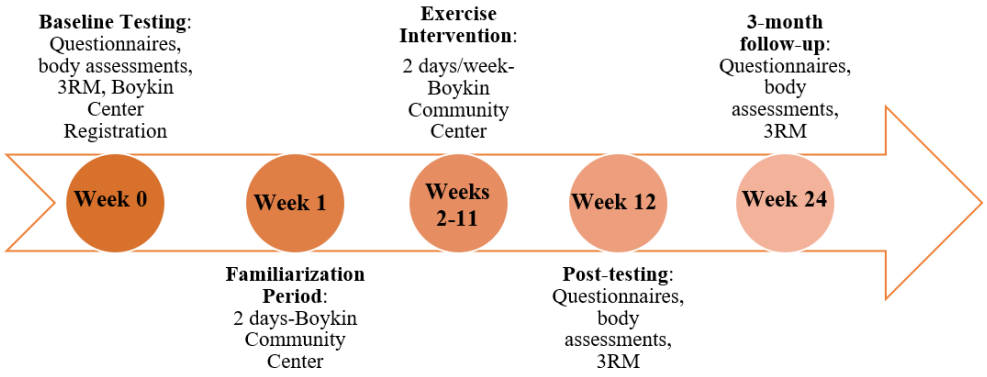

Figure 2: Study Timeline

Resistance Exercise Protocol

At the beginning of each training session, participants participated in a dynamic warm-up targeting the major muscle groups that were used. This warm-up included performing light movements contracting and extending the muscles to increase blood flow to the involved musculature (118). Following the dynamic warm-up, participants performed seven total body resistance exercises targeting the following muscle groups: quadriceps, hamstrings, chest, back, shoulders, biceps, and triceps. These exercises were divided into two protocols (listed in Table 1) each targeting the same muscle groups. Protocol A consisted of a back squat, seated hamstring curls, barbell bench press, lat pulldown, shoulder press, bicep curls, and overhead triceps

extensions. Protocol B consisted of front lunges, Romanian deadlifts, chest flys, bent-over rows, upright rows, hammer curls, and triceps cable extensions.

Table 2: Exercise Description for Optimal Completion

Exercise	Targeted Muscle Group	Optimal Completion
Back Squat[a]	Quadriceps (legs)	Start with feet in parallel position to each other, shoulder-width apart and bar placed above the posterior deltoids with hands placed slightly wider than shoulder-width. Flex the knees and hips while maintaining a flat back and chest up and out, until thighs are parallel with the floor. Simultaneously extend the knees and hips and return to start position.
Seated Hamstring Curls[a]	Hamstrings (legs)	In a seated position, rest ankles on the roller pad and adjust stationary pad across the lap. With legs parallel to each other, fully flex the knees avoiding lifting of the hips. Return to start position by slowly extending the knees.
Barbell Bench Press[a]	Chest	Lying in supine position, place hands on the barbell in neutral position (slightly wider than shoulder-width apart). Lower the bar to touch the chest, then extend elbows fully to return to starting position.
Lat Pulldown[a]	Back	Place hands on the bar in neutral position (slightly wider than shoulder-width apart). Pull bar down to chest until touching clavicle and upper chest area. Return to starting position by fully extending elbows upward.
Dumbbell Shoulder Press[a]	Shoulders	Start in a seated position with dumbbells in hand and shoulders extended 90° and elbows flexed 90° on each side of the head. Push dumbbells overhead until elbows are fully extended, then return to start position.
Dumbbell Bicep Curl[a]	Biceps	Start in standing position with dumbbells in hand with supinated grip. Flex elbows until dumbbells are near anterior deltoids. Return to start position by fully extending.
Overhead Triceps Extension[a]	Triceps	In a standing position, hold 1 dumbbell with both hands directly over the head with elbows fully extended. While keeping the upper arms stationary, flex the elbows and lower dumbbell towards to back of the head. Return to start position by fully extending elbows.

Front Lunges[b]	Quadriceps (legs)	Start with dumbbells hanging at arm's length and feet in parallel position to each other. Take one large step forward with the leading leg allowing the knee to slowly flex and remaining directly above the lead foot. The rear foot should remain in starting position and the rear knee should flex until 1-2 inches above the ground. Use the lead foot to push off the ground (extending the knee) to return to start position. Alternate lead legs.
Romanian Deadlift[b]	Hamstrings (legs)	Start with dumbbells in hand in a pronated grip resting on the front of the thighs with elbows fully extended and feet shoulder-width apart. Flex torso forward (keeping the back flat or slightly arched), knees slightly bent, and hips pushing backwards. Lower the dumbbells approximately mid-shin, staying close to the legs. Return to start position by slowly extending torso.
Chest Flys[b]	Chest	Lying in supine position, extend elbows fully and press dumbbells together above the chest. Lower dumbbells in an arc movement until leveled with the shoulders or chest maintaining a slight bend in the elbows. In an arc movement, return dumbbells to start position
Bent-over Rows[b]	Back	Start with feet shoulder-width apart, knees slightly flexed, torso flexed forward nearly parallel to the ground, and a flat back. With dumbbells in hanging position by the side, flex elbows while simultaneously pulling them up towards the back keeping elbows close to the body. Return to start position extending elbows and lowering dumbbells to hanging position.
Upright Rows[b]	Shoulders	Start with dumbbells in hand in a pronated grip resting on the front of the thighs with elbows fully extended. Pull dumbbells up towards the chin until aligned with shoulders keeping elbows pointed out to the sides. Lower dumbbells by fully extending elbows and returning to start position.
Hammer Curls[b]	Hamstrings (legs)	Start with dumbbells in neutral grip, elbows fully extended. Flex elbows until dumbbells reach the anterior deltoid, then return to start position.
Triceps Cable Extensions[b]	Triceps	Grasp bar with pronated grip approximately 12 inches apart with upper arms against the torso. Start with elbows flexed at 90° or slightly less then push bar down until elbows are fully extended. Return to start position by flexing elbows

Notes: [a] = protocol A, [b] = protocol B (118)

This training protocol followed the classical or linear progression approach in which training volume (the combination of sets x repetitions) decreases as intensity (load/resistance) increases over time (119). Following this training approach, participants completed two sets of 12 repetitions (2x12) during Week 2 to allow their muscles to get acclimated to the exercises. Weeks 3-5, participants completed three sets of 12 repetitions, three sets of 10 reps during Weeks 6-8, and three sets of 8 during Weeks 9-11. Beginning resistance was determined based upon participants' 3RM for the back squat and chest press (60% of their estimated 1RM for back squat and bench press). Resistance increased incrementally once the participant was able to complete two or more repetitions of an exercise beyond the weekly goal in the last set in at least two consecutive exercise sessions (118).

Experimental Groups

Theory-based Culturally Tailored Intervention Group (MEG)

Participants randomized to the MEG received a culturally tailored infographic with images of Black women, exercise education materials, self-regulatory strategies, and a list of barriers and motivators for exercise reported by Black women (Appendix M). Exercise education materials included content such as the PA recommendations, physical and mental benefits of exercise, and basic RE guidelines (progressive overload, specificity). This content aimed to increase the knowledge of exercise, and consequently self-efficacy, of the participants and targeted the SDT construct, competence. Self-regulation strategies to maintain exercise included goal setting, self-monitoring, time management, social support, reinforcements, and relapse prevention. Examples of each can be found in Table 2. The women received a weekly text message to reinforce topics discussed in person that week beginning Week 2. Components of the infographic and weekly text messages were reinforced by the trainer over the 10-week training

period. During unsupervised exercise, text messages were reduced to one every other week, and the women received two phone calls to discuss current exercise, motivators, challenges, and collaboratively identified methods to overcome barriers if needed. An overview of this information and its time of delivery are in Table 3 and scheduled text messages are listed in Table 4.

Table 2: Self-Regulation Strategies and Examples

Self-Regulation Strategy	Examples
Goal-setting	Set short- and long-term goals • Days/week, time of day, duration of workout, body weight/appearance goals, weightlifting goals) • Targeting desired outcomes and avoiding negative outcomes
Self-monitoring	Create a journal/log • Record feelings pre- and post-workout, pros and cons of workout, accomplishments, setbacks
Time-management	Set reminders Create a schedule • Time of day, days of the week, duration Prepare in advance • Clothing, schedule, types and number of exercises, location, childcare, other obligations Be efficient
Social Support	Recognize and seek sources of social support Gym facility, companions, family, friends, exercise professionals, online websites, social media platforms/groups
Reinforcements	Acknowledge accomplishments of goals Encourage self-praise and photos Acknowledge external praise
Relapse Prevention	Identify high-risk situations Identify coping skills Create back-up plans

Table 3: Study training weeks, measures, training, and strategical topic timeline

Time Period	Training Weeks	Measures	RE Prescription	Exercise Education/Strategical Topic	SCT or SDT Constructs Targeted
Baseline	0	Questionnaires, finger prick, BP, height, weight, WC, body composition, upper and lower body 3RM			
Familiarization Week	1		1 x 12	Exercise safety, proper technique, and form	Competence
Intervention	2		2 x 12	National PA recommendations, benefits of exercise, and basic principles of resistance training	Competence
	3-5		3 x 12	Setting short- and long-term goals, self-monitoring behavior, strategies for managing time/schedule, common barriers to exercise for Black women	Goal setting, self-monitoring, time management
	6-8		3 x 10	Recognizing and seeking social support, acknowledging accomplishments of goals, self-reflection on helpful strategies, providing autonomy support	Social support, self-monitoring, reinforcements, autonomy
	9-11		3 x 8	Assessing comfortability with exercises, revisit goal setting, strategies to overcome barriers	Competence, self-monitoring, reinforcement, goal setting, relapse prevention
12-week post-testing	12	Questionnaires, finger prick, BP, height, weight, WC, body composition, upper and lower body 3RM			

	14		Reminder of goals, importance of tracking exercise behavior and setting reminders for exercise sessions	Goal-setting, self-monitoring, and time management
	16		Acknowledgement of successes and setbacks	Reinforcements, relapse prevention
	18		Reminder of eliciting social support and utilizing in-person and virtual support	Social support
	22		Acknowledgement of successes and setbacks, external support from trainer	Reinforcements
3-month follow-up	24	Questionnaires, finger prick, BP, height, weight, WC, body composition, upper and lower body 3RM	Acknowledgment of internal feelings towards exercise and reminder of exercise goals	Goal-setting, reinforcements

Notes: RE = resistance exercise; SCT = Social Cognitive Theory; SDT = Self-determination Theory; BP = blood pressure; WC = waist circumference; 3RM = 3-repetition maximum; PA = physical activity

Table 4: Weekly Scheduled Text Messages

Text Messaging Schedule and Examples		
Training Week	**SCT or SDT Construct**	**Examples**
2	**Competence**	Do you know that exercising can improve your overall quality of life, sleep, anxiety and depression? It's about more than just looking good, it makes you feel good too! With exercise, you must increase your workload to continue improving. Think about it as an ongoing challenge for your body. Once it meets one goal, you have to start chasing the next one!
3	**Goal setting**	Think of some short-term goals that you have for yourself related to exercise. How many days can you commit to working out? What time of day? What about long-term goals? Remember, these goals should be realistic, attainable, and have a set timeline to reach them. Do you have body weight, appearance, or weightlifting goals? Write them down and set a timeline to reach them.
4	**Self-monitoring**	It's important to monitor your experience with exercise through writing it down or taking pics. Ask yourself questions like, 'How have I been feeling since I've started working out?' and 'What are some pros and cons of working out?' Acknowledge your accomplishments even if they're small. These can include making it to all your workout sessions for the week or noticing it's becoming easier to carry groceries into the house. It's an accomplishment! It's also important to pay attention to any setbacks or barriers keeping you from reaching your goals. What are your major barriers right now and how can you lessen them?
5	**Time-management**	How have you been managing your new schedule since you've been working out? Setting specific times and days to workout can help with creating a routine. Also, set yourself up for success! Set reminders on your phone for when it's time to workout. Try getting your workout clothes together the night before and think about how you're going to manage any other duties you may have that day. Planning and preparation is the key! Lastly, be efficient with your time in the gym. In and out is the motto!
6	**Social support**	As your trainer, you know I'm here for you, but it's important to establish other supportive relationships along this journey as well. Find friends, companions, or family members to talk to about your new journey into exercising. Find others who are already active and share or discuss your experiences with them. It's important to have social support and to know that you're not doing this alone! Try using social media to stay connected with other active people. You can join groups or simply follow someone that inspires you. However, use your best judgement about safe practices.

7	**Self-monitoring, reinforcements**	You're more than halfway through the program! Congratulate yourself sis! Take a minute to think about what's been helping you stay consistent so far. Is there anything you need to change to help you be more consistent and if so, how can you change it? This is just a reminder that you're doing great! I hope you're acknowledging and checking off your short-term goals! Show yourself some love!
8	**Autonomy, relatedness, social support**	It's important to remember that you're in control of your own journey. Ask yourself, 'Am I doing this for me or for external reasons?' Do you enjoy working out? If not, what can make it more enjoyable? Also, think about your gym setting. It's important to find environments that make you feel comfortable and to change them if you do not. How has your support system been in helping you achieve your workout goals? Be sure to find people who are supportive and encouraging throughout your journey. Make friends with the gym staff or others working out around you. It's called building your fitness family!
9	**Competence**	Do you feel comfortable using the equipment during your weekly routines? Do you understand what exercises are working specific muscle groups? It's important to understand how to do an exercise and why you're doing it to increase the chances continuing. Ask me if you have questions! During your routines, do you feel like you know what you're doing? Do you feel confident that you can complete these exercises alone? If not, why not? Remember to rely on me, your trainer, or other exercise professionals if you feel like you need some guidance.
10	**Self-monitoring, reinforcement, goal setting**	We're almost towards the end! Think about how you feel. Have you been keeping up with your goals and accomplishments? It's time to think about your goals after this study. It's still recommended to complete two days per week of resistance training, but that's just the minimum. Keep setting your weekly goals (ex: days/week, duration of workout, time of day, type of exercises).
11	**Relapse Prevention**	As we all know, life happens! There will be times when you're unmotivated to exercise or something else pops up in your schedule. That's okay! The key is how you deal with it. Identify high risk situations that keep you from exercising (ex: bad traffic in the mornings by your house or gym, late work nights on Wednesdays). Find ways to work around these barriers (ex: go to the gym at an earlier or later time to avoid traffic, change your workout day to Tuesdays instead of Wednesdays). Again, planning and preparation is key! It's helpful to create back-up plans if you're short on time or miss a workout. Find another way to squeeze in exercise. Cut down the time of your workout if

		needed. Make-up your missed session later in the week when you have more time. You have to keep in mind your goals and use all the strategies we've discussed to reach them. You've come so far. You can't stop now! You can do this without me :)
14	**Goal-setting, self-monitoring, and time-management**	How are you? It's been about 2 weeks since our last training sessions. I know things may be different without me being present with you in the gym, but I know you're killing it! I hope you've been able to stick with the weekly plans that you came up with. Remember, one of the best ways to make sure you're sticking to your goals is to keep track of them. Write down why you started this journey if you haven't already. Set reminders and timers on your phone for days you plan to workout. Lastly, keep track of the actual exercises you're doing. Discipline and organization leads to consistency! You got this, and I'll talk to you in a couple weeks.
16	**Reinforcements, relapse prevention**	It's been a whole month since you've been on your own! That's amazing! How are you feeling? I hope things have been going well for you, but it's also good to acknowledge if there are some things that you've been having trouble with. If you've been having a hard time maintaining your schedule, think about the main thing(s) that's been holding you back. Hold those thoughts or write them down. I'll be calling you this week to discuss them in detail!
18	**Social Support**	Hello my good sis! I hope your weeks have been treating you well, and our last phone call was helpful and uplifting. I'm checking in to see if you have been using your newly forming fitness family. Remember, social support can come in many forms. This can be support from family, friends, new gym/exercising partners, fitness facility staff, and even social media. Support can be from those who aren't exercising or those who are. It's good to have a mix. Remember, you never know who you could be inspiring and be a role model to, so share with your family/friends. Keep up the great work!
20	**Reinforcements**	Hi lady! First, I would like for you to acknowledge how far you've come since we started this program. I'm proud of you and you should also be proud of yourself! How has your workout journey been coming along? What's been working and what has not? Think of how you can change the things that are now working for you. I know sometimes it can be mentally and physically tough to maintain your schedule, but I want you to remember all the benefits of doing so. You are your biggest hype girl! You know you can do this, and in case you forgot, I'm here to tell you. "YOU CAN DO THIS!" I'll be calling you soon to talk about your pros and cons so far. Talk to you later!
22	**Goal-Setting, Reinforcements**	Time has passed us by. It's been nearly six months since we started this fitness journey together! How are you feeling? I hope your response is GOOD! I know I've told you this before, but I'm

	so proud of you for consistently showing up for yourself! Continuing to be your best self each week and meeting your weekly goals is such an accomplishment! Keeping a weekly schedule is a great way to continue your success, so stick with it! Also, don't forget the reasons you started this journey and the motivation that allows you to continue each week. You've come too far to stop now. Continue to be great sis! See you in two weeks!

Lastly, participants in MEG group were given a choice of exercise protocol they desired to complete first each week based upon the protocols listed above. More specifically, women were able to choose between Protocol A or Protocol B to complete Day 1 with the understanding that the alternate protocol was to be completed on Day 2 of their weekly training. Providing this option aimed to provide the women a sense of choice, but not choice overload, with the intent of increasing their sense of autonomy over their weekly exercise routine.

Standard Exercise Comparison Group

Participants of the comparison group, SEG, only completed the RE protocol led by their trained research personnel. Protocol A of the RE protocol was delivered on Day 1 and Protocol B was delivered on Day 2 weeks 2-6. Weeks 7-11, Protocol B was delivered on Day 1 and Protocol A on Day 2.

Statistical Analyses

An *a prioi* sample size calculation completed with G power suggested a sample size of 24 participants (12 per group) with an effect size of .50, alpha level of .05 and power of .80. The moderate effect of .50 was chosen based on the effect of RE on outcome variables calculated from several meta-analyses (7-9). We oversampled by 20% and aimed to recruit 30 participants, 15 per group. Statistical analyses for each research question can be found in Table 5. Descriptive statistics and frequencies were calculated for all demographic variables and exercise adherence.

Commented [AR1]: Which? RE adaptations, CMD risk factors, psychological?

Commented [CJ2R1]: Not sure if we have enough data for RE and psych outcomes

Commented [DW3R1]: I think we leave it for now and change it for the journal article. I can't find any psych papers that would help with this.

A mixed ANOVA analyzed differences in all physical variables (SBP, DBP, TC, TG, HDL-C, LDL-C, glucose, weight, BMI, waist circumference, lean body mass, fat mass, percent body fat, bone mineral density, and muscular strength) and all psychosocial and behavioral outcomes (competence, autonomy, relatedness, amotivation, external, introjected, identified, integrated regulation, intrinsic motivation, self-efficacy, and self-regulation). Time (pre-test, post-test, and 3-month follow-up) served as the within factor and group (MEG or SEG) served as the between factor. Upon group, time, or group by time interactions, Bonferroni post-hoc tests identified specific points of statistical differences. Statistical significance was set at $p \leq 0.05$. All analyses were performed using IBM SPSS version 27 (IBM Corporation: Armonk, NY).

Table 5: Research Questions and Statistical Analyses

Research Question	Independent Variables	Outcome Variables	Proposed Analysis
Determine whether there are differences in short-term and long-term resistance exercise adherence between a MEG and SEG in response to a RE intervention in young Black women?	Group (2)	Adherence to supervised sessions and unsupervised sessions in both groups	Descriptive means
Determine whether there are differences in CMD risk factors, body composition, and strength between a MEG and SEG after 12 and 24 weeks of RE in young Black women?	Group (2) Time (3)	Blood profiles, body composition, BMI, waist circumference, upper and lower body strength	Mixed ANOVA
Determine whether there are differences in psychosocial and behavioral outcomes between a MEG and SEG after 12 and 24 weeks of RE in young Black women?	Group (2) Time (3)	Basic psychological needs, type of motivation, self-efficacy, self-regulation	Mixed ANOVA

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Chapter 4: Manuscript 1

Black women are F.I.R.E.- fitting in resistance exercise: the impact of a 24-week resistance exercise intervention on cardiometabolic, body composition, and physical strength outcomes in young women

Cardiovascular disease (CVD) remains the number one cause of death in the U.S., and Black adults are 32% more likely to die from CVD compared with other racial and ethnic groups (120). Cardiovascular disease risk factors such as obesity (including abdominal obesity), high blood pressure, high blood glucose, and irregular blood lipid profiles often overlap with risk factors for metabolic disease, therefore the term Cardiometabolic Disease (CMD) is commonly used as an umbrella term for these combined risk factors. Disparities within CMD exist as a greater percentage of Black adults exhibit "poor" CMD risk profiles based on aggregated scores of the presence of diabetes, hypertension, hypercholesterolemia, and obesity compared to White adults (14.7% versus 9.3%, respectively). This is not surprising as Black adults have the highest rates of high blood pressure (121) and obesity in the U.S. (14). Type2 diabetes is also more prevalent in the Black population (122), and young Black adults are more likely to be diagnosed earlier in life than their White adults (121). Worsening CMD profiles are appearing more frequently in all young adults (17, 18). Concerning increases in obesity (19), diabetes (20), and hypertension (21, 22) have occurred over the last 20 years in young adults. Indeed, an assessment of hospitalizations for acute myocardial infarctions demonstrated rising numbers in American adults 35-54 years from 1995 to 2014 primarily driven by women (from 21% to 31%; $p <$ 0.0001) (71). There are similar trends in ischemic stroke hospitalizations with increases by 27.3% in adults ages 18-34 years by 35.6% in adults aged 35-44 years from 2003 to 2012 (72).

Young Black adults in particular have worse CMD outcomes compared to White adults for obesity (44.1% versus 33.4%), prediabetes (30.3% versus 22.2%), diabetes (6.1% versus 3.4%), and hypertension (16.9% versus 8.9%) (17). A larger percentage of young Black adults (56.4%) have at least two negative lifestyle risk factors (e.g., poor diet, inadequate physical activity or sleep, etc.) for CMD risk factors compared with young White adults (20.1%) (17). Furthermore, Black women are the least active demographic in the U.S. (123) and the most likely to have obesity (14). The culmination of these risk factors elevate the risk for developing other comorbidities at a young age and even premature death (122, 124) and underscore the need for proactive measures to address and mitigate unfavorable health outcomes early in life. Young adults are positioned in a critical place between adolescence and middle-age and physical activity participation and maintenance during this time period can influence their long-term health trajectories (23). However, studies geared towards examining effective exercise strategies to manage CMD risk factors in this demographic are few and even more uncommon in young Black women.

Resistance exercise (RE) has shown to improve cardiometabolic outcomes (7) in addition to body composition (8, 44), and physical strength (9). Despite the benefits, fewer Americans participate in RE (3.6%) in comparison to aerobic exercise (30.0%) (125). When assessed by biological sex amongst Black adults, higher participation rates are seen in Black men (5.0%) compared to Black women (3.3%). Furthermore, the few exercise and physical activity interventions for Black women utilize aerobic exercise to improve health outcomes and few studies have included RE (41-43, 126, 127). Moreover, most of the studies were in middle- or older-aged adults. The worsening health conditions of young adults highlight the necessity for deeper exploration of the impact of RE specifically aimed towards young Black women.

Using culturally-tailored approaches to address behaviors lead to the greater likelihood of accepting and adopting a behavior (32), and has been used in previous physical activity and exercise studies in Black women (27, 36-38, 128). This includes utilizing social and cultural characteristics and norms aligned with the targeted population on a deep or surface level within the study (32). Deep-level strategies include addressing barriers specifically encountered by Black adults, and performing the research in Black community centers or churches (30, 31). Surface-level strategies may include incorporating Black trainers/interventionists (28, 38) and educational material with depictions of Black people (33, 34, 37). Theoretical principles from the Social Cognitive Theory (SCT) have also been used previously, and include setting goals (24, 59), self-monitoring (27, 36) and engaging social support (24, 27, 38) to improve exercise behavior in Black women. However theoretical principles aligned with exercise adherence and predictors of exercise participation from the Self-Determination Theory (SDT) (62) have not been used in conjunction to support strategies from the SCT to increase exercise adherence in Black women.

To summarize, young Black women are at increased risk for developing CMD risk factors compared to other Americans (14, 17). Most studies to improve or modify health outcomes in Black women have not had an emphasis on young women, utilized aerobic exercise, and most do not capture long-term follow-up measures (3, 4, 6, 129). It is critical to take a deeper exploration of the connection between RE and CMD and other physical outcomes among young Black women. It is equally important to identify the strategies to sustain exercise behavior should favorable results emerge to inform future research. Therefore, the purpose of this study was to explore the effects of a culturally-tailored and theory-based 24-week RE intervention on CMD risk factors (i.e., blood pressure, blood lipid profiles, blood glucose, waist circumference),

body composition and physical strength in young Black women compared to a standard exercise intervention.

METHODS

Study Design

This study was a randomized-control trial (#NCT05733260) assessing short- and long-term differences in CMD risk factors, body composition, and strength in response to RE in young Black women. This study took place over 24 weeks with the following timeline: pre-test visit (Week 0), familiarization period (Week 1), supervised RE (Weeks 2-11), post-test visit (Week 12), unsupervised training (Weeks 13-23), and 3-month follow-up visit (Week 24). During the pre-test visit, women were randomized to either the motivational exercise group (MEG) or the standard exercise group (SEG) determined by a coin toss. Participants assigned to MEG received a deeper level of culturally-tailored strategies, weekly discussions surrounding exercise education, barriers, motivators, and strategies to maintain participation, and choice in exercise protocol order.

Participants

Women for this study were recruited from a southeastern city in U.S. Eligible women self-identified as Black, were 18-34 years, and low-risk non-exercisers. Non-exercisers were defined as no exercise for 30 minutes or greater at least three days per week in the last three months. Risk for physical activity was assessed by the Physical Activity Readiness Questionnaire (Par-Q) (130). Participants who answered “no” to all seven questions were considered low risk for exercise. Women were excluded from the study if they were pregnant or planning to become pregnant or did not live, work, or go to school within the city limits due to registration requirements at the community fitness center. Details related to eligibility,

randomization, retention, and timeline overview are in Figure 1. Eligible participants received a complimentary, life-term membership to a local community fitness center (valued at $30) and $25 at the completion of the study as a token of appreciation. This study was approved by the Auburn University Institutional Review Board (#22-492 MR 2212) for Human Subjects and conformed to the latest Declaration of Helsinki.

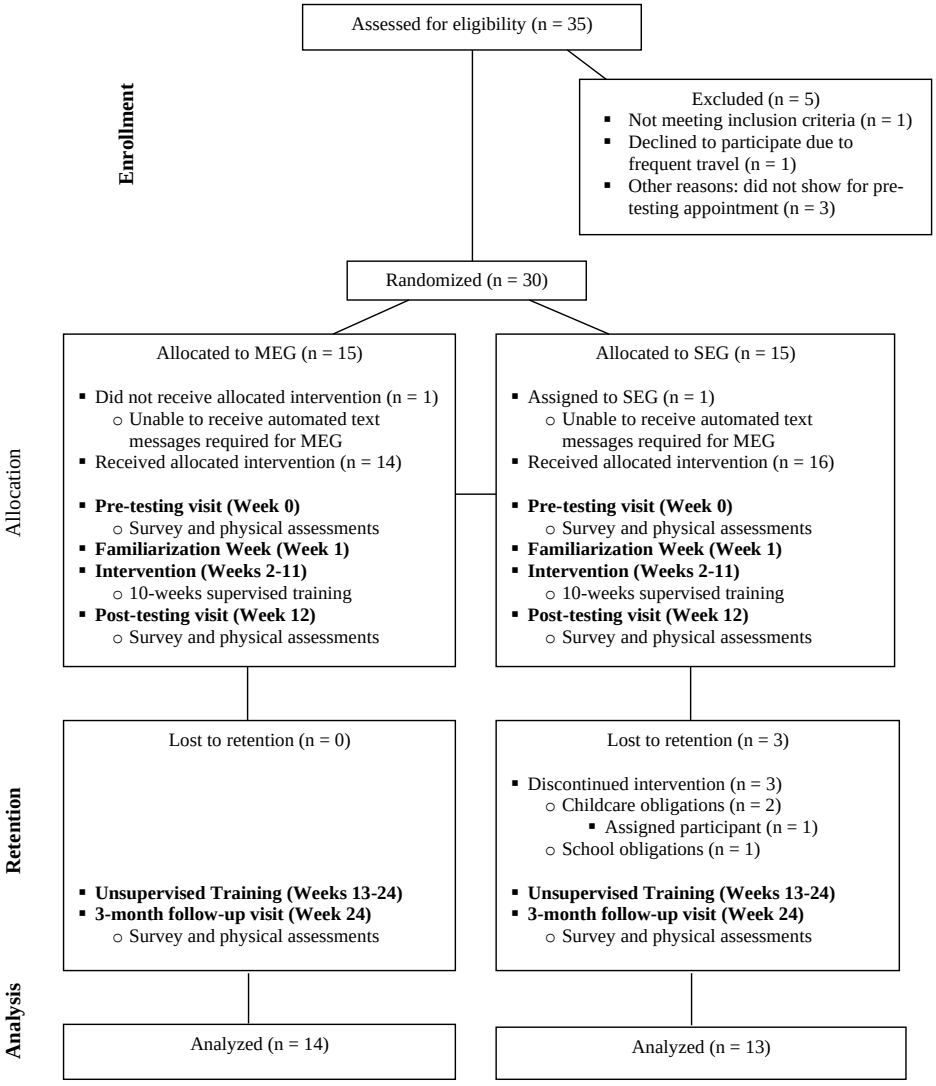

Figure 1: CONSORT Flow Diagram

Measures

All potential participants underwent a telephone screening to ensure eligibility. This screening inquired information regarding their age, race, exercise status, pregnancy status, residential status, and confirmed safety to participate in an exercise study using the PAR-Q. Following the screening, eligible participants met at the on-campus laboratory space to complete baseline data collection. Prior to data collection, all participants signed an informed consent. Baseline data collection included a series of questionnaires followed by physiological assessments. Although other questionnaires related to psychological measures were administered at this time, only the information for the demographics survey is relevant to this particular study (e.g., age, marital status, number of children/dependents, employment status, education, and gross income). Next, measurements for blood pressure, lipid profiles, height, weight, waist circumference (WC), body composition, and upper and lower body strength tests were completed. Participants arrived in a fasting state and ate a snack prior to strength tests.

Blood Pressure and Lipid Profile Measurements

Resting blood pressure was measured using an Omron (Model BP5100) monitor , an oscillometric device, after the participant had been calmly seated for a minimum of five minutes. Measurements were taken at least twice. A third or fourth measurement was taken if systolic blood pressure (SBP) differed by ≥ 6 mmHg or if the diastolic blood pressure (DBP) differed by ≥ 4 mmHg. The two closest measurements were averaged and used for analysis. Values for total cholesterol (TC), triglycerides (TG), high-density lipoproteins (HDL-C), low-density lipoproteins (LDL-C), and fasting glucose were assessed via a capillary blood draw. A trained lab personnel used a lancet, blood fingerstick, and a capillary tube to withdraw the blood which

was analyzed by the Cholestech LDX. The accuracy of the Cholestech device to measure blood lipids is high in comparison to venipuncture standard lipid panels (R = 0.962) (113).

Anthropometric and Body Composition Measurements

Height and mass were measured using a digital stadiometer. Participants were instructed to remove their shoes and to stand erect with their head faced away from the stadiometer. Height was measured to the 0.1 cm and mass to the 0.1 kg. Waist circumference was measured twice using an nonelastic tape measurer placed around the narrowest part of the torso beneath the xiphoid process and above the umbilicus (112). If measurements differed by more than 0.5 cm, a third measurement was taken. Results were used to estimate abdominal adiposity, a cardiometabolic disease risk factor. For women, < 88cm is recommended for optimal health (112).

Body composition was assessed using dual energy x-ray absorptiometry, also known as the iDEXA (GE Healthcare Lunar' Madison WI). Participants were instructed to arrive at the lab in a fasted state (≥ 8 hours of no nutritional intake), and the test was performed by a certified lab technician. Participants were asked to remove all metal from the body prior to the scan to produce the most accurate results. The iDEXA measured three components of the body including lean body mass (kg), fat mass (kg), bone mineral density (g/cm^2), and percent body fat was calculated based on lean body mass and fat mass (114). Coefficient of variances have been reported for total body composition for bone mineral content, lean mass, and fat mass (<1%) and regional body composition for bone mineral content, lean mass, and fat mass (~2.5%) indicating the usefulness and precision of the iDEXA for body composition assessments (116).

Muscular Strength

To assess the effectiveness of the intervention on traditional RE outcomes, participants completed a 3-repetition maximum (3RM) using the bench press for upper body strength and back squat for lower body strength. For each of these tests, demonstrations of how to perform the exercise along with communicating proper lifting techniques were provided to the participants by trained lab personnel. For the bench press, participants practiced proper technique and completed a warm-up set using an 18lb bar. Participants were instructed to grip the bar such that the thumbs were shoulder distance apart when the bar was resting on the support props. Complete range of motion consisted of lowering the bar until it touched the chest and pressing it upward until locking of the elbows at the top of the press. For the back squat, participants practiced and modified their form and movement by performing bodyweight squats. Next participants completed their warm-up set using a 45lb barbell. Participants were instructed to attain a 90-degree angle between the femur and tibia for squat depth. Warmup sets included 10 repetitions. After the warmup, weight was increased as participants worked toward reaching their 3RM. On average, three rep max values are 93% of an individual's 1RM; therefore, final 3RM values will be divided by 0.93 to estimate the participant's 1RM (118).

Exercise Adherence

Adherence during the supervised programming was measured by the total number of attended sessions by the participants divided by the total number of offered sessions (20 sessions). Similarly, adherence during the unsupervised programming was measured by the total number of self-reported days completing full body RE divided by the total number of suggested days of completion (22 sessions).

Intervention

The 24-week protocol consisted of 10 weeks of supervised RE sessions twice per week (20 sessions total) and 11 weeks of unsupervised RE with a suggestion of two days minimum (22 sessions total). Each supervised session lasted approximately 60 minutes including ten minutes for a warm-up and cool-down. The dynamic warm-up consisted of light movements contracting and extending the muscles to increase blood flow to the involved musculature (118), and the cool-down utilized full-body static stretching.

Resistance Exercise Protocol

The weekly RE regimen alternated between two protocols each consisting of seven exercises. Protocol A consisted of a Smiths' machine back squat, lying hamstring curls, barbell bench press (or chest press for lighter weights), lat pulldown, dumbbell shoulder press, dumbbell bicep curls, and dumbbell overhead triceps extensions. Protocol B consisted of forward dumbbell lunges, dumbbell Romanian deadlifts, dumbbell chest flys, dumbbell bent-over rows, dumbbell upright rows, dumbbell hammer curls, and triceps cable extensions. These exercises were selected based on equipment availability within the community center. Week 1 of the study (familiarization week) consisted of trainers spending two days demonstrating and teaching correct form and motion of all fourteen exercises (one set of 12 or 1x12). Following a linear progression approach, training volume proceeded as follows: Week 2: 2x12, Weeks 3-5: 3x12, Weeks 6-8: 3x10, and Weeks 9-11: 3x8. Beginning weights for the squat and bench/chest press were calculated as 60% of their 1RM based on their 3RM. Resistance increased incrementally once the participant was able to complete two or more repetitions of an exercise beyond the weekly goal in the last set in at least two consecutive sessions (118).

Experimental Groups

Women in MEG had twice-weekly discussions in-person during both RE sessions, and topics were reiterated through automated text messages aimed to increase their knowledge of and strategies to maintain regular exercise. Topics included physical activity guidelines, RE training guidelines, and best practices to facilitate continued participation (e.g., goal setting). Further culturally-tailored adaptations for women in MEG included discussing motivators and barriers to exercise specifically for Black women. All educational material for women in MEG was included on an infographic with images of Black women. Lastly, women in MEG were able to self-select which RE protocol to begin with for the week with the alternate being completed on Day 2. During the unsupervised period of the study, women in MEG continued to receive motivational text messages every other week (five total) and two phone calls discussing motivators, barriers, and methods to overcome their barriers. Both groups received culturally-tailored experiences such as having an ethnically-matched trainer and completing all supervised RE sessions in a community fitness center with a majority Black staff located in a predominantly Black neighborhood. Those in SEG received basic instruction on how to perform each exercise safely and properly, but no further education or motivational strategies were provided. Both groups received a 5-question survey at Weeks 18 and 24 inquiring how many days of full-body RE they have participated in over the past weeks.

Statistical Analyses

An a priori sample size calculation completed with G Power suggested a sample size of 24 participants with an effect size of .50, alpha level of .05, and power of .80. Effect size was calculated based on outcomes for RE variables from previous meta-analyses (7-9). We oversampled by 20% for dropout consideration and therefore aimed to recruit 30 participants, 15

per group. Means, standard deviations, and frequencies were calculated for all demographic and adherence variables. Baseline differences for demographic variables between the two groups were assessed using a MANOVA. A mixed ANOVA analyzed the differences between all physical outcomes across the three timepoints: pre-test, post-test, and 3-month follow-up. Group served as the between factor and time served as the within factor. Upon significant group by time interactions or main effects, Bonferroni post-hoc analyses followed. Statistical significance was set at $p \leq 0.05$. All analyses were performed using IBM SPSS version 27 (IBM Corporation: Armonk, NY).

RESULTS

In total, 35 women showed interest in the study. After the telephone screening, two participants were excluded due to being an active exerciser (n = 1) and inability to adhere to the weekly time commitment (n = 1). After the screening and confirmation of eligibility, three women did not show to their pre-test appointment visit and became non-responsive. Thirty women were randomized to either MEG or SEG; however, one participant was later assigned to SEG during Week 2 due to the inability to receive the weekly motivational text messages required for MEG. During the intervention, three women withdrew from the study due to school obligations (n = 1), and childcare obligations (n = 2). Two of the women who withdrew had four children each whereas the other women of the study all reported zero children. It is also important to note that one of these women who withdrew was the participant that was assigned to SEG after not being able to receive text messages. Therefore, the final sample size for analysis included a total of 27 women (MEG: n = 14; SEG: n = 13). Demographics of the participants are included in Table 1. Overall, the women were young, mostly single, without children, some level of college or greater, employed part-time or less, and low income. MANOVA tests showed there

were statistical differences in age (p = .046), but not for marital status, children, education, employment, or income between the two groups at baseline (p > .05).

Table 1: Participant Demographics

	Total (n= 27) mean±SD or %	MEG (n= 14) mean±SD or %	SEG (n= 13) mean±SD or %	P-Value	η^2
Age (years)	24.67±3.77	23.29±3.77	26.15±3.29	0.046	.150
Marital Status				.675	.007
Single	88.9	85.7	92.3		
Married	0.0	0.0	0.0		
Cohabitating	7.4	7.1	7.7		
Divorced	3.7	7.1	0.0		
Children					
Zero	100.0	100.0	100.0		
Education				.208	.063
High School	3.7	7.1	0.0		
Some College	25.9	35.7	15.4		
Bachelor's Degree	29.6	21.4	38.5		
Grad/Professional Degree	40.7	35.7	46.2		
Employment				.089	.111
Not employed	29.6	50.0	7.7		
Yes, <30 hours	55.6	35.7	76.9		
Yes, ≥ 30 hours	14.8	14.3	15.4		
Income				.166	.075
<$29,999	77.8	92.9	61.5		
$30,000-49,999	14.8	0.0	30.8		
$50,000-74,999	3.7	7.1	0.0		
$75,000-99,999	3.7	0.0	7.7		

All cardiometabolic and other physical outcomes can be found in Table 2. There were no group by time interactions between the two groups over the three time points. Despite there being an overall difference in TC by group, post-hoc analyses revealed no further statistical differences (p >.05). There were significant differences in body composition and strength variables over time. Increases in lean body mass from pre- to post-test were seen for those in

MEG ($p < .001$) as well as the women in SEG ($p = .023$). Percent body fat significantly decreased from pre- to post-test for MEG ($p = .005$), but significantly increased from post-test to 3-month follow-up ($p = .004$). Bench press 3RM increased for the women in MEG from pre- to post-test ($p = .002$) and remained significantly higher than baseline at 3-month follow-up ($p < .001$). For the women in SEG, bench press 3RM was significantly higher from pre-test to 3-month follow-up ($p < .001$). Lastly, squat 3RM was significantly higher from pre- to post-test for both MEG ($p < .001$) and SEG ($p < .001$) and remained significantly higher from pre-test to 3-month follow-up for both groups ($p < .001$).

Table 2: Cardiometabolic and Physical Outcomes Repeated Measures ANOVA Results

		Pre-test (1)	Post-test (2)	3-mo (3)	Main Effect by Group			Main Effect by Time			Group X Time			*p:* 1-2	*p:* 2-3	*p:* 1-3
					F	*p*	η^2	F	*p*	η^2	F	*p*	η^2			
Overall Mixed Anova	**SBP**				0.058	0.811	0.003	3.456	**0.040**	0.136	0.367	0.695	0.016			
	DBP				0.035	0.853	0.002	1.816	0.175	0.076	0.140	0.870	0.006			
	TC				4.391	**0.048**	0.166	2.171	0.126	0.090	0.255	0.776	0.011			
	TRG				2.495	0.128	0.102	2.205	0.122	0.091	0.898	0.415	0.039			
	HDL				3.297	0.083	0.130	0.086	0.918	0.004	1.510	0.232	0.064			
	LDL				2.742	0.112	0.111	2.848	0.069	0.115	0.536	0.589	0.024			
	Gluc				0.037	0.849	0.002	0.278	0.759	0.012	2.507	0.093	0.102			
	Wt				0.014	0.906	0.001	2.347	0.107	0.096	1.225	0.304	0.053			
	BMI				0.053	0.820	0.002	2.227	0.120	0.092	1.208	0.308	0.052			
	WC				0.046	0.833	0.002	1.021	0.369	0.044	1.154	0.325	0.050			
	LBM				0.127	0.725	0.006	10.775	**<.001**	0.329	0.802	0.455	0.035			
	FM				0.000	0.985	0.000	2.439	0.099	0.100	0.881	0.421	0.039			
	% BF				0.050	0.826	0.002	8.629	**0.002**	0.282	0.283	0.694	0.013			
	BMD				0.858	0.364	0.038	2.020	0.145	0.084	0.522	0.597	0.023			
	B-3RM				0.028	0.870	0.001	15.351	**<.001**	0.411	0.682	0.511	0.030			
	S-3RM				0.137	0.715	0.006	38.295	**<.001**	0.646	2.286	0.114	0.098			
SPB	**MEG**	109.68±10.83	110.43±10.22	114.21±15.17										1.000	0.225	0.147
	SEG	110.37±9.44	109.67±9.95	112.75±8.16										1.000	0.353	1.000
DBP	**MEG**	78.11±10.09	76.21±8.05	79.14±10.07										1.000	1.000	1.000
	SEG	77.46±8.49	76.50±8.07	78.17±4.59										1.000	1.000	1.000
TC	**MEG**	138.78±17.39	144.00±20.78	142.57±18.69										0.825	1.000	1.000
	SEG	153.83±20.84	160.50±23.62	162.17±21.61										0.920	1.000	0.281
TRG	**MEG**	111.79±68.08	153.78±100.75	110.50±69.11										0.320	0.410	1.000
	SEG	108.17±52.91	96.75±64.72	73.50±31.43										1.000	1.000	0.272

HDL	**MEG**	49.93±10.17	52.86±11.00	49.28±7.02	0.507	0.442	1.000
	SEG	58.83±10.56	58.08±12.12	60.17±17.54	1.000	0.993	1.000
LDL	**MEG**	64.00±23.34	60.28±25.71	69.21±24.37	1.000	0.498	0.975
	SEG	73.42±23.23	80.25±27.54	87.33±22.10	1.000	0.796	0.165
Gluc	**MEG**	87.78±5.81	85.43±5.77	86.86±11.06	0.667	1.000	1.000
	SEG	84.67±8.91	88.67±9.06	87.50±8.13	0.234	1.000	0.500
Wt	**MEG**	79.73±26.47	81.04±27.46	80.71±26.88	0.071	1.000	0.453
	SEG	81.70±29.34	82.26±29.26	81.47±29.89	1.000	0.480	1.000
BMI	**MEG**	28.35±8.34	28.81±8.66	28.69±8.47	0.080	1.000	0.539
	SEG	29.32±9.09	29.52±9.03	29.23±9.30	1.000	0.436	1.000
WC	**MEG**	85.19±17.42	84.50±17.64	85.26±17.32	0.970	0.561	1.000
	SEG	87.27±21.12	86.89±20.36	86.27±20.71	1.000	0.951	0.326
LBM	**MEG**	44.82±8.67	46.38±9.11	45.39±8.65	**<.001**	0.109	0.573
	SEG	46.64±8.32	47.65±8.50	46.58±8.82	**0.023**	0.086	1.000
FM	**MEG**	31.91±18.65	31.68±19.20	32.53±19.07	1.000	0.082	0.830
	SEG	32.23±21.18	31.61±20.99	32.07±21.40	0.337	0.923	1.000
% BF	**MEG**	38.64±10.56	37.51±10.65	38.66±10.93	**0.005**	**0.004**	1.000
	SEG	37.47±11.89	36.57±11.98	37.28±12.27	0.054	0.133	1.000
BMD	**MEG**	1.26±0.17	1.25±0.17	1.26±0.18	0.621	1.000	1.000
	SEG	1.33±0.14	1.31±0.14	1.31±0.14	0.568	1.000	0.272
B-3RM	**MEG**	59.71±18.33	87.00±36.41	75.71±12.44	**0.002**	0.202	**<.001**
	SEG	66.50±15.42	84.58±13.72	79.42±13.25	0.075	1.000	**<.001**
S-3RM	**MEG**	116.08±34.31	152.31±38.51	155.23±37.87	**<.001**	1.000	**<.001**
	SEG	116.75±34.91	151.00±26.83	151.40±33.17	**<.001**	0.190	**<.001**

Notes: SBP: Systolic blood pressure, DBP: diastolic blood pressure, TC: total cholesterol, TRG: triglycerides, HDL: high-density lipoprotein, LDL: low-density lipoprotein, Gluc: glucose, Wt: weight in kilograms, BMI: body mass index, WC: waist circumference, LBM: lean body mass in kilograms, FM: fat mass in kilograms, %BF: percent body fat, BMD: bone mineral density, B-3RM: bench press 3-repetition maximum, S-3RM: squat 3-repetition maximum.

Women in MEG on average completed more supervised sessions than women in SEG resulting in a slightly higher adherence rate for women in MEG (93.9%) versus SEG (88.8%). During the unsupervised period, less women in MEG adhered to two or more days of RE (14.3%) than women in SEG (15.4%). However, results were greater for women in MEG who completed at least one or more days of RE during the unsupervised period (64.3%) versus the women in SEG (38.5%).

DISCUSSION

This study sought to identify the impact of a 24-week RE intervention on CMD risk factors, body composition, and strength between two experimental groups of young Black women: a motivational and standard exercise group. We found that 10 weeks of supervised training had a meaningful impact on body composition and strength, successfully encouraged women to adhere to RE twice per week and led to most women being able to sustain total body RE at least one day per week unsupervised.

Lean body mass increased in both experimental groups after the 10 weeks of supervised training. During the unsupervised portion of the training (11 weeks) women reported continuing RE, however their efforts were not sufficient to maintain their increases in lean body mass between their post-test and their 3-month follow-up visits. Women in MEG did experience a greater increase in lean body mass (not significantly higher than SEG) which resulted in significant decreases in their percent body fat measured during their post-test visit. Similar to lean body mass, women in MEG did not participate in unsupervised RE frequently enough to sustain the differences in body fat percentage as values returned to near baseline levels. Increases in lean body mass is a common result of RE (76-78). Building and preserving lean body mass can improve insulin resistance (131), BMD (77, 132), balance, and strength (2, 133), which are

all important factors aligned with aging. Results from this study demonstrate that lean body mass can increase and decline over 24 weeks depending on regularity of participation in RE, yet women can maintain their strength gains despite this decline in lean body mass. The idea of "feeling strong" has been shown to be a common reason for women participating and preferring to complete RE in young women who exercise regularly (Jones et al., 2024-in review). Most women in the current study were able to maintain strength outcomes based on the 3RMs from baseline to 3-month follow-up and were made aware of these findings.

Women in our study had insignificant decreases in fat mass by -.26kg, $p = 1.00$ (MEG) and -.62kg, $p = .337$ (SEG). These findings were comparable with average differences observed in women who performed RE in a recent meta-analysis (-.35kg, $p = .008$) (8). For body fat percentage, women in the current study showed smaller improvements than results found in the same meta-analysis (MEG: -1.13%, $p = .005$; SEG: -.9%, $p = .054$; Wewege et al.: -1.53%, $p < 0.0001$). Responses to aerobic exercise have been greater as a meta-analysis by Keating et al. found changes in fat mass by -1.38kg for (high-intensity interval training), -.91kg (moderate-intensity continuous training), and in body fat percentage by -1.26% (high-intensity interval training) and -1.48% (moderate-intensity continuous training) (134). Changes in fat mass in response to concurrent exercise in studies with predominantly White women have ranged from ~ -1.5-2.5kg (41, 135-137) and for body fat percentage from ~ -2.5% -3% (41, 43, 135, 137). Differences in fat mas and percent body fat have been less favorable in Black women for concurrent training only showing decreases of .8kg (41) and .5-1.68% decreases in percent body fat (41, 43). Notably, the goal of this study was to assess changes in cardiometabolic outcomes, not specifically weight loss, and a diet component was not included. These results suggest that RE can improve body composition, but compiled results from previous studies imply that

concurrent training may be the best option to target improvements in total body composition for women.

No changes were observed in the women's blood lipid profiles. have Prior studies have reported mixed findings amongst women regarding changes in lipid concentrations after RE, as results have been both favorable and unfavorable. For example, post-menopausal women who completed RE three times per week over 24 weeks saw increases in LDL, and TC and decreases in HDL (138). These findings oppose results from a more recent study in overweight and obese middle-aged women who saw beneficial changes in TC, TRG, LDL, and HDL in participants that performed RE three times per week over 24 weeks (139). Results from a meta-analyses by Ashton et al., including adults across the lifespan showed that there appeared to be no effect of short-, medium-, or long-term RE on TC, LDL, HDL, or TG (140). However, when assessed by age groups, healthy older adults (≥ 40 years) demonstrated greater benefits from RE on CMD risk factors compared to adults younger than 40 years, and unhealthy older adults showed the greatest magnitude of favorable changes in lipid profiles after RE in comparison to all healthy and younger adults (140).

Being that this is one of the first studies to assess the impact of RE on lipid profiles in young Black women, there are limited references to compare our results with Joseph et al., recently published findings from a mobile-based walking program in young Black women aged 24-49 years, and these results showed the inability of 8 months of aerobic physical activity to successfully impact CMD risk factors (128). Typically, a higher dose of exercise or significant improvements in blood lipid profiles are seen in response to RE in older adults or those with increased risk for CMD (140, 141). Overall, it appears that RE has small effects on improving blood lipid values in young adults, but could potentially be used to help maintain levels

associated with favorable CMD outcomes. More studies should focus on the transition from adulthood to middle-age from a longitudinal standpoint to examine whether RE can withhold significant increases in blood lipids typically seen at this pivotal time. Exploring potentially effective doses of RE for this effect would also be beneficial.

Positive changes in glucose immediately after an acute bout of RE have been shown in women with (142-144) and without type 2 diabetes (145). Results from Ashton (2022) showed significant reductions in fasted glucose after medium-term RE interventions in young healthy adults ages 18-35 years, but results are based upon only four studies (140). Davey and colleagues reported that 34% of middle-aged, prediabetic participants returned to normal ranges for blood glucose concentration after 3 months of supervised RE and 12 months of unsupervised RE (146). This study also reported much higher adherence rates to two days of RE during the unsupervised portion of 78% (nine months) and 53% (15 months) in comparison to our study's retention rates. We did not see any significant reductions in fasting glucose levels at post-test or 3-month follow-up, which could potentially be contributed to low adherence rates during the unsupervised training period or results may be impacted by the fact that our participants were within normal glucose concentration.

There were no significant changes in SBP or DBP in either experimental group, which is comparable to other studies who examined the effect of RE on blood pressure. Campa and colleagues reported no differences in SBP or DBP between or within groups of o middle-aged women with obesity who participated in low (one day) or high (three days) amounts of days of RE after 24 weeks (139). Despite these findings, the systematic review and meta-analysis by Ashton and colleagues showed that both medium-term (7-23 weeks) and long-term (≥ 24 weeks) RE regimens can decrease SBP by 4.02 mmHg (p <.0001) and 5.08 mmHg (p = .04),

respectively (140). Decreases were seen in DBP after medium-term RE by 1.73mmHg (p = .003) and 4.93mmHg (p = .008) after long-term RE. Additionally, a greater response in SBP and DBP to RE was seen in healthy older adults (-4.36 mmHg, p < .0001) than healthy young adults (-.56 mmHg, p = .27). Although we did not see any clinical or significant differences in SBP (~ 2 mmHg) or DBP (~-1 mmHg) in the current study, results from a study by Staffileno et al., showed otherwise in a group of young, pre-hypertensive Black women. There were positive responses in SBP (-6.4 mmHg, p = .036) and DBP (-3.3 mmHg, p > .05) after an 8-week intervention with a prescribed 150 minutes/week of lifestyle, self-selected physical activity (59). The home-based activities were also coupled with biweekly clinic visits to discuss health education, goals, barriers, and methods to overcome the barriers. Women had a self-reported adherence rate to physical activity duration of 87%. Women in the current study had normotensive BP averages prior to completing the intervention, therefore changes to BP may not be needed. Out of the 173 RCTs included in Ashton et al., most used machines and 64% had training sessions three times per week (140). Our total training volume was remarkably less compared to the results of this review and support the evidence that three days of training per week for six months or greater are most likely to elicit significant changes in SBP and DBP in adults.

Lastly, we noticed women in MEG attended a higher percentage of supervised training sessions (~94%) than the women in SEG (~89%). These values are comparable to other studies with in-person RE which ranged from ~89-95% over 12 weeks (38), ~97% over nine months (67) based on attended sessions out of total number of offered sessions. Other studies that measured adherence by percent of participants that attended 75-80% of the sessions had lower numbers than our study such as 23% over 12 weeks (147) and 76.5% over 24 weeks (46)

compared to 93% of the women in our study. Due to no differences between the experimental groups, our retention rates may be associated with the culturally tailored intentions of the study and underscores the necessity of designing RE intervention aspects that appeal to young Black women.

During the unsupervised training period, both groups were completing about half of the recommended number of days of RE (1day) at both check-in time points resulting in low adherence rates for the recommended two days per week (average of 14.8% for both groups). Vilojen et al., reported adherence rates of 60% for two days per week over 12 weeks in post-menopausal women after 24 weeks of supervised RE (46). Older adults in a study by Kekekailen showed 22% adherence to one day/week and 24% to two days/week in a 1-year follow-up after 36 weeks of supervised RE (67). Lastly, older adults in a study by Winett et al., showed 74% adherence to two days/week of RE with virtual contact from the staff, and 53% maintained adherence for six months with no contact following 12 weeks of supervised training (45). Although our adherence rates are undesirably lower than those of other studies, it is important to highlight that many of those studies were conducted in middle-to older-aged adults who report having less barriers to physical activity and exercise (148, 149).

The women in MEG who had continued contact with the study staff via scheduled text messages and phone calls, had a larger number percentage of women who participated in at least one day per week of RE. This result could potentially be attributed to the periodic check-ins and text messages as there was an increase in the average number of days of RE after the midway point versus the decrease in average number of days of RE seen in the women in SEG. During the phone calls, women discussed their current exercise status, barriers, and motivators for exercise. If women disclosed that they were facing challenges during this unsupervised period,

their trainer guided them through strategies to overcome these barriers in addition to motivational support for their continued journey. Similar strategies were used in the study by Winett (2015) in which after supervised RE, study staff scheduled a low number of check-in appointments (two) versus a high level of check-in appointments (nine) over six months either face to face, by telephone, or video call. Results from that study showed regardless of the amount of contact, adherence rates were non-statistically different amongst the two groups (45). These findings support the literature regarding the importance of periodic check-ins with participants when they are no longer under direct supervision of their exercise trainer. Despite most of the women in the current study completing one day/week of RE, more efforts are needed to identify how women can sustain unsupervised RE training.

Strengths and Limitations

Our study suggested that 24 weeks of combined supervised and unsupervised RE can improve body composition and strength variables in young Black women. Additionally, the inclusion of culturally-tailored methods are beneficial in retaining this demographic in an exercise program for 6 months, which is a notable strength of this study. The addition of discussing motivational topics during supervised exercise sessions did not increase adherence during supervised RE training, however, communication and tailored discussions with the women during self-led workouts appear to be valuable and efficacious as more than half of the women in our study continued RE for at least one day per week unsupervised.

This study has several limitations. First, this study relied on self-report of participation in RE during the unsupervised training period. Currently, the ability of wearable devices to accurately and reliably measure RE is questionable (150). Although the thought of using check-ins/scans into the fitness facility that was used during supervised training, this idea was

abandoned due to the possibility of the women using other facilities. Secondly, most of the women in this population were college students, and their environment to complete RE changed during unsupervised periods as each time point occurred during summer months and winter break in which students likely returned home to their city of residence. This disturbance in living situations may have disrupted their normal schedules and access to the fitness facility used in this study. Finally, dietary habits and consumption were not a focus of this study, therefore study personnel cannot conclude that results from blood lipid profiles were not affected by changes in eating habits throughout the 24 weeks. However, all participants were asked to not change their eating habits over the study period.

Conclusion

Our study demonstrated that 10 weeks of supervised RE can improve lean body mass and body fat percentage in young Black women. Additionally, women maintained improvements in upper and lower body strength 12 weeks beyond in-person training sessions even with low adherence rates. Periodical check-ins by phone calls during unsupervised exercise demonstrated the potential to increase low adherence to RE (at least one day/week). Greater examination of the needs and support systems that are essential to sustain unsupervised RE in young Black women remain warranted to achieve optimal improvements in CMD risk factors.

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Chapter 5: Manuscript 2

Black Women are F.I.R.E- Fitting in Resistance Exercise: The Assessment of Psychological and Behavioral Outcomes in Response to Resistance Exercise in Young Black Women

A majority of adults do not meet physical activity (PA) recommendations in the United States (U.S.), and Black women present some of the lowest participation rates amongst their racial, ethnic, and gender counterparts (1, 123). PA rates in the U.S. show that only 16.5% of Black women are meeting the national PA Guidelines, which is lower than White women (24.3%), Hispanic women (18.0%), and Asian women (16.7%) (123). These statistics spark concern as Black women also have the highest rates of obesity in the U.S. (14, 121) and overall poor cardiometabolic disease profiles (121, 122). Additionally, young adults aged 18-39 years in the U.S. are exhibiting cardiovascular disease risk factors at earlier ages including increases in cardiac events, which are typically seen later in life (16, 17, 23, 71). These statistical trends highlight the need for programs designed to support and increase PA in young Black women.

Studies aimed at increasing exercise participation and adherence amongst Black women exhibit several literature gaps including a lack of focus on young adults, lack of measuring long-term follow-up outcomes, and the majority of studies utilize aerobic exercise modalities only (3-6). Although the national PA guidelines recommend participating in sufficient amounts of aerobic and muscle-strengthening activities to maximize health benefits, American adults participate in more aerobic activity (30.0%) than muscle-strengthening activities (3.6%) overall (1, 123). Regular participation in muscle-strengthening PA, such as resistance exercise (RE) can be beneficial for cardiometabolic health (7), body composition (8, 44), and physical strength (9). However, women have reported unique barriers to RE including lack of knowledge to properly

perform RE (10) and discomfort in performing unsupervised exercise (11, 151). Other reported challenges include feeling unwelcomed in male-dominated strength training areas in gym facilities, lack of encouragement, and fear of developing “manly” or “bulky” body figures (10). Despite these concerns, interests in RE have seemingly increased in women (39, 45, 67, 152) (Jones 2024-in review), yet are still underutilized in exercise interventions for Black women (41-43).

Although RE may be unfamiliar to women, participants within RE training studies have reported that RE is enjoyable and a new challenge (11-13). Gaining satisfaction from seeking and mastering a new skill labeled as the psychological need of competence in Self-Determination Theory (SDT) can lead to increased intrinsic motivation to complete a behavior (40). Intrinsic motivation is an internal motivation sourced from inherent satisfaction and personal enjoyment. The SDT proposes that the fulfillment of an individual’s three basic psychological needs (competence, autonomy, and relatedness) can foster intrinsic motivation versus extrinsic motivation, which is propelled by external rewards (40). Increased intrinsic motivation is associated with increased participation in a behavior and is related to exercise adherence (62, 67). As a lack of motivation is a common barrier to exercise reported by Black women (24, 81, 82), employing and assessing strategies to increase motivation, particularly intrinsic motivation for exercise could be beneficial in sustaining exercise behavior.

In addition to exploring avenues to cognitively increase intrinsic motivation for exercise, implementing behavioral practices to help sustain this behavior is also instrumental. Having the cognitive ability to exercise control over one’s actions is known as self-regulation (52). Self-regulation is a construct within the Social Cognitive Theory (SCT), and includes employing regular practices of setting goals, monitoring one’s behaviors, providing reinforcements for a

behavior, managing one's time, eliciting social support, and putting boundaries in place to prevent a relapse in the behavior (90). Consistent implementation of self-regulatory behaviors bolsters exercise maintenance (45, 153). The SCT also proposes that an individual must have high self-efficacy, or belief in their ability to complete a behavior when facing challenges, to increase the chances of sustaining a behavior (90). The integration of components from the SDT and SCT are understudied, particularly in conjunction with each other and within young Black women. However, a cross-sectional study by Ahn et al., in university students showed that exercise participation had a significant and positive association with self-regulation, and this was further increased by the addition of intrinsic motivation (54). Incorporating concepts from both theories could potentially aid inactive women to increase participating in RE.

Studies in Black women have also used culturally-tailored methods to enhance the acceptance and adoption of novel behaviors (27, 128, 154). On the surface level, this involves the inclusion of cultural characteristics and norms of the targeted population such as designing materials with pictures that resemble them (33, 154) and having racially or ethnicity-matched interventionists (28, 38). Deep level strategies aim at social norms and values of the population which can include completing an intervention in their local churches or community centers (30, 37) or addressing specific challenges that a demographic may face (33, 36). However, culturally tailored methods combined with evidence based theoretical approaches to increase RE participation rates are insufficiently explored in young Black women. Therefore, this study aimed to employ concepts from the SDT and SCT with culturally-tailored enhancements to assess psychological, behavioral, and adherence outcomes in response to a 24-week RE intervention in young Black women.

METHODS

Study Design

This study utilized a randomized-control trial study design to assess the impact of a theory-based and culturally-tailored RE intervention on psychological outcomes, behavioral outcomes, and adherence to RE. The study took place over 24 weeks in which three weeks were dedicated towards testing/exercise familiarization, 10 weeks of supervised RE, and 11 weeks of unsupervised exercise. During the pre-test, post-test, and 3-month follow up visits, participants completed psychological and behavioral questionnaires related to exercise. Participants also answered two open-ended questions during their post-test and 3-month follow-up visits to assess their experience with the study components. Eligible women were randomized to either of two groups. The motivational exercise group (MEG) incorporated theory-based strategies and exercise education topics twice a week and followed up with text-messages throughout the supervised 10 weeks. During the unsupervised portion, MEG participants received text messages and phone calls to support continued RE participation. The standard exercise group (SEG) only received safety guidelines for RE. Both groups received some surface level cultural tailoring which included being trained by a Black woman in a community center located in a predominantly Black neighborhood. All study procedures were approved by the Institutional Review Board for Research of Auburn University under protocol #18-323 AR 1809 and registered at clinicaltrials.gov under #NCT05733260.

Participants

This study aimed to recruit young women who were not regular exercisers in a southeastern city in the U.S. Eligibility requirements included women aged 18-34 years, self-identified as Black, were low-risk non-exercisers, and residents or employees of the city in which

the study took place. Women who were pregnant or planning to become pregnant during the study's timeframe were excluded from the study. A non-exerciser was defined as not exercising at least 30 minutes a day, three days a week for the past three months. Risk for exercise was determined using the Physical Activity Readiness Questionnaire (PAR-Q) in which participants had to respond "No" to all questions to qualify for the study. Recruitment took place using digital and physical flyers, targeted emails, personal contacts, and Black student organizations on campus. During the pre-test visit, women received and signed an informed consent. Eligible participants received a complimentary life-term membership to the local gym where the study was conducted (valued at $30), as well as $25 upon completion at the 3-month follow-up visit. Figure 1 displays an overview of enrollment, allocation, retention, and analysis.

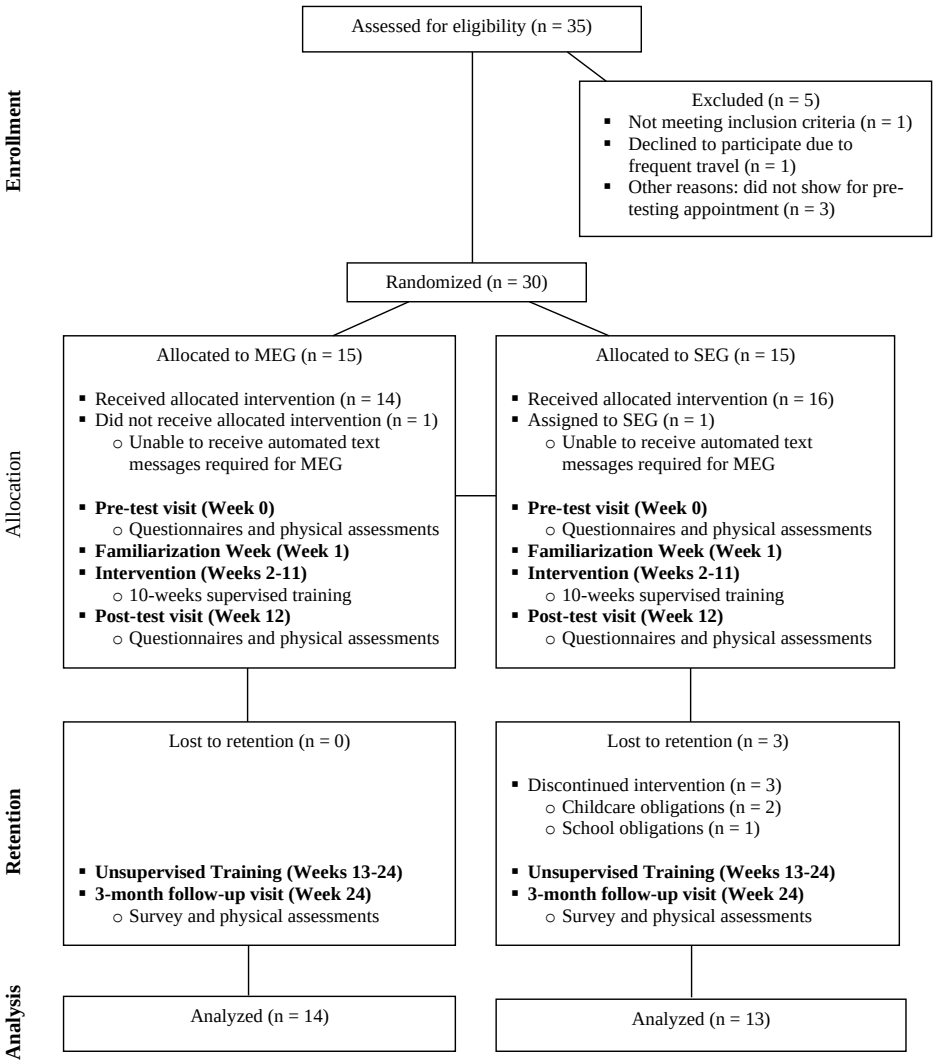


Figure 1: CONSORT Diagram and Study Timeline

Measures

Prior to visitation to the laboratory on campus, women underwent a telephone pre-screening to ensure eligibility (age, race, exercise status, pregnancy status) and risk for exercise using the PAR-Q. After confirming eligibility, women were invited to the campus laboratory to complete their pre-test visit. During this visit, women read and signed the informed consent and completed a demographics survey, multiple psychological questionnaires related to exercise, physical assessments, received randomized group assignment, and were registered as a member to the local fitness center used for the study. All physical assessments are detailed elsewhere.

Demographics

The demographics survey completed by the women inquired about their age, marital status, number of children/dependents, employment status, education, and gross income.

Basic Psychological Needs in Exercise Scale

The Basic Psychological Needs in Exercise Scale (BPNES) assessed components of the SDT including competence, autonomy, and relatedness regarding exercise. This questionnaire consists of 11 statements in which participants were instructed to rate their level of agreement using a 5-point Likert scale ranging from 1 “I don’t agree at all” to 5, “I completely agree”. Scores for each of the three basic psychological needs were averaged, and higher scores indicated a higher level of fulfillment of that need. This questionnaire has been previously validated in adults for both men and women (104, 105).

Behavior Regulation Exercise Questionnaire-3

The Behavior Regulation Exercise Questionnaire-3 (BREQ-3) assessed the source of motivation for exercise. The BREQ-3 provided a measurement of external or internal regulation of motivation for six domains (amotivation or non-regulation, external regulation, introjected

regulation, identified regulation, integrated regulation, and intrinsic regulation). The questionnaire contains 24 statements about reasons an individual exercises and participants were asked to score the statements on a 5-point Likert scale ranging from 0, “not true for me” to 4, “very true for me”. An average was calculated for each of the six domains as higher scores indicated greater motivation from that domain. Cronbach’s alpha showed acceptable internal consistency amongst all factors (0.73- 0.96) (107, 108).

Self-efficacy to Regulate Exercise Scale

Participants’ level of self-efficacy to complete exercise regularly was measured by the Self-efficacy to Regulate Exercise Scale. This survey contains 18 statements in which participants rated their level of confidence on a scale of 0 “cannot do at all” to 100 “highly certain can do” to complete exercise under challenging conditions. Scores from all statements were averaged, and higher scores represented greater self-efficacy to participate in exercise. This scale has been deemed a valid and reliable tool for measuring self-efficacy (110).

Physical Activity Self-Regulation-12

Self-regulation of exercise including practices that the women use to continue exercise was measured using the Physical Activity Self-Regulation 12-item (PASR-12) questionnaire. The frequency of using behavioral practices (goal-setting, self-monitoring, time-management, eliciting social support, reinforcements, and relapse prevention) were measured on a 5-point Likert scale ranging from 1 “never” to 5, “very often”. Scores from all six behavioral practices were summed. Overall scores can range from 12-60, with higher scores demonstrating more frequent use of that self-regulatory strategy to exercise. The PASR-12 has been validated in adults and construct validity showed strong correlations between the original PASR-43 item and the PASR-12 ($r = .96$) (111).

Exercise Adherence

Short-term exercise adherence to the supervised portion of study was determined by the percentage of sessions attended by the participants (e.g., completed sessions divided by total number of sessions). Over 10 weeks, a total of 20 sessions were offered during the supervised portion. Resistance exercise during the unsupervised portion of the study was self-reported and calculated by the number days the participant completed RE over the 11 weeks. Long-term adherence was defined as the percentage of participants who completed an average of two days per week of RE, meaning at least 22 days of completed RE during the unsupervised 11 weeks.

Procedures

Experimental Groups

Women were randomized to either the MEG or the SEG. All women received a surface-level of culturally-tailored experiences including having a Black woman trainer and having access and exercising in a fitness center in predominantly Black neighborhood with a predominantly Black staff. Women randomized to MEG also received deep-level culturally-tailored experiences in which discussions about motivators and barriers to exercise specifically for Black women took place. Participants in MEG had in-person weekly discussions grounded in concepts from the SCT and SDT, and were reinforced by informational text messages twice per week. Conversations during the RE training sessions were about methods to increase the use of goal-setting, self-monitoring, time management, social support, reinforcements, and relapse prevention to target self-regulation concepts. Concepts surrounding SDT were related to increasing the women's competence and sense of autonomy for exercise. All topics were included on an infographic (also including the motivators for exercise) with images of Black

women, which was shared with the women weekly. Table 2 shows weekly topics and the theory-based concept that they target along with the study's outline.

Exercise education materials included content about PA recommendations, physical and mental benefits of exercise, and basic RE guidelines (progressive overload and specificity). This content aimed to increase the knowledge of exercise and subsequently self-efficacy for exercise as well as competence. To further a sense of autonomy, women in MEG were able to self-select their exercise protocol order for the week. For example, women were able to choose to start with either Protocol A or Protocol B, with the understanding that the alternative protocol was completed on Day 2 of their weekly training. Lastly, during the unsupervised segment of the study, women in MEG received biweekly text messages, and two telephone calls to discuss current exercise, barriers and motivators for exercise, and strategies to overcome challenges they encountered.

Participants in the SEG completed twice weekly RE sessions with their trainer without any additional suggestions for how to continue exercising regularly. Women in this group completed Protocol A on Day 1 and Protocol B on Day 2 for five weeks, and vice versa for the second five weeks.

Acceptability of Mobile and In-person Interactions

Women in MEG were provided deeper level culturally tailored content by text messages during supervised and unsupervised sessions. They additionally received two phone calls during the unsupervised period. Acceptability of these interactions was assessed at post-test and 3-month follow-up for women in MEG by responses from two open-ended questions. These questions at post-test included, "Tell me about your experience with weekly topics: in-person and via text messages," and "Do you think the text messages were tailored or specific to you?

Why or why not?" For in-person interactions, women were prompted with, "Discuss the interaction with your trainer."

Implementation Fidelity Assessment

The degree to which the supervised training sessions adhered to SCT and SDT constructs was assessed by analyzing audio recordings of the RE training sessions. Approximately 5% of the RE sessions with each trainer were audio recorded and analyzed to determine how often constructs from SCT and SDT were targeted. Over the course of the intervention, four Black trainers delivered the exercise intervention with three for the SEG and one for the MEG. A minimum of three sessions from each trainer at the beginning, middle and end of the ten-week intervention were audio recorded. An independent observer listened to the RE session audio files and tallied discussions, feedback, and verbal interactions with each trainer based on previous defined definitions of SDT and SCT constructs. Definitions used to analyze the sessions and results of the analyses are in Table 1.

Recorded training sessions ranged from 55-63 minutes in length. The MEG sessions focused on building competence, autonomy and self-regulation. In contrast, the SEG sessions predominately focused on competence, relatedness, self-efficacy, or did not align with theoretical constructs.

Table 1: Implementation Fidelity Results

Construct	Definition	MEG		SEG	
		Total	Percent	Total	Percent
SDT					
Autonomy	Providing rationale for activities; Acknowledging importance of participants perspective; Providing choice or options; avoidance of control.	90	13.9	12	2.7
Competence	Collaboratively setting goals and expectations; tailoring goals and strategies to the participants; offering clear and relevant feedback; instrumental and practical skill training.	242	37.4	167	37.8
Relatedness	Providing empathy by attempting to see the situation through the participant's perspective; Displaying affection; Paying attention and gathering knowledge about the participant.	67	10.4	112	25.33
SCT					
Self-regulation	Discussing or referring to goal-setting, self-monitoring, time-management, eliciting social support, reinforcements, and relapse prevention.	112	17.3	3	1.0
Self-efficacy	Discussion of past performance accomplishments; Verbal persuasion or encouragement; Utilization of social modeling; Goal setting; Celebrating success or accomplishment;	94	14.5	66	14.9
No theoretical concept identified		42	6.5	82	18.6

Table 2: Study training weeks, measures, exercise prescription, and strategical topic timeline for MEG

Time Period	Training Weeks	Measures	RE Prescription	Exercise Education/Strategical Topic	SCT/ SDT Constructs Targeted
Baseline	0	Demographics survey, BPNES, BREQ-3, Exercise Self-Efficacy Scale, PASR-12			
Familiarization Week	1		1 x 12	Exercise safety, proper technique, and form	Competence
Intervention	2		2 x 12	National PA recommendations, benefits of exercise, and basic principles of resistance training	Competence
	3-5		3 x 12	Setting short- and long-term goals, self-monitoring behavior, strategies for managing time/schedule, common barriers to exercise for Black women	Goal setting, self-monitoring, time management
	6-8		3 x 10	Recognizing and seeking social support, acknowledging accomplishments of goals, self-reflection on helpful strategies, providing autonomy support	Social support, self-monitoring, reinforcements, autonomy
	9-11		3 x 8	Assessing comfortability with exercises, revisit goal setting, strategies to overcome barriers	Competence, self-monitoring, reinforcement, goal setting, relapse prevention

12-week post-testing	12	Demographics survey, BPNES, BREQ-3, Exercise Self-Efficacy Scale, PASR-12		
	14		Reminder of goals, importance of tracking exercise behavior and setting reminders for exercise sessions	Goal-setting, self-monitoring, and time management
	16		Acknowledgement of successes and setbacks	Reinforcements, relapse prevention
	18		Reminder of eliciting social support and utilizing in-person and virtual support	Social support
	20		Acknowledgement of successes and setbacks, external support from trainer	Reinforcements
	22		Acknowledgment of internal feelings towards exercise and reminder of exercise goals	Goal-setting, reinforcements
3-month follow-up	24	Demographics survey, BPNES, BREQ-3, Exercise Self-Efficacy Scale, PASR-12		

Notes: RE= resistance exercise, SCT= Social Cognitive Theory, SDT= Self-Determination Theory, BPNES= Basic Psychological Needs Exercise Scale, BREQ-3= Behavioral Regulation of Exercise Questionnaire-3, PASR-12= Physical Activity Self-Regulation-12 item, PA= physical activity

Resistance Exercise Protocol

All women in the study completed identical training protocols on a weekly basis with the exception of three women who had to have an alternative exercise for at least one exercise due to a previous injury or discomfort. All sessions began with a dynamic warm-up and ended with static stretches for a cool down. Following the warm-up, women completed seven total body resistance exercises targeting the following major muscle groups: quadriceps, hamstrings, chest, back shoulders, biceps, and triceps. Two protocols were developed, Protocol A and Protocol B, each including different exercises targeting the same muscle groups. Intensity over the 10 weeks progressed linearly in which women began with two sets of 12 repetitions (2x12) during Week 2 to allow their muscles to get acclimated to the exercises, then progressed to three sets of 12 (Weeks 3-5), three sets of 10 reps (Weeks 6-8), and ended with three sets of 8 (Weeks 9-11).

Statistical Analysis

Sample size was calculated using G Power. An a priori sample size was determined to be 24 participants (12 per group) with an effect size of .50, alpha level of .05, and a power of .80. The moderate effect of .50 was chosen based on the effect of RE on outcomes variables calculated from several meta-analyses (7-9). To account for attrition, we oversampled by 20% and aimed to recruit 30 participants in total. Means and standard deviations were calculated for continuous variables and frequencies were calculated for all categorical variables related to demographics and exercise adherence. Separate mixed ANOVAs analyzed differences in psychological variables for each questionnaire from pre-test, post-test, and 3-month follow-up scores as well as between the two experimental groups. Time (pre-test, post-test and 3-month follow-up) served as the within factor and group (MEG or SEG) served as the between factor. Upon significant group, time or group X time interactions, Bonferroni post-hoc analyses

determined where the differences occurred. Statistical significance was set at $p \leq .05$. Multivariate ANOVAs analyzed differences in baseline demographics. Assumptions were met for determining differences in psychological variables across the three time points and baseline differences for demographic variables. Differences in psychological variables at 3-month follow-up amongst level of exercise (< 1day/week versus ≥ 1 day/week) were analyzed by Multivariate ANOVAS. Variables that violated Box's M (autonomy, amotivation, external regulation, introjected regulation) were analyzed using Kruskal-Wallis tests. All numerical analyses were performed using IBM SPSS 27 (IBM Corporation: Armonk, NY). Responses to open-ended questions underwent a thematic analysis using an artificial intelligence software Chat-GPT (OpenAI: San Fransico, CA), in which recurring patterns were identified. This form of analysis was deemed justifiable for the content of the open-ended questions as the main goal was to recognize and develop common emerging themes (155). For example, this analysis was used for automated theme identification rather than more complex tasks that may require more human cognition such as theory development (156).

RESULTS

Thirty-five women expressed interest in participating in the study. Two women were excluded from the study after the initial telephone screening due to their current frequency of exercise exceeding the study's limits (n = 1) and inability to commit two days per week for the in-person RE sessions (n = 1). Three women were screened and deemed eligible for the study, but did not attend their pre-test visit and did not respond to communications (n = 3). In total, 30 eligible women were randomized to either MEG or SEG. During Week 2 of the study, one of the participants was reassigned to SEG as she was unable to receive the weekly text messages that were essential to be a part of MEG. Over the course of the intervention, three women decided to

withdraw from the study due to childcare (n = 2) and school obligations (n = 1) in which one of the women was the participant who had to be reassigned to SEG. Notably, the two women who withdrew from the study due to childcare obligations each had four children making them dissimilar from the other women of the study who all reported having zero children. Twenty-seven women were included in the final analysis for the study (MEG: n = 14; SEG: n = 13). An overview of the women's demographics can be found in Table 3. MANOVA tests determined there were statistical differences between the two groups at baseline for age (p = .046), but not for marital status, children, education, employment, income, or body mass index (p > .05).

Table 3: Participant Demographics

	Total (n= 27) mean±SD or %	**MEG (n= 14) mean±SD or %**	**SEG (n= 13) mean±SD or %**	**P-Value**	**η^2**
Age (years)	24.67±3.77	23.29±3.77	26.15±3.29	0.046	.150
Marital Status				.675	.007
Single	88.9	85.7	92.3		
Married	0.0	0.0	0.0		
Cohabitating	7.4	7.1	7.7		
Divorced	3.7	7.1	0.0		
Children					
Zero	100.0	100.0	100.0		
Education				.208	.063
High School	3.7	7.1	0.0		
Some College	25.9	35.7	15.4		
Bachelor's Degree	29.6	21.4	38.5		
Grad/Professional Degree	40.7	35.7	46.2		
Employment				.089	.111
Not employed	29.6	50.0	7.7		
Yes, <30 hours	55.6	35.7	76.9		
Yes, ≥ 30 hours	14.8	14.3	15.4		
Income				.166	.075
<$29,999	77.8	92.9	61.5		
$30,000-49,999	14.8	0.0	30.8		
$50,000-74,999	3.7	7.1	0.0		
$75,000-99,999	3.7	0.0	7.7		

Notes: BMI= body mass index

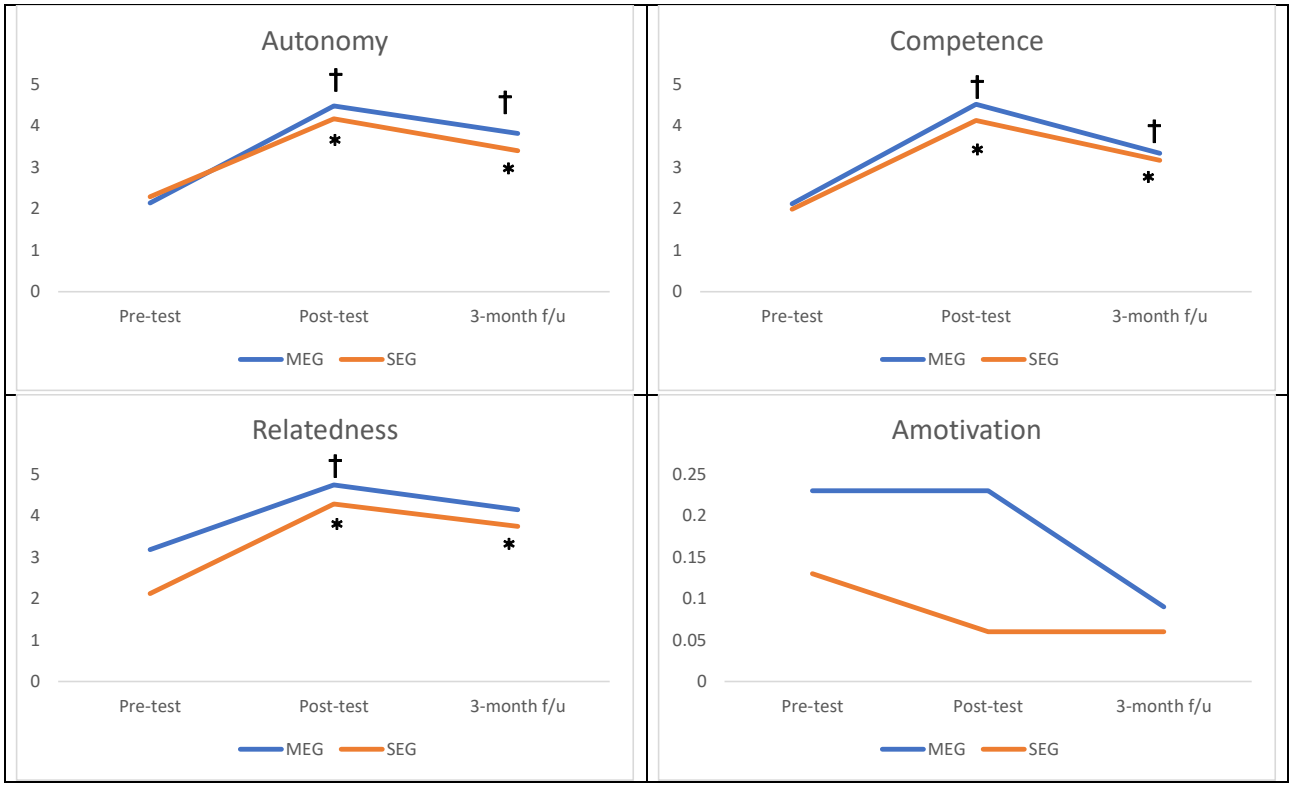
Repeated measures ANOVAs across all three timepoints revealed no significant group by time interactions. There were significant effects of time for competence, autonomy, relatedness, self-efficacy, self-regulation as well as introjected, identified, integrated and intrinsic motivation. Amotivation and external regulation did not change over the course of the study for either group ($p > .05$). There were also significant group differences for relatedness and self-regulation, but post-hoc, revealed no significant differences across the three timepoints. Results for all psychological variables can be found in Table 4 and graphical depiction of changes in Figure 2. Differences in psychological variables by level of adherence (<1day/week versus ≥1 day/week) can be found in Figure 3.

Table 4: Repeated Measures ANOVA Results for Psychological Variables

		Pre-test (1)	Post-test (2)	3-mo (3)	Main Effect by Group			Main Effect by Time			Group X Time			*p:* 1-2	*p:* 2-3	*p:* 1-3
					F	***p***	**η^2**	**F**	***p***	**η^2**	**F**	***p***	**η^2**			
Overall Mixed Anova	Autonomy				1.585	0.220	0.060	101.167	<.001	0.802	1.974	0.150	0.073			
	Competence				1.28	0.269	0.049	72.476	<.001	0.744	0.269	0.765	0.011			
	Relatedness				6.053	0.021	0.195	27.741	<.001	0.526	1.018	0.344	0.039			
	Amotivation				0.954	0.338	0.037	1.080	0.348	0.041	0.444	0.644	0.017			
	External				0.103	0.750	0.004	1.314	0.275	0.05	0.944	0.377	0.036			
	Introjected				0.103	0.751	0.004	8.448	<.001	0.253	1.498	0.233	0.057			
	Identified				0.253	0.620	0.010	19.651	<.001	0.440	3.007	0.058	0.107			
	Integrated				3.479	0.074	0.122	15.916	<.001	0.389	1.158	0.322	0.044			
	Intrinsic				0.266	0.611	0.011	30.058	<.001	0.546	0.861	0.429	0.033			
	Self-efficacy				1.187	0.287	0.049	13.984	<.001	0.378	0.552	0.579	0.023			
	Self-Regulation				6.251	0.020	0.221	47.939	<.001	0.685	0.256	0.775	0.011			
Autonomy	**MEG**	2.14±.65	4.48±.44	3.82±.87										**<.001**	**0.008**	**<.001**
	SEG	2.29±.60	4.17±.40	3.40±.52										**<.001**	**0.003**	**<.001**
Competence	**MEG**	2.12±.78	4.52±.42	3.34±1.01										**<.001**	**<.001**	**0.001**
	SEG	1.99±.82	4.13±.71	3.17±.77										**<.001**	**0.002**	**0.003**
Relatedness	**MEG**	3.18±1.53	4.74±.30	4.14±.74										**0.001**	**0.025**	0.115
	SEG	2.12±1.37	4.28±.61	3.74±1.02										**<.001**	0.057	**0.005**
Amotivation	**MEG**	.23±.42	.23±.49	.09±.27										1.000	0.575	0.408
	SEG	.13±.42	.06±.21	.06±.15										1.000	1.000	1.000
External	**MEG**	.75±1.00	.68±.83	.75±.76										1.000	1.000	1.000
	SEG	1.11±1.38	.69±1.06	.69±.84										0.482	1.000	0.196
Introjected	**MEG**	2.00±1.14	2.27±1.07	3.02±.98										0.990	**0.006**	**0.003**

	SEG	2.08±1.05	2.33±1.09	2.54±1.12	1.000	1.000	0.337
Identified	**MEG**	2.39±.82	3.14±.50	3.18±.53	**<.001**	1.000	**<.001**
	SEG	2.52±.56	3.13±.62	2.77±.54	**0.004**	**0.049**	0.506
Integrated	**MEG**	1.43±1.03	2.59±.83	2.48±.82	**<.001**	1.000	**0.002**
	SEG	1.33±.50	2.10±.73	1.85±.70	**0.027**	0.838	0.244
Intrinsic	**MEG**	1.80±.97	3.00±.58	2.78±.69	**<.001**	0.633	**<.001**
	SEG	1.90±.58	2.85±.65	2.52±.60	**<.001**	0.234	**0.034**
Self-efficacy	**MEG**	43.75±19.92	62.11±13.25	49.66±16.67	**<.001**	**0.011**	0.664
	SEG	39.56±13.22	52.56±15.37	45.61±12.99	**0.014**	0.289	0.618
Self-Regulation	**MEG**	25.51±13.20	49.00±5.29	36.00±12.57	**<.001**	**0.002**	**0.050**
	SEG	19.19±6.06	41.83±6.31	31.58±10.71	**<.001**	**0.017**	**0.010**

Notes: Bolded p-values indicate a significance < .05.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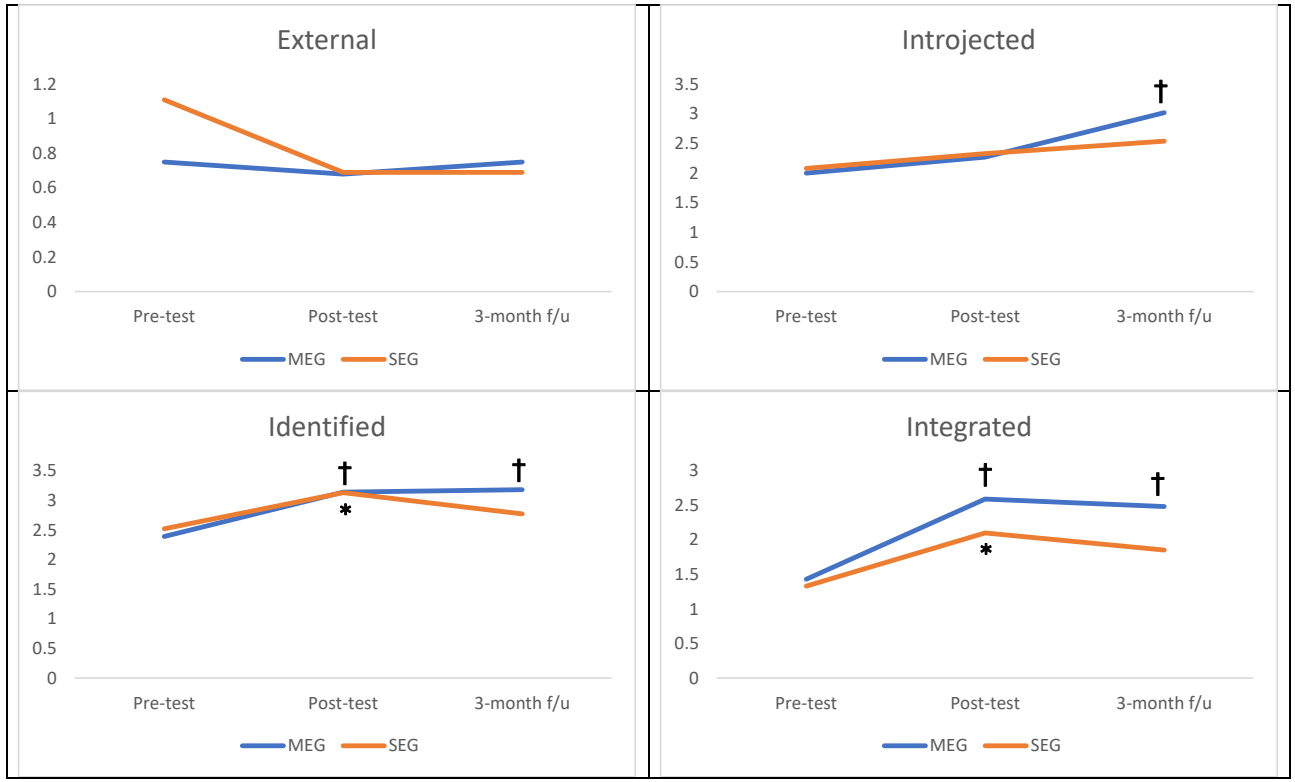
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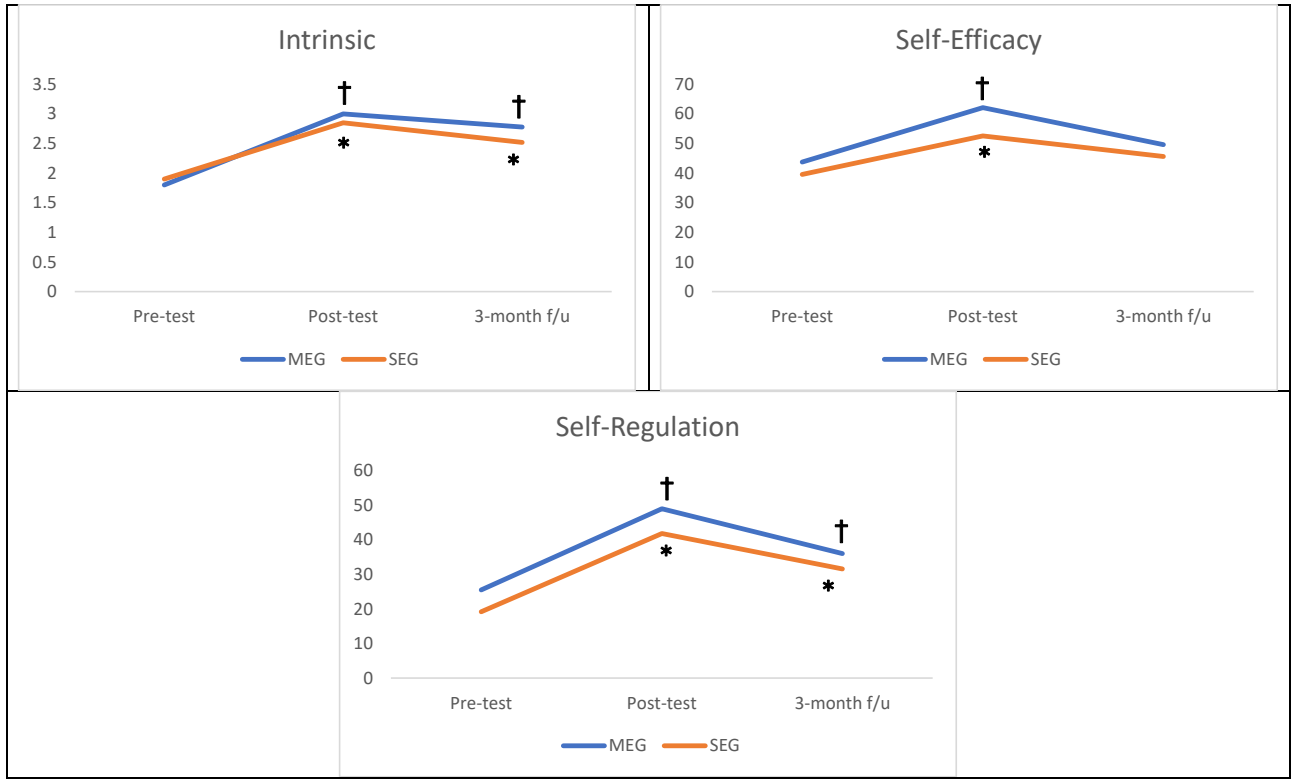

Figure 2: Changes in psychological variables from pre-test, post-test, and 3-month follow-up

Notes: †= significant difference from baseline in MEG ($p < .05$). *= significant difference from baseline in SEG ($p < .05$)

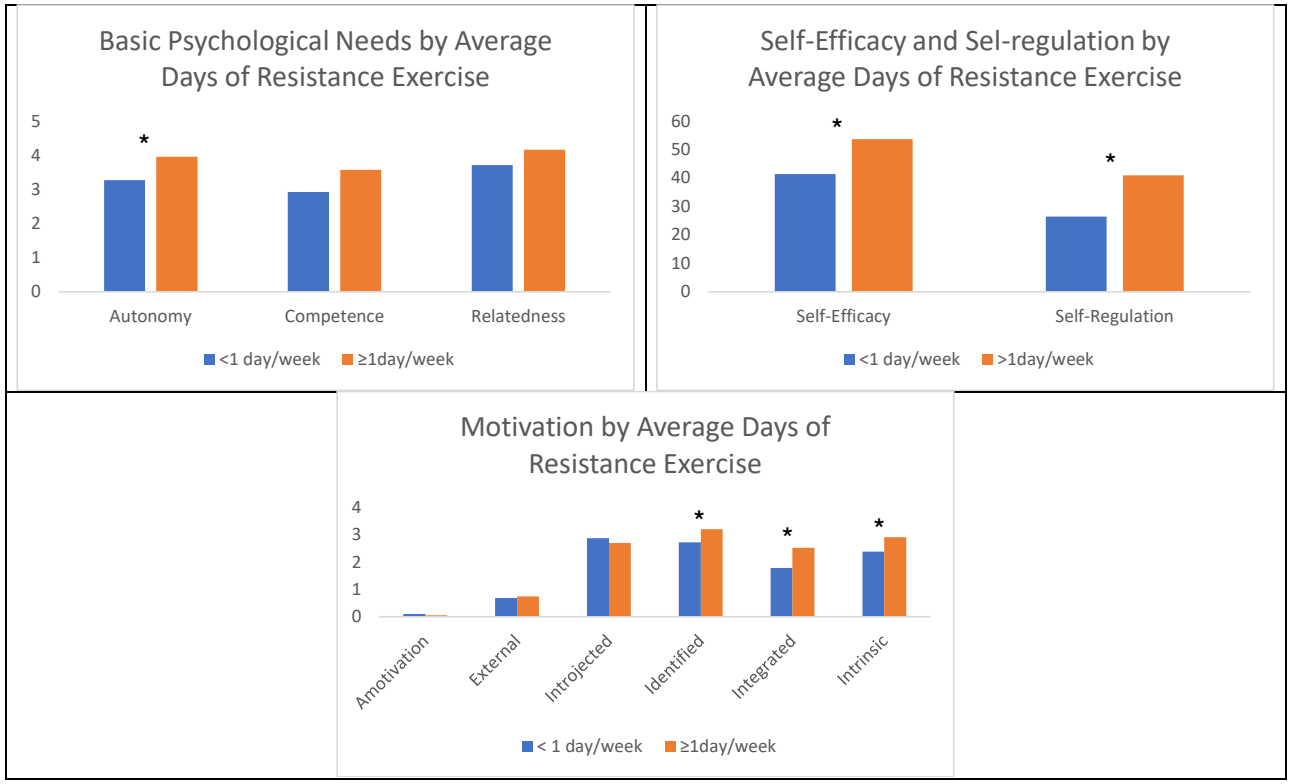

Figure 3: Differences in psychological variables by frequency of resistance exercise

Notes: *= significance of $p < .05$

Basic Psychological Needs for Exercise Scale

Basic psychological needs of autonomy and competence increased significantly from pre- to post-test for both groups ($p < .001$), and decreased from post-test to 3-month follow-up (MEG: $p = .008$, $p < .001$; SEG: $p = .003$, $p = .002$). Overall, competence and autonomy remained significantly higher at 3-month follow-up compared to pre-test values for MEG ($p < .001$, $p = .001$) and SEG ($p < .001$, $p = .003$). Relatedness increased significantly for MEG ($p = .001$) and SEG ($p < .001$) from pre- to post-test, but showed a decrease from post-test to 3-month follow-up for MEG ($p = .025$). Women in SEG showed significantly higher 3-month follow-up values than pre-test values ($p = .005$). Women who completed at least one or more days of RE per week ($n = 14$) versus less than one ($n = 13$) during the unsupervised period had significantly higher autonomy (H [3] = 4.934, $p = .026$), and higher competence (F [1] = 6.744, $p = .057$). Relatedness did not differ between the levels of RE during the unsupervised period (F [1] = 1.746, $p = .198$).

Behavior Regulation Exercise Questionnaire-3

Results for changes in sources of behavioral regulation for exercise significantly increased in MEG and SEG for identified regulation ($p < .001$; $p = .004$), integrated regulation ($p < .001$; $p = .027$), and intrinsic motivation ($p < .001$; $p < .001$) from pre- to post-test visits. In MEG, these values remained significantly higher at 3-month follow-up in comparison to pre-test for identified regulation ($p < .001$), integrated regulation ($p = .002$), and intrinsic motivation ($p < .001$). In SEG, identified regulation decreased from post-testing to 3-month follow-up ($p = .049$), but intrinsic motivation remained higher from pre-testing to 3-month follow-up ($p = .034$). Lastly, introjected regulation continually increased over the three timepoints for MEG (pre-test to 3-month follow-up: $p = .003$; post-test to 3-month follow-up: $p = .006$). During the

unsupervised period, women who completed at least one day per week of RE had significantly higher identified (F [1] = 5.802, p = .024), integrated (F [1] = 6.862, p = .015), and intrinsic motivation (F [1] = 5.096, p = .033) compared to those that did not. There were no differences between levels of RT during the unsupervised portion for amotivation (H [1] = .014, p = .906), external (H [1] = .249, p = .618), or introjected regulation (H [1] = .218, p = .641).

Self-Efficacy to Regulate Exercise Scale

Women in MEG showed increases in self-efficacy for exercise from pre- to post-test (p < .001) but had a significant decrease from post-testing to 3-month follow-up (p = .011). In SEG, self-efficacy to complete exercise was only significant between pre- and post-testing visits (p = .014). Self-efficacy was also significantly higher in women who completed 1 or more days of RE unsupervised (F [1] = 5.273, p = .030).

Physical Activity Self-Regulation-12

The use of self-regulatory behaviors for exercise were similar in both groups in which results showed a significant increase in MEG and SEG from pre- to post-test visits (p < .001), decreases from post-test to 3-month follow-up visits (p = .002; p = .017, respectively), yet remained higher than baseline at their 3-month follow-up visit (p = .050; p = .010, respectively). Women who completed 1 or more days weekly of unsupervised RE had a greater use of self-regulation than women who did less than one day per week (F [1] = 17.356, p < .001).

Exercise Adherence

Women in MEG completed an average of 18.7 supervised RE sessions out of 20, while women in SEG completed an average of 17.8. During the unsupervised period, women in MEG self-reported an average of 13.0 days out 22 compared to 11.4 reported by the women in SEG. In MEG, 14.3% of the women completed RE at least two days per week, 64.3% completed at least

one day per week, and 35.7% completed less than an average of 1 day per week. For the women in SEG, 15.4% participated in RE at least two days per week, 38.5% did at least one day per week, and 61.5% completed less than one day per week of RE on average.

Acceptability of Mobile and In-person Interactions

At post-test, women in MEG revealed a preference for face-to-face interaction compared to the text messages: "*I think the in person was more beneficial to me than like the text messages*." Participants described face-to-face interactions as a better way to personalize conversations and responses and to for participants to get immediate clarification if questions arose: "*It's nice because they're right there and you can just ask questions*."

For text messages, some women expressed confusion if the text messages were intended for informational and motivational purposes only, or if a response was expected. Additionally, there was an overall sense of generalization with the text messages. Example quotes were, "*I was not 100% sure if I should respond to them or if they were more of like, topics to think about*" and "*I felt they were pretty generic*."

At 3-month follow-up, women in MEG discussed appreciating the text messages and phone calls because they served as reminders to remain active. One participant stated, "*They helped remind me of like, especially like me getting like caught up in work and everything, to help kind of remind me of ... things I need to focus on.*" However, there were mixed results about the effectiveness of the text messages as some perceived them as helpful, while others did not read them. One participant stated, "*I read the text message, I was like, well, that's a good point. I need to do that*", while another one responded, "*They were good, but I'm gonna be honest, I don't read any of my text messages*". Participants reported consistency in the benefits of the phone calls. Women in MEG liked that they personalized, encouraging, and allowed time to discuss

their goals, progress, and any barriers they were facing: "*Calling was the most beneficial because when she would call that's when I would have the best week usually like, I'd be like, okay, you know, she's right, these goals are attainable.*"

DISCUSSION

The current study assessed the impact of culturally-tailored and evidence-based concepts from the SDT and SCT on adherence, psychological, and behavioral outcomes over a 24-week RE intervention in young Black women. Overall, the supervised RE sessions were successful, reflected by the high adherence rates, but greater effort is needed to identify effective methods for sustaining exercise adherence beyond in-person training. There were no significant group by time interactions in psychological and behavioral variables between the motivational and standard exercise groups. However, our results support that higher adherence to RE is associated with culturally appropriate methods, self-regulation, and psychological concepts from SDT.

Adherence rates during the supervised portion of the study were high in both experimental groups with a higher, but insignificant, rate in the MEG. Participants in MEG revealed through open-ended questions that the weekly in-person discussions were beneficial and personally tailored towards their experiences. Less favorable adherence rates were seen during the unsupervised period of the study with merely 15% of the women in both groups continuing RE on an average of two days per week as suggested. A larger percentage of women in MEG did complete at least one or more days of RE than the women in SEG (64.30% versus 38.50%). Being that there were no differences in psychological or behavioral variables between the two groups, this disparity may be attributed to the continued contact via text messages and telephone calls that the women in MEG received. Text messages were automated, but the telephone calls were used to discuss specific challenges and collaborate on ways to navigate their barriers to

encourage regular exercise regimens and were preferred over the text messages. These results are dissimilar to a study by Wilbur and colleagues that reported no differences in leisure moderate-to-vigorous PA or minutes of walking in middle-aged Black women who received or did not receive check-in telephone calls over 24 weeks of a maintenance period (157). Differences in preferences for communication may be due to differences in age or the period of time for maintenance phase as the study by Wilbur was twice as long as our study's maintenance/unsupervised phase. Also, personal communication differences could vary by individual and perhaps type of preferred communication by age group or personality type should be further explored. Despite the positive increased number of days of RE found in our study, further research is needed to establish methods to successfully transfer women from guided to sustained self-led RE.

Although the SDT has been previously used to increase exercise behaviors, it has not been well studied in Black women (3-6). Findings between exercise behavior and the three basic psychological needs (competence, autonomy, and relatedness) have been mixed. Previous systematic reviews showed competence (62, 158) and autonomy (158) to be most linked to exercise behavior and adherence. Both competence and autonomy increased over the 24 weeks in both groups and remained significantly higher at 3-month follow-up. This is not surprising for competence as women had consistent opportunities to demonstrate competence throughout the supervised portion by achieving RE goals and increased mastery to perform resistance exercises and results of the fidelity assessment demonstrate that support for competence occurred in both groups. Women who continued unsupervised RE at least one day per week had higher, but insignificant levels of competence (p = .057) than the women who did not, regardless of experimental group. This is an important finding as RE is not an inherent activity and requires

learning. Women who completed more days of RE were able to show a greater mastery of their skills, improving a sense of competence, which potentially led to further and ongoing participation in RE. Despite our efforts to provide more autonomy support for women in MEG by allowing them to choose the order of their exercise protocols, women in both MEG and SEG reported similar changes across the study. However, comparing women by exercise adherence at 3-month follow-up (< 1 day/week versus ≥ 1 day/week), autonomy was the only significantly higher basic psychological need of the three. Positive relations between autonomy and autonomous motivation exist and taken together have previously shown higher levels of exercise adherence (158, 159). Our results align with those findings as women who had higher days of adherence also had higher autonomous motivation, and may support the need for autonomy support in exercise interventions.

As anticipated, relatedness increased over the course of the in-person training sessions. Further, relatedness may have increased due to the intentional inclusion of ethnically and gender-matched trainers aimed to increase this connection. Interestingly, relatedness in SEG remained higher than baseline despite women in MEG discussing their appreciation for the two check-in calls and women in SEG receiving no contact or support during the unsupervised sessions. This sense of belonging and connecting with others has shown no or low association with exercise behavior (62, 158). Although these women did not have contact with study personnel, we cannot confirm that they did not rely on other social influences during their unsupervised training which could have affected our results. Future studies should explore the impact of relatedness on long-term exercise behavior in women who have ongoing contact with other woman exercisers as social contact and support have been noted as motivators to continue exercise (46, 160, 161).

Women in MEG had increased identified and integrated regulation at post-test and 3-month follow-up. Additionally, women who completed one or more days per week of unsupervised RE scored the highest in identified regulation on the motivation scale. Identified and integrated regulation are forms of autonomous extrinsic motivation, and increases have had positive associations with exercise behavior (62) and adherence (158). Even though identified and integrated are labeled as extrinsic motivation, they have a higher degree of self-determination and are more aligned with internal goals. Women in MEG discussed personal goals and reasons for wanting to initiate and maintain exercise, which could have sourced greater autonomous motivation.

In MEG, introjected regulation continually increased across the three timepoints at a significant rate. Increases in introjected regulation are not surprising within training studies, but is not optimal as introjected regulation is a type of controlled extrinsic motivator (97). When participants were questioned about their experiences with their trainers, women in both groups mentioned they enjoyed the in-person sessions and that some motivation stemmed from not wanting to disappoint the PI who a Black woman. Commitment and positive relationships between participants and study personnel have been reported before in RE interventions (13, 46). Older African American adults who participated in a concurrent 12-week intervention mentioned having a Black trainer was motivation to continue the study and they enjoyed ease of communication and relatability to their trainer (13). The inclusion of ethnically-matched interventionist can be seen as beneficial for the adoption of exercise and high retention rates for in-person activities. However, it could also be concealing women's true motivation for exercise as external factors are influencing their decision to continue versus their own internal drive. However, intrinsic motivation followed desired outcomes as increases persisted from baseline to

24 weeks for both MEG and SEG. This type of motivation stems from the highest level of self-determinism, suggests that behavior is performed out of satisfaction and enjoyment (97), and shows consistent and positive relations with exercise adherence (62, 158, 162, 163). Even though the women in our study showed high levels of autonomous and intrinsic motivation, long-term adherence levels were still suboptimal, suggesting other factors may be associated with long-term participation in RE (164).

Self-efficacy has previously been recognized as a predictor for exercise in Black women (165), but has not also been associated with adherence (166, 167). Several studies have shown self-efficacy to only be associated with short-term exercise behavior but not long-term (168-170). Our results mirror that literature in which self-efficacy increased during the in-person sessions but returned to near baseline levels by the 3-month assessment. Perhaps participants' confidence to be able to complete exercise alone diminishes with the removal of their trainer or coach for accountability. However, implementing behavioral strategies have been more closely aligned with regular exercise (39, 171). This includes the use of self-regulation such as setting goals, monitoring oneself, providing or receiving feedback (54, 80, 161, 172). In this study, self-regulation peaked at post-test, declined over the unsupervised period, but remained higher than pre-study for both groups.

Introducing and placing a greater emphasis on self-regulation has the potential to increase sustained exercise behavior (45, 152, 153, 173, 174). This is especially true for RE given the complexity of planning training days, rest days, type of exercises performed on each day, and monitoring and managing progression. Trainers in this study were responsible for tracking and managing progression of weights for all the exercises. Even though progressive overload was a topic discussed in MEG, perhaps it would have been more advantageous for women to record

and keep track of their weights themselves prior to transitioning to unsupervised training. In total, planning and organizing are important components of RE regimens and our findings support the necessity to include these skills in RE interventions.

Strengths and Limitations

To our knowledge, this is one of the first studies to assess changes in psychological and behavioral variables in response to RE in Black women. Our findings indicate positive and sustained increases in competence, autonomy, intrinsic motivation, and self-regulation in both experimental groups over 24 weeks. No significant differences occurred between the two experimental groups for any psychological variables suggesting that inclusion of culturally-tailored modifications and basic training guidelines for RE were satisfactory to encourage sustained exercise at least one day per week beyond in-person training. However, adherence rates for two or more days per week for the women were low, and strategies to improve these rates are still warranted. Our findings also highlighted key distinguishing factors between those that completed less than one day compared to those that completed one or more days of RE per week showing higher levels of autonomy, self-efficacy, self-regulation, autonomous extrinsic, and intrinsic motivation. Lastly, this intervention included long-term follow-up assessments which has been seen infrequently in PA or exercise interventions in Black women, and not performed for RE interventions.

Women in the current study were mostly single and without children. Research has shown that life experiences such as getting married and having children can present increased challenges to being physically active for women (149), therefore the women in this study may have faced less opposition to completing workout sessions on a weekly basis. Additionally, the women in this study were highly educated as nearly 70% had a bachelor's or

graduate/professional degree potentially making our results less generalizable to all Black women. The intervention fidelity assessment only assessed how closely the trainers' verbal interaction aligned with theoretical constructs. We were unable to assess other nonverbal forms of communication and the participants' perceptions of these interactions. Reports of adherence during the unsupervised segment of the study relied on self-report and memory recall over 6 weeks increasing the chances of over- or under-reporting days of RE. Future studies may consider objective measurements or more frequent reports of exercise via mobile applications to increase the likelihood of more accurate data, however, it is important to consider self-regulatory skills associated with monitoring exercise, as well as reactivity to self-monitoring. To provide ecologically validity and not impact self-regulatory strategies we choose not to have participants report weekly RE behavior. Finally, although we met our minimal sample size, future studies would benefit from a larger sample size.

Conclusion

In conclusion, our study reveals that employing culturally-tailored strategies and provision of basic safety and training guidelines for supervised RE can modestly improve unsupervised exercise behaviors 12 weeks beyond in-person training. Basic psychological needs, autonomous motivation, and intrinsic motivation showed improvements over the 24 weeks and were also more distinct in women who exercised one or more days per week.

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APPENDICES

APPENDIX A

IRB

Revised 07/12/2022

~~AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING~~
HUMAN SUBJECTS

PROTOCOL REVIEW FORM FULL BOARD or EXPEDITED REVIEW

For assistance, contact: **The Office of Research Compliance (ORC)**

Phone: **334-844-5966** E-Mail: **IRBAdmin@auburn.edu** Web Address: **http://www.auburn.edu/research/vpr/ohs** **Submit completed form and supporting materials as one PDF through the IRB Submission Page**

Handwritten forms are not accepted. Where links are found hold down the control button (Ctrl) then click the link.

1. Proposed Start Date of Study: 1/4/2023 Today's Date: **October 20, 2022** Submission Status (Check One): ☒ New ☐ Revisions (to address IRB Review Comments) Proposed Review Category (Check One): ☒ Full Board (greater than minimal risk) ☐ Expedited
If Expedited, Indicate Category(ies) ((Link to Expedited Category Review Sheet) Click or tap to enter category.

2. Project Title: A resistance training program for Black women: Project F.I.R.E.

3. Principal Investigator (PI): Danielle Wadsworth
Degree(s): Ph.D. Rank/Title: Professor
Department/School: Kinesiology
Role/responsibilities in this project: PI- Oversight of the project, consenting participants, data collection, data analysis and dissemination.

Preferred Phone Number: 3348441836 AU Email: wadswd@auburn.edu Faculty Advisor Principal Investigator (if applicable): Click or tap here to enter text.

Rank/Title: Choose Rank/Title Department/School: Choose Department/School Role/responsibilities in this project: Click or tap here to enter text.

Preferred Phone Number: Click or tap here to enter text. AU Email: Click or tap here to enter text.

Department Head: **Mary Rudisill** Department/School: Kinesiology

Preferred Phone Number: **3348441458** AU Email: rudisme@auburn.edu

Role/responsibilities in this project: None

4. Funding Support: ☒ N/A ☐ Internal External Agency: Click or tap here to enter text. Pending ☐ Received ☐
For federal funding, list funding agency and grant number (if available): Click or tap here to enter text.

5. a) List any contractors, sub-contractors, and other entities associated with this project: Click or tap here to enter text.

a) List any other AU IRB approved protocols associated with this study and describe the association: Click or tap here to enter text.

b) List any other institutions associated with this study and submit a copy of their IRB approval(s): Click or tap here to enter text.

Protocol Packet Checklist

Check all applicable boxes. A completed checklist is required.

☒ **Protocol Review Form** (All required signatures included and all sections completed)
(Examples of appended documents are found on the website: https://cws.auburn.edu/OVPR/pm/compliance/irb/sampledocs)

☒ **CITI Training Certificates** for key personnel

☒ **Consent Form or Information Letter** and any releases (audio, video or photo) that participants will review and/or sign

☒ **Appendix A** "Reference List"

☒ **Appendix B** if e-mails, flyers, advertisements, social media posts, generalized announcements or scripts, etc., will be used to recruit participants.

☒ **Appendix C** if data collection sheets, surveys, tests, other recording instruments, interview scripts, etc. will be used for data collection. Attach documents in the order they are listed in item 13c.

Continued on Page 2

☐ **Appendix D** if they study will use a debriefing form or will 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.

1. General Research Project Characteristics

6A. Research Methodology

Check all descriptions 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
- ☐ Locations or Tracking Measures
- ☒ Physical / Physiological Measures or Specimens
- ☒ Surveys / Questionnaires
- ☐ Other: Click or tap here to enter text.
- ☐ Internet / Electronic
- ☒ Audio
- ☐ Video
- ☐ Photos
- ☐ Digital Images
- ☐ Private records or files

6B. Participant Information

Check all descriptors that apply to the TARGET population. (link to definition of target population)
☐ Males ☒ Females ☐ AU students

Vulnerable Populations
☐ Pregnant Women/Fetuses ☐ Prisoners ☐ Institutionalized
☐ Children and / or Adolescents (under age 18 in AL; if minor participants, at least 2 adults must be present during all research procedures that include the minors)

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

Will participants be compensated? ☒ Yes ☐ No

6C. Risks to Participants

Identify all risks participants might encounter in this research.

- ☒ Breach of Confidentiality*
- ☐ Deception
- ☐ Psychological
- ☐ None
- ☒ Other (COVID-19, other medical):

COVID-19

- ☐ Coercion
- ☒ Physical
- ☐ Social

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

6D. Corresponding Approval/ Oversight

- **Does the study include participant exposure to radiation?** ☒ **Yes** ☒ **No**
  If yes indicate: ☒ **DEXA** ☐ **PQCT** ☐ **Other**

- **Is IBC Approval required for this study?**
  ☒ **Yes** ☐ **No**

  If yes, BUA # 954 **Expiration Date** 9/2/2024

- **Is IACUC Approval required for this study?**
  ☐ **Yes** ☒ **No**

  If yes, PRN # Click or tap here to enter text. **Expiration Date** 2/1/2024

- **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**

Continued on Page 3

Does any portion of this project require review by the MRI Safety Advisory Council?

☐ **Yes** ☒ **No**

2. Project Assurances

7A. Principal Investigator's Assurances

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 not 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 I have read, understand and agree to conduct this research project in accordance with the assurances listed above.

Danielle Wadsworth Danielle D. Wadsworth _____

_10/20/22_

Principal Investigator Name **Principal Investigator Signature**

Date

7B. 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.

Revised 07/12/2022

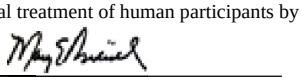
Faculty Advisor / Sponsor Name	Faculty Advisor Signature	Date

Continued on Page 4

7C. Department Head's Assurance

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 — Department Head Name



Department Head Signature

10/20/22 — Date

3. Project Overview:

8A. A summary of relevant research findings leading to this research proposal:

*(Cite source; include a "Reference List" as **Appendix A**.)*

Black women are disproportionately affected by physical inactivity and as a result have higher rates of and susceptibility to obesity and cardiometabolic risk factors (Telford et al., 2016; Stierman et al., 2021). Previous exercise intervention shows mixed findings in physiological and psychological outcomes (Jenkins, 2017). This raises uncertainty in the best practices to increase PA and exercise behavior in Black women. Currently there is a gap in the literature as to what strategies promote long-term exercise adherence in Black women. Furthermore, most PA or exercise interventions in Black women have solely focused on aerobic activities undermining the importance of resistance exercises. Resistance training is crucial for women given its potential to improve body composition and slow down the rate of bone mass loss due to menopause (U.S. Department of Health and Human Services, 2018). Therefore, the purpose of this study is to examine the effect of a theoretical-based culturally tailored resistance training intervention on exercise adherence, psychological and physiological outcomes in Black females.

8B. A brief summary/abstract of the study methodology, including design, population, and variables of interest. (350 word maximum, in language understandable to someone who is not familiar with your area of study. Note this summary/abstract can be used to prepare the concise summary in the consent document.):

This study will utilize a randomized control trial design, with participants randomly assigned to a theoretically-based culturally tailored intervention or standard of care group.

Baseline (Week 0), 12- week, and 3-month follow-up (Week 24) procedures will take place in the Kinesiology building at Auburn University. Measures will include: demographics (i.e. height, weight, date of birth), body composition by iDXA (i.e. fat mass, lean mass and bone mineral density), cardiometabolic measures (i.e. HDL and LDL cholesterol, glucose, triglycerides, waist circumference, blood pressure), psychological assessments (i.e. basic psychological needs in exercise scale, behavior regulation exercise questionnaire, self-efficacy, self-regulation) and sleep quality (i.e. Pittsburgh quality sleep survey) and a 3-repetition maximal test for upper and lower body strength. Participants will also receive a wrist worn sleep monitor to wear for seven days. The exercise intervention will include a total body resistance training protocol and will take place at the Auburn City Recreation Facilities (Frank Brown and Boykin) twice per week. Participants will be randomized to either the theoretical-base culturally tailored intervention group or the standard exercise group in which each will be facilitated and supervised by a Black trained research personnel following cultural -tailored recommendations (Joseph et al., 2017). All participants will attend a 10-week resistance training program twice per week for a total of 20 sessions from Weeks 2-11. Week 1 will be used to familiarize the participants with the resistance training exercises. Those randomized to the culturally tailored intervention group will receive health education, weekly

text messages and self-regulatory strategies to overcome barriers to exercise. Participants will return for post testing at weeks 12 and 24. Post-testing will include all pretesting measures and semi-structured interviews to assess their experiences with the program.

4. Purpose

9A. State the purpose of the study and all research questions or aims. (Include a sentence that begins, "The purpose of this study is…")

The purpose of this study is to examine the effect of a theoretical based culturally tailored resistance training intervention on exercise adherence, psychological and physiological outcomes in Black females. Aim 1: Determine the effect of the intervention on adherence to resistance training within the intervention and post

intervention. Adherence is defined as the number of days per week participants participate in resistance training. Aim 2: Determine the effects of the intervention on psychological outcomes including changes in self-efficacy, self-regulation, psychological needs, and motivation. Aim 3: Determine the effects of the intervention on physiological variables including body composition and cardiometabolic outcomes.

9B. Describe how results of this study will be used? (e.g., presentation? publication? thesis? dissertation?)

This study is part of a dissertation and will be used for publication and presentation.

5. Key Personnel. Describe responsibilities as specifically as possible. Include information on research training or certifications related to this project. **To determine key personnel see decision tree at https://cws.auburn.edu/OVPR/pm/compliance/irb/training. Submit a copy of CITI training documentation for all key personnel.** (For additional personnel, add lines as needed).

To determine Auburn University HIPAA – covered entities click link to HIPAA Policy.

If any key personnel have a formal association with institutions/entities involved in the study (for example is an employee or supervisor at the site research will occur), describe that affiliation. For all non-AU affiliated key personnel, submit a copy of their IRB approval.

Principal Investigator: Danielle Wadsworth
Rank/Title: Professor **Email Address:**
wadswdd@auburn.edu **Degree(s): Ph.D. Dept / Affiliation:** Kinesiology H**IPAA Covered Entity? Yes** ☐ **No** ☒

Roles / Responsibilities: Oversight of the project, consenting participants, data collection, data analysis and dissemination.

- AU affiliated? ☒ Yes ☐ No If no, name of home institution: Click or tap here to enter text.
- Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.
- Do you have any known competing financial interests, personal relationships, or other interests that

could have influence or appear to have influence on the work conducted in this project? ☐ Yes ☒ No

- If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.
- Completed required CITI training? ☒ Yes ☐ No If NO, complete the appropriate CITI basic course and update the revised Exempt Application form.
- If YES, choose course(s) the researcher has completed: Human Sciences Basic Course 8/18/2025

Choose a course Expiration Date

Individual: Chloe Jones **Rank/Title:** Ph.D. Candidate

Email Address: csj0025@auburn.edu **Degree(s): Master of Science**

Dept. / Affiliation: Kinesiology **HIPAA Covered Entity? Yes ☐ No ☒**

Roles / Responsibilities: Oversight of the project (exercise trainer and spotter), consenting participants, data collection, data analysis, and dissemination,

- AU affiliated? ☒ Yes ☐ No If no, name of home institution: Click or tap here to enter text.
- Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.
- Do you have any known competing financial interests, personal relationships, or other interests that could have

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influence or appear to have influence on the work conducted in this project? ☐ Yes ☒ No
- If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.
- Completed required CITI training? ☒ Yes ☐ No If NO, complete the appropriate CITI basic course and update the revised Exempt Application form.
- If YES, choose course(s) the researcher has completed: Defining Research with Human subjects 8/24/2024

Social and Behavioral Emphasis 8/24/2024

Individual: Katherine (Katie) Spring **Rank/Title:** Ph.D. Candidate

Email Address: kzw0076@auburn.edu **Degree(s):** **Master of Science**

Dept. / Affiliation: Kinesiology **HIPAA Covered Entity? Yes ☐ No ☒**

Roles / Responsibilities: Data collection, analysis and dissemination

- AU affiliated? ☒ Yes ☐ No If no, name of home institution: Click or tap here to enter text.
- Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.
- Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project? ☐ Yes ☒ No
- If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.
- Completed required CITI training? ☒ Yes ☒ No If NO, complete the appropriate CITI basic course and update the revised Exempt Application form.
- If YES, choose course(s) the researcher has completed: Social and Behavioral Emphasis 7/12/2025

Choose a course Expiration Date

Individual: Mason McIntosh **Rank/Title:** PhD Student

Email Address: mzm0309@auburn.edu **Degree(s):** **Master of Education**

Dept. / Affiliation: Kinesiology **HIPAA Covered Entity? Yes ☐ No ☒**

Roles / Responsibilities: data collection (exercise trainer and spotter)

- AU affiliated? ☒ Yes ☐ No If no, name of home institution:

- Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.
- Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project? ☐ Yes ☒ No
- If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.
- Completed required CITI training? ☒ Yes ☐ No If NO, complete the appropriate CITI basic course and update the revised Exempt Application form.
- If YES, choose course(s) the researcher has completed: Social and Behavioral Emphasis 10/25/2025

Defining Research with Human subjects

10/25/2025

Individual: Click or tap here to enter text. **Rank/Title:** Choose Rank/Title

Email Address: Click or tap here to enter text. **Degree(s):** Click or tap here to enter text.

Dept. / Affiliation: Choose Department/School **HIPAA Covered Entity? Yes ☐ No ☐**

Roles / Responsibilities: Click or tap here to enter text.

- AU affiliated? ☐ Yes ☐ No If no, name of home institution: Click or tap here to enter text.
- Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.
- Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project? ☐ Yes ☐ No
- If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.
- Completed required CITI training? ☐ Yes ☐ No If NO, complete the appropriate CITI basic course and update the revised Exempt Application form.
- If YES, choose course(s) the researcher has completed: Choose a course Expiration Date

6. Location of research.

11A. List all locations where data collection will occur. If applicable, attach permission letters as Appendix E. (School systems, organizations, businesses, buildings and room numbers, servers for web surveys, etc.) **Be as specific as possible.**

(See sample letters at https://cws.auburn.edu/OVPR/pm/compliance/irb/sampledocs)

Data collection will occur in the School of Kinesiology room 149. The 10-week training program will take place at the Auburn Parks and Recreation Boykin and Frank Brown recreation facilities. Permission letter from Auburn Parks and Recreation is in the Appendix.

11B. Will study data be stored within a HIPAA covered facility? Yes ☐ No ☒

If yes, which facility(ies) (To determine AU HIPPA covered entities, go to VII of the HIPPA Hybrid Entity Policy)**:**

Click or tap here to enter text.

7. Participants (If minor participants, at least 2 adults must be present during all research procedures that include the minors.)

12A. Describe the targeted/ intended participant population for the study. Include the anticipated number of participants and inclusion and exclusion criteria and the procedures to ensure more than 1 adult is present during all research procedures which include the minor.

☐ Check here if existing data will be used and describe the population from whom data was collected including the number of data files.

☐ Check here if permission to access existing data is required and submit a copy of the agreement to access.

30 black women aged 18-34 will be recruited from the Auburn community. To qualify for the study participants must be: 1) Be between the ages of 18 and 34 years and identify as a black female, 2) Not actively participating in some type of exercise on a regular basis (at least three days a week for the past three months) 3) Low risk for medical complications from exercise (as determined by the PAR-Q), 4) Not pregnant or planning to become pregnant throughout the duration of the study and 5) Must live, work, or be a student in the city of Auburn, AL.

12B. Describe, step-by-step in lay language all procedures 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 https://cws.auburn.edu/OVPR/pm/compliance/irb/sampledocs)

Participants will be recruited from the local Auburn community via flyers, listserves, and social media. The Auburn Parks and Recreation department will place flyers for the study in their facilities and recruit within their advertisements. We will also attend the auburn parks and recreation health fair in early January to recruit for the study.

12C. Minimum number of participants required to validate the

study? 30 Number of participants expected to enroll? 30

Provide the rationale for the number of participants. An aprioi sample size calculation completed with G power suggested a sample size of 24 participants (12 per group) with an effect size of .50, alpha level of .05 and power of .80. We will oversample by 20% and aim to recruit 30 participants, 15 per group.

Is there a limit to the number of participants that will be included in the study?

☐ **No** ☒ **Yes, the number is** 40

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12D. Describe the process to compensate, amount and method of compensation and/or incentives for participants. **AU Procurement and Business Services (PBS) policies**

(benefits to participants are NOT compensation)

If participants will not be compensated, check here: ☐

Indicate the amount of compensation per procedure and in total: $25 lifetime membership to fitness center and $25 for data collection at week 24

Indicate the type of compensation: ☐ Monetary ☒ Incentives

☐ Raffle or Drawing incentive (Include the chances of winning.)

☐ Extra Credit (State the value)

☒ Other

Describe how compensation will be distributed (USPS, email, etc.): Each participant will receive a free lifetime membership to the Auburn Parks and Recreation Fitness center. The cost of membership is $25. In addition, each participant who post tests at 24 weeks will receive an additional $25 in cash.

8. Project Design & Methods

13A. Describe, step-by-step, all procedures and methods that will be used to consent participants. If a waiver is being requested, indicate the waiver, and describe how the study meets the criteria for the waiver. If minors will be enrolled describe the process to obtain parental/ legally authorized guardian permission.

☐ **Waiver of Consent (including using existing data)**

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

☐ **Waiver of Parental Permission (for college students 18 years or younger)**

Participants who inquire about the study will be screened by phone to ensure they meet the inclusion requirements for the study and have not been exposed to COVID-19. Exclusionary criteria (not self-identifying as a Black women, not within the age range, or pregnant or intending to become pregnant during the time of the study) will also be addressed prior to participants coming to the laboratory for baseline testing. Additionally, the research personnel will administer the Physical activity readiness questionnaire (PAR-Q) via telephone. Based upon these questions, participants will be ineligible to participate and dismissed from the study if they answer yes to any of the following questions: 1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
2. Do you feel pain in your chest when you do physical activity? 3. In the past month, have you had chest pain when you were not doing physical activity? 4. Do you lose your balance because of dizziness or do you ever lose consciousness?
5. Do you have a bone or joint problem that could be made worse by a change in your physical activity? 6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition? 7. Do you know of any other reason why you should not do physical activity? Those who qualify will be provided

directions to report to room 149 in the Kinesiology. Participants will meet with Dr. Wadsworth or Chloe Jones and review the consent form. Each potential participant will review and sign the consent form. Those who consent to the study will continue with Baseline testing.

13B. In lay language, understandable by someone not familiar with the area of study, describe the complete research design and methods that will be used to address the purpose. Include a clear description of who, when, where and how data will be collected. Include specific information about participants' time and effort.

Participants who are eligible for the study will complete assessments at week 0, week 12 and week 24. On the first visit to the lab participants will arrive in a fasting state (no food for 8 hours prior to the visit and no blood pressure medication until after blood pressure is assessed), participants will read and sign the university-approved informed

consent form and a demographics survey. Dr. Wadsworth or Chloe Jones will present all informed consent briefings. Following participants will complete several questionnaires assessing psychosocial and sleep factors. Questionnaires
include: the Basic Psychological Needs in Exercise Scale, Behavior Regulation Exercise Questionnaire-3, Self-Efficacy to Regulate Exercise scale, Physical Activity Self-Regulation-12 questionnaire, and the Pittsburgh Sleep Quality Index questionnaire. Blood pressure measurements will be taken after five minutes of seated rest using a digital blood pressure monitor. Blood draws will be taken using a fingerstick and will be completed by trained study personnel. Blood analyses will include the assessment of total cholesterol, triglycerides, high-density lipoproteins, low-density lipoproteins, and fasting glucose. Fasting capillary blood will drawn after an 8-hour fast and assayed for blood glucose, high density lipoprotein, low-density lipoprotein, and serum triglycerides. Participant will be asked to sit comfortably in the blood collection chair for blood to be drawn (5 microliters (µL)) from a fingerstick using a 28-gauge lancet (Unistick 3 comfort, Owen Mumford, Marietta, GA) which will be collected in a glass, lithium heparin-coated capillary tube. This capillary tube transports blood to a cassette loaded into the Alere Cholestech LDX (Alere San Diego, inc. San Diego, CA) for analysis. While collecting blood samples all research staff will wear nitrile gloves and masks. In addition, single use lancets will be used. The lancets and capillary tubes will be disposed of into sharps containers. Following blood draws, height, weight, and waist circumference will be measured using a stadiometer and an elastic tape measurer. An iDEXA scan will assess body composition. After the scan participants will be given a snack. Upper and lower body strength will be assessed by a 3-repetition maximum (3-RM) bench press and back squat. Prior to 3RM testing, participants will observe a demonstration of the requested exercises (bench press and back squat) and instructed on proper techniques for each exercise. Proper form for the back squat will entail an assessment to ensure participants are in the following position: feet in parallel position to each other, shoulder-width apart and bar placed above the posterior deltoids with hands placed slightly wider than shoulder-width. Flex the knees and hips while maintaining a flat back and chest up and out, until thighs are parallel with the floor. Simultaneously extend the knees and hips and return to start position. Proper position and technique for the bench press will assess participants are in the following position and movement: lying in supine position, place hands on the barbell in neutral position (slightly wider than shoulder-width apart). Lower the bar to touch the chest, then extend elbows fully to return to starting position. Following, participants will receive a sleep activity watch and asked to wear the watch for 7-days. A time to meet at the Boykin or Frank Brown community center to initiate membership will be made for the following week. Total time for the assessment is approximately 60 minutes. The following week participants will meet the study staff at the fitness center on two separate occasions to become familiar with resistance training procedures including the back squat, seated hamstring curls, barbell bench press, lat pulldown, shoulder press, bicep curls, overhead triceps extensions, front lunges, Romanian deadlifts, chest flys, bent-over rows, upright rows, hammer curls, and triceps cable extensions. A member of the research team will verbally describe each exercise and allow time to practice with correct form. For the next 10 weeks participants will meet at the fitness center twice per week to participate in the resistance exercise intervention. Participants in the culturally tailored intervention group will receive health education materials, strategies to overcome common barriers to exercise in Black women, a list of motivators for exercise by Black women, weekly training sessions, and choice in resistance training protocol selection (protocol A or B) during the week.
Participants of the standard resistance exercise group will only receive typical coaching guidance related to form and technique for exercises. Time commitment will be approximately 2 hours per week for 10 weeks. The resistance training protocol consists of a general warm-up and two alternating training protocols. Sets, reps, and intensity will be altered over the ten weeks based on periodization principles as follows: Week 2: 2 sets of 12 reps, Weeks 3-5: 3 sets of 12 reps, Weeks 6-8: 3 sets of 10 reps, and Weeks 9-11: 3 sets of 8 reps. Each program will be individualized based participants. All training will be overseen by trained research personnel. At week 12 and week 24 we will retest all variables examined at baseline. Participants will complete an interview to assess current resistance training, perceptions, challenges, and areas for improvement related to the

program at weeks 12 and 24 as well. This interview will be audio recorded. The audio tapes will be destroyed after the transcription is complete, which is typically six months after the interview.
Participants will receive available results at 12 and 24 weeks.

13C. 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.)

Data collection form, PAR-Q, the Basic Psychological Needs in Exercise Scale, Behavior Regulation Exercise Questionnaire-3, Self-Efficacy to Regulate Exercise scale, Physical Activity Self-Regulation-12 questionnaire, and the Pittsburgh Sleep Quality Index questionnaire

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13D. Data analysis: Describe how data will be analyzed. If a data collection form (DCF) will be used, submit a copy of the DCF.

A mixed ANOVA will examine changes within and between groups. Audio files will be transcribed to identify
subsequent themes individually by researchers and collectively with qualitative research software (i.e.Nvivo). Both theme datasets will be reviewed by researchers and organized into higher order and subordinate themes.

13E. List any drugs, medications, supplements, or imaging agents that participants will ingest/ receive during participation in the study or indicate not applicable (N/A).

N/A

9. Risks & Discomforts: List and describe all the risks participants may encounter in this research including risks from item 6d of this form, in this research. If deception will be part of the study, provide the rationale for the deception, describe the debriefing process, and attach a copy of the debriefing form that will be used as Appendix D. (Examples of possible risks are in section #6C)

1. Since we will be using human subjects and will not be collecting data anonymously, breach of confidentiality is always a risk.
2. While performing any exercise, there is a chance of muscle strains, sprains, pull, and even death. The American College of Sports Medicine estimates the risk of sudden cardiac death 1 per 36.5 million hours of exertion or 1 in 10,000.
3. With any blood collection procedures, there is a risk of infection, bleeding, bruising, irritation, and injection site, and/or fainting.
4. Participants will experience a small amount of radiation from the iDexa scan.
5. Exposure to COVID-19

10. Precautions / Minimization of Risks

15A. Identify and describe all precautions that will be taken to eliminate or reduce risks listed in items 6.c. and 14. If participants can be classified as a "vulnerable" population, describe additional safeguards that will be used to assure the ethical treatment of vulnerable individuals. **If applicable, submit a copy of any emergency plans/procedures and medical referral lists in Appendix D. (Sample documents can be found online at** https://cws.auburn.edu/OVPR/pm/compliance/irb/sampledocs **precautions)**

1. **Breach of Confidentiality -** 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 filing cabinet until the end of the study when it will be destroyed. All research personnel have completed CITI training and will follow consenting procedures. These include: describing all aspects of the

study, informing the participant about their rights and providing a copy of the consent form to the participants. Furthermore, data will be presented in aggregate themes in which answers could not be linked to a participant.

2. **Risk of Exercise –** All participants will be screened with the Physical Activity Readiness Questionnaire prior to participation. While exercising the intensity in terms of sets and reps utilizes a periodization that is appropriate for adults starting an exercise program. All exercises will be supervised by exercise research scientist who will monitor participant safety while exercising ((Dr. Danielle Wadsworth, Chloe Jones M.S., Katie Spring M.S.). Participants are able to stop or scale back exercise at any time. For baseline testing, the squat rack will be used to perform the 3RM and Mason McIntosh (with assistance from Chloe Jones, Danielle Wadsworth, or Katie Spring) will be primary spotter to ensure proper technique and safety. Additionally, safety guards/rails will be present on the squat rack to catch the barbell for any failed attempts. A bench press will be used to perform the 3RM for the bench press exercise and Mason McIntosh will be the primary spotter (with assistance from Chloe

Jones, Danielle Wadsworth, or Katie Spring) to assist with safely lifting the barbell in any failed attempted exercises.

3. **Blood data collection –** The blood panel will be collected with a finger prick by trained personnel (Dr. Danielle
Wadsworth, Chloe Jones M.S., Katie Spring M.S.). All personnel have been trained with Auburn Bioraft and have completed blood borne pathogens, medical waste, and lab biosafety training. Additionally, specific Cholestec training has been completed. A finger prick is a minimal invasive method to obtain blood. Safety precautions include: proper storage of testing materials, sterile blood-gathering equipment, and using aseptic techniques (i.e. alcohol, disinfectant) throughout all data collection and analysis processes. Following blood data collection all participants will be given a snack.
4. **iDXA scan –** Participants will be screened for recent radiation examination, so not to exceed medical radiation recommendations. Only trained personnel will administer the iDXA scan (Dr. Danielle Wadsworth, Chloe Jones, Katie Spring). Radiation from the scan is equivalent to a 10-minute walk outside. Approval from the state radiation safety committee will be sought after IRB approval.
5. **Exposure to COVID-**19 – This study will be a Category A study involving High-Risk Procedures for COVID-19 transmission (See COVID matrix attached. Precautions will be implemented using the COVID-19 2022 Precautions Matrix to determine appropriate precautions at the time of data collection(s) for a Category A study.

15B. If the internet, mobile apps, or other electronic means will be used to collect data, describe confidentiality and/or security precautions that will be used to protect (or not collect) identifiable data? Include protections used during collection of data, transfer of data, and storage of data. If participant data may be obtained and/or stored by apps during the study, describe.

Interview data will be transcribed by the Otter.ai website. An audio file is loaded into the program, which generates a transcription file. The transcription file is then downloaded from the website and the transcription is not maintained on the website. Participants audio files will not contain any identifying information, nor will it include a subject identifier. Please note that this service is free for the amount of transcription that is needed for this study and does not require a purchase. Researchers will add a unique identifier after the transcription file is stored on box. The computer used to load the audio files is protected and maintained by the College of Education. Cookies will be disabled on the computer during data collection. All audio recordings will be stored on the AU box drive. In addition, the folder within the drives will be password protected. Only researchers will have access to the drive. All audio recordings will be deleted after the conclusion of the study and the interviews have been transcribed (approximately 6 months).

☐ :

A. **Provide the name of the product** Click or tap here to enter text.
and the manufacturer of the product Click or tap here to enter text.

B. **Briefly describe use of the product in the proposed human subject's research.**
Click or tap here to enter text.

C. **To ensure compliance with AU's Electronic and Information Technology Accessibility Policy, contact AU IT Vendor Vetting team at vetting@auburn.edu to learn the vendor**

registration process (prior to completing the purchase).

D. **Include a copy of the documentation of the approval from AU Vetting with the revised submission.**

15D. Additional Safeguards

Will DEXA, pQCT, or other devices which emit radiation be used? ☒ Yes ☐ No

If yes, the IRB will notify the Auburn Department of Risk Management and Safety, who will contact the Alabama Department of Public Health (ADPH) and secure approval. Research which includes device(s) which emit radiation may NOT be initiated NOR will IRB stamped consent documents be issued until the IRB is notified of ADPH approval.

Will a Certificate of Confidentiality (CoC) issued by NIH be obtained ☐ Yes ☒ No If yes, include CoC language in consent documents and include the documentation of CoC approval. Research which includes

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a CoC may not be initiated NOR will IRB stamped consent documents be issued until the IRB is notified of CoC approval. **AU Required CoC Language**

Is the study a clinical trial? ☒ Yes ☐ No

If yes, provide the National Clinical Trial (NCT) # Clinical trial data has been submitted but a number has not been assigned yet **and include required clinical**

trial information in all consent documents. **AU Clinical Trial Information**

11. Benefits

16A. List all realistic direct benefits participants can expect by participating in this study. (Compensation is not a benefit) If participants will not directly benefit check here. ☐

All participants will participate in a resistance training exercise program led by trained exercise scientist. In addition all participants will be given their results at 12 (post-testing) and 24 weeks (3-month follow-up). These results will be explained at the end of each appointment by Dr. Danielle Wadsworth or Chloe Jones.

16B. List realistic benefits for the general population that may be generated from this study.

This study will identify potential training environments to encourage continued participation in resistance training for Black women.

☐ Anonymously with no direct or indirect coding, link, or awareness by key personnel of who participated in the study (skip to item E)

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

☒ Confidentially with collection and protection of linkages to identifiable information.

17B. If data are collected with identifiers and coded or as coded or linked to identifying information, describe the identifiers and how identifiers are linked to participants' data.

Participants will have a unique identifier (letter and number combination) in the master data set. It is necessary to link participant data as data is collected over time.

17C. Provide the rationale for need to code participants' data or link the data with identifying information.

It is necessary to link participant data as data is collected over time.

17D. Describe how and where identifying data and/or code lists will be stored. (Building, room number, AU BOX?) **Describe how the location where data is stored will be secured. For electronic data, describe security measures. If applicable, describe where IRB-approved and participant signed consent documents will be kept on campus for 3 years after the study ends.**

The Identifying data code will be stored electronically on AU Box within a password protected folder. The computer used for this storage system is maintained by the College of Education. Cookies will be disable when using the computer. The signed consent forms will remain in the Kinesiology building room 149 for three years. The room is locked when not in use.

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17E. Describe how and where data will be stored (e.g., hard copy, audio/ visual files, electronic data, etc.), and how the location where data is stored is separated from identifying data and will be secured. For electronic data, describe security. Note use of a flash drive or portable hard drive is not appropriate if identifiable data will be stored; rather, identifying participant data must be stored on secured servers.

Hard copies of data will be stored in a locked filing cabinet in room 149. Electronic data (Audio files and data entry from hard copy data) will be stored on AU box within a password protected folder and files. The code list will be stored electronically in a different AU box protected file and will not be within the same folder as the data.

17F. List the names of all who will have access to participants' data? (If a student PI, the faculty advisor must have full access and be able to produce study data in the case of a federal or institutional audit.)

Dr. Wadsworth and Chloe Jones will have access to the data.

17G. 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 ☐)

Identifiers will be removed and the code list will be destroyed approximately 6 months from the conclusion of the study. That is the estimated time needed to input all data and link qualitative data.

APPENDIX B

INFORMED CONSENT

AUBURN UNIVERSITY
COLLEGE OF EDUCATION

Informed Consent for a Research Study entitled:

"Black Women are Fitting in Resistance Exercise (F.I.R.E.)- A culturally-tailored exercise intervention for young adult women."

Project Overview

You are invited to participate in a research study that will examine the effect of a culturally tailored resistance training program versus a standard resistance training program on exercise adherence, mental/behavioral outcomes, body composition, cardiometabolic outcomes, and sleep behavior in women ages 18-34. We are recruiting participants to complete a 24-week study (two weeks pre- and post-testing, one week familiarization, 10 weeks of resistance training, one follow-up assessment). Participants will be randomized into a culturally tailored resistance training program or a standard resistance training program.

General Information	You are invited to participate in a research study assessing the impact of a culturally tailored resistance training program versus a standard resistance training program on exercise adherence in young Black women. Additionally, the impact of two programs on mental/behavioral outcomes, body composition, cardiometabolic outcomes, and sleep behavior will be assessed. The study will require participants to complete pre- and post-testing, 10 weeks of supervised resistance training exercises and a follow up assessment.
Purpose	The purpose of this investigation is to examine differences in exercise adherence, mental/behavioral outcomes, body composition, cardiometabolic outcomes, and sleep behavior between a 10-week culturally tailored resistance training program versus a standard resistance training program.
Duration & Visits	This study will require a total time commitment of 24 weeks. Participants will be required to make 3 visits (pre- and post-testing, 3-month follow-up) to the Exercise Adherence and Obesity Prevention Laboratory in the Kinesiology building at Auburn University. Additionally, participants will be asked to come to the Boykin or Frank Brown Community Center in Auburn, AL for the familiarization period with the exercises (week 1-two visits) and twice per week for supervised resistance training sessions over 10 weeks. Each visit should last approximately 60 minutes.

Overview of Procedures	Participants will undergo a telephone screening process to ensure eligibility for the study including the Physical Activity Readiness Questionnaire (PAR-Q). Following, eligible participants will come to the Exercise Adherence and Obesity Prevention Laboratory in the Kinesiology building at Auburn University to complete pre-testing assessments (week 0). These assessments will include a demographics survey, Basic Psychological Needs in Exercise Scale, Behavior Regulation Exercise Questionnaire-3, Self-Efficacy to Regulate Exercise scale, Physical Activity Self-Regulation-12 questionnaire, and the Pittsburgh Sleep Quality Index questionnaire. Further, blood pressure, total cholesterol, triglycerides, high-density lipoproteins, low-density lipoproteins, and fasting glucose, body composition, height, weight, waist circumference will be measured. Lastly, participants will complete a 3-repetition maximal (3RM) test for upper and lower body strength and receive sleep monitors. Participants will be given information to set up account at the Boykin or Frank Brown Community Center in Auburn, AL and a wrist-worn sleep monitor to wear for one week. The following week, participants will be asked to report to the Boykin or Frank Brown Community Center to become familiar with the resistance training exercises. This community center is located at 400 Boykin St, Auburn, AL 36832. Sleep monitors will be returned to the study personnel. Weeks 2-11, participants will be asked to complete exercise protocols at the fitness center twice per week. During week 12 and week 24, post-testing and follow-up assessments will be conducted and will mimic pre-testing procedures.

Risks	Data will not be collected anonymously, so breach of confidentiality is a risk. While performing any exercise, there is a chance of muscle strains, sprains, pull, and even death. Due to the high intensity nature of some of the exercises, you may feel sore or tired after completing the exercises. With any blood collection procedures, there is a risk of infection, bleeding, bruising, irritation, and injection site, and/or fainting. Participants will experience a small amount of radiation from the iDEXA scan.
Benefits	You will receive 10 weeks of organized and supervised resistance training, along with performance assessments including: body composition, 3 RM, and blood profiles. In addition, you will receive a complimentary life-term membership to a local fitness facility. You will also receive reinforcements to help you transition to exercising on your own. Lastly, you will receive $25 if you participate in week 24 data collection.
Alternatives	The alternative is to not participate in this study.

Purpose

The purpose of this investigation is to examine differences in exercise adherence, mental/behavioral outcomes, body composition, cardiometabolic outcomes, and sleep behavior between a 10-week culturally tailored resistance training program versus a standard resistance training program.

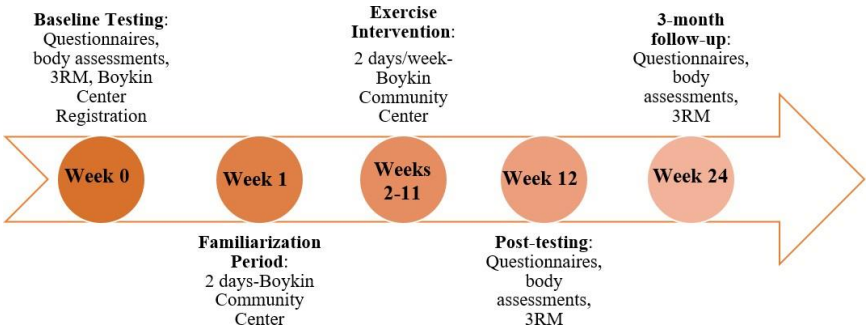
Eligibility

To be eligible, you must be:

1. Be between the ages of 18 and 34 years.
2. Not actively participating in some type of exercise on a regular basis (at least three days a week for the past three months).
3. Low risk for medical complications from exercise (as determined by the PAR-Q).
4. Not pregnant or planning to become pregnant throughout the duration of the study
5. Must live, work, or be a student in the city of Auburn, AL.
6. You must meet all requirements to be eligible for participation in this study.

What will be involved if you participate?

If you agree to participate in the current study, you will be asked to contribute approximately 24 weeks of your time (See study timeline below). There will be 3 lab visits on Auburn's campus (one hour each), and 22 visits over 11 weeks to the Auburn Recreation Community Fitness Center including the familiarization week.



Week 0

Day 1- Pre-testing Visit: Prior to your lab visit you will complete a COVID-19 exposure screening. On the first visit to the lab, you will complete the PAR-Q questionnaire, read and sign the university-approved informed consent, and a demographics survey. Dr. Wadsworth or Chloe Jones will present all informed consent briefings. Following you will complete several questionnaires assessing several mental/behavioral and sleep factors including the Basic Psychological Needs in Exercise Scale, Behavior Regulation Exercise Questionnaire-3, Self-Efficacy to Regulate Exercise scale, Physical Activity Self-Regulation-12 questionnaire, and the Pittsburgh Sleep Quality Index questionnaire. Blood pressure measurements will be taken after five minutes of seated rest using a digital blood pressure monitor. You will need to arrive to the lab in a fasting state (i.e., no food or medication for eight hours prior to your lab visit). Blood draws will be taken using a fingerstick and will be completed by trained study personnel. Blood analyses will include the assessment of total cholesterol, triglycerides, high-density lipoproteins, low-density lipoproteins, and fasting glucose. The risk of blood draws includes a bruise at the point where the fingerstick occurred, redness, infection, and a rare risk of fainting. Blood draws by finger prick will be repeated at weeks 12 and 24 for post-testing visits. Following blood draws, your height, weight, and waist circumference will be measured using a stadiometer and an elastic tape measurer. We ask that you avoid any pain medicines such as Advil or Motrin the day before the test and to take your blood pressure medications after the test. Afterwards, you will complete an iDEXA body composition scan. The scan is an x-ray that measures the amount of muscle, fat, and bone mineral density in your body. The radiation you are exposed to during this scan is equal to walking outside on a sunny day for 10 minutes. After the scan you will be given a snack or juice after the assessments. These scans will be repeated at weeks 12 and 24. The last assessment will consist of an upper and lower body strength test. You will be asked to perform a 3RM test for the back squat and bench press guided and supervised by a research personnel. Afterwards, you will receive your sleep activity watch before you leave in which you will wear for seven days and will return it during Week 1. Lastly, you will be given instructions and directions to set up your account at the Boykin or Frank Brown Community Center in Auburn, AL prior to leaving the building.

Total time for Day 1 is 60 minutes.

Week 1

Days 2-7-Familiarization Period: Over this 5-day period, you will meet the study staff at the Boykin or Frank Brown Community Center on two separate occasions to become familiar with resistance training procedures including the back squat, seated hamstring curls, barbell bench press, lat pulldown, shoulder press, bicep curls, overhead triceps extensions, front lunges, Romanian deadlifts, chest flys, bent-over rows, upright rows, hammer curls, and triceps cable extensions. A member of the research team will verbally describe the exercise and allow you time to practice with correct form.

Total time for each visit is 60 minutes.

Weeks 2-11

- Training will take place two days per week: Monday/Wednesday or Tuesday/Thursday
- Participants will be asked to consume at least 1 pint of water before reporting for the workout
- Participants of the culturally relevant intervention will receive health education materials an advice, strategies to overcome common barriers to exercise in Black women, a list of motivators for exercise by Black women, and choice in resistance training protocol selection (protocol A or B) during the week.
- Participants of the standard resistance exercise group will receive typical coaching guidance related to form and technique for exercises.
- Time commitment each week will be approximately 2 hours per week (20 hours over the course of the 10-week training program).

Resistance Training Protocol

- General warm-up will be completed before each session
- Two alternating training protocols will be used
- Sets, reps, and intensity will be altered over the ten weeks
    - Week 2: 2 sets of 12 reps
    - Weeks 3-5: 3 sets of 12 reps

- Weeks 6-8: 3 sets of 10 reps
- Weeks 9-11: 3 sets of 8 reps

- Each program will be individualized based on your testing variables
- All training will be overseen by trained research personnel
- Time commitment will be approximately 2 hours per week

Week 12

Post-testing and 6-month follow-up: Will retest all variables examined in Week 0.

After you have completed all of your post-testing, you will be asked to complete a brief interview. The interviewer will ask you questions about your experiences with our program, such as perceptions, challenges, and areas for improvement. This interview will be audio recorded with your individual subject identifier. The audio tapes will be destroyed after the transcription is complete, which is typically six months after your interview. At this time, you will receive all of your results thus far.

Total time commitment: 90 minutes

Weeks 13-24

Adherence to protocol-Upon the conclusion of your lab training, participants in the culturally tailored group may receive reinforcement messages via text or phone calls to help you maintain your activity levels. You may receive up to three messages each week. You will be responsible for any costs occurred via text. You have the option to opt-in or opt-out of text messages if you prefer and this will not affect your eligibility to be in the study.

Week 24

Retention Measures-There will be follow-up testing where you will be asked to return to the lab and complete all assessments from Week 0 and an interview.

Total time commitment: 90 minutes

Test Descriptions:

iDEXA- An x-ray that assess your body composition in terms of percent fat mass and lean mass. It also assesses your bone mineral density

Blood draw via finger prick- An assessment of your blood by pricking one of your fingers with a lancet and gather a small amount of blood.

3-Repetition Max (RM)- We will assess how strong you are when completing a back squat and bench press. We will monitor your form and gradually increase weight until you can only complete three repetitions or terminate the test.

Sleep Monitor- We will assess your sleep behaviors over seven days using a wrist-worn sleep watch (Phillips Actiwatch Sprectrum).

Potential Risks:

1. As data is not collected anonymously, breach of confidentiality is always a risk.
2. While performing any exercise, there is a chance of muscle strains, sprains, pull, and even death. The American College of Sports Medicine estimates the risk of sudden cardiac death 1 per 36.5 million hours of exertion or 1 in 10,000.
3. Due to the high intensity nature of some of the exercises, you may feel sore or tired after completing the exercises.
4. With any blood collection procedures, there is a risk of infection, bleeding, bruising, irritation, and injection site, and/or fainting.
5. Participants will experience a small amount of radiation from the iDexa scan.
6. Because we are collecting data in person, COVID-19 is a risk.

"Note" Although injuries are not anticipated in this protocol, it is important for you to acknowledge that the investigators have no plans for compensation in the event of an injury you experience.

Precautions:

1. Even though data will not be collected anonymously, it will be recorded anonymously. All research personnel have completed training on maintaining data security. Your data will be presented in aggregate forms in which answers could not be linked to you.
2. We have employed the use of the PAR-Q to assist in eliminating participants that have potential medical or orthodontic identified risks.
3. After each exercise bout, you will be monitored and be give a chance to cool-down.
4. Investigators participating in blood draws via fingerstick have been trained. Only new sterile blood-gathering equipment and aseptic techniques will be utilized throughout all data collection and analysis processes.
5. Prior to beginning the program, proper lifting techniques, volume and intensity manipulation, and spotting will be employed to decrease the risk of injury.
6. Should an emergency arise, we will call 911 and follow emergency procedures posted by Auburn Recreation Center. You are responsible for any cost associated with medical treatment.
7. Discomfort associated with the blood pressure cuff will dissipate after the cuff has been deflated.
8. The iDEXA scan radiation is the equivalent to walking outside in the sun for 10 minutes. We utilize standard procedures approved by radiation safety.
9. This study will be a Category A study involving High-Risk Procedures for COVID-19 transmission (See COVID matrix attached. Precautions will be implemented using the COVID-19 2022 Precautions Matrix to determine appropriate precautions at the time of data collection(s) for a Category A study.

Benefits:

You will receive 10 weeks of organized and supervised resistance training, along with performance assessments including: body composition, 3 RM, and blood profiles. In addition, you will receive a complimentary life-term membership to the Auburn Recreation Fitness Center. If you attend post test at week 24 you will receive an additional $25.

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 if we are able to separate your data.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 Exercise Adherence and Obesity 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 Chloe Jones at csj0025@auburn.edu or DanielleWadsworth at wadswdd@auburn.edu. You will be given a copy of this form for your records.
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	**Printed Name**	**Date**
Investigator Obtain Consent	**Printed Name**	**Date**
Co-Investigator	**Printed Name**	**Date**

Information on COVID-19 For Research Participants (updated 05/27/2021)

Auburn University recognizes the essential role of research participants in the advancement of science and innovation for our university, community, state, nation, and beyond. Therefore, protection of those who volunteer to participate in Auburn University research is of utmost importance to our institution.

As you are likely aware, COVID-19 references the Coronavirus that is being spread around the world including in our country, state, and community. It is important that we provide you with basic information about COVID-19 and the risks associated with the virus so that you can determine if you wish to participate or continue your participation in human research.

How is COVID-19 spread? COVID-19 is a respiratory virus that is spread by respiratory droplets, mainly from person-to person. This can happen between people who are in close contact with one another. COVID-19 may also be spread by exposure to the virus in small droplets that can linger in the air. This kind of spread is referred to as airborne transmission. It is also possible that a person can get COVID-19 by touching a surface or object (such as a doorknob or counter surface) that has the virus on it, then touching their mouth, nose, or eyes.

Please visit the CDC's web page for more information on how COVID-19 spreads.

Can COVID-19 be prevented? Although there is no guarantee that infection from COVID-19 can be prevented, there are ways to minimize the risk of exposure to the virus. For instance, stay 6 feet apart from others who don't live with you; get a COVID-19 vaccine when it is available to you; avoid crowds and poorly ventilated indoor spaces; use effective barriers between persons; wear personal protective equipment like masks, gloves, etc.; wash hands with soap and water or use hand sanitizer after touching objects; disinfect objects touched by multiple individuals.

What are the risks of COVID-19? For most people, COVID-19 causes only mild or moderate symptoms, such as fever and cough. For some, especially older adults and people with existing health problems, it can cause more severe illness.

While everyone is still learning about this virus, current information suggests that about 1-3% of people who are infected with COVID-19 might die as a result.

Who is most at risk? Individuals over age 65 and those with chronic conditions such as cancer, diabetes, heart or lung or liver disease, severe obesity, and conditions that cause a person to be immunocompromised have the highest rates of severe disease and serious complications from infection.

What precautions should be taken? Based on the proposed research, precautions for the risk of COVID-19 will be addressed on a project by project basis. You will be provided with information about precautions for the project in which you may participate. Any site where research activities will occur that are not a part of Auburn University (offsite location) are expected to have standard procedures for addressing the risk of COVID-19. It is important for participants to follow any precautions or procedures outlined by Auburn University and, when

applicable, offsite locations. Further, participants will need to determine how best to address the risk of COVID-19 when traveling to and from research locations. The US Center for Disease Control and Prevention has issued recommendations on types of prevention measures you can use to reduce your risk of exposure and the spread of COVID-19.

Auburn University is continuing to monitor the latest information on COVID-19 to protect our students, employees, visitors, and community. Our research study teams will update participants as appropriate. *If you have specific questions or concerns about COVID-19 or your participation in research, please talk with your study team.* The name and contact information for the study team leader, along with contact information for the Auburn University Institutional Review Board for Protection of Human Research Participants, can be found in the consent document provided to you by the study team.

APPENDIX C

INITIAL TELEPHONE SCREENING: GENERAL SCREENING FORM

Hello, my name is Chloe Jones, and I am a graduate student at Auburn University. I'm reaching out regarding my exercise study that you expressed interest in. In brief, this is a study aimed to show young Black women how to exercise and provide them with motivational strategies to maintain exercise. More specifically, you will be asked to participate in a 12-week study in which 10 weeks are a resistance training program. During this program, you will receive one-on-one personal training twice per week, a physical activity tracking watch, and life-long membership to a fitness facility in Auburn, AL. I will also be asking you to come to Auburn University before and after the 10-week study to take a few surveys about your participation in exercise and as well as several physical assessments including blood pressure, a blood draw through a finger prick, body composition, and a strength test. These visits will take approximately 60 minutes per visit. If you are interested, may I ask you a few questions to confirm if you're eligible?

NO:

Thank you for your time. If you change your mind, please feel free to contact me at csj0025@auburn.edu. Have a great day! (END CALL)

YES:

Great! Now I'll be asking you a little about yourself.

1. Do you identify yourself as a Black woman? YES NO

   _____

2. What is your current age?

   _____

3. Are you currently pregnant or trying to become pregnant? YES NO

_____

4. Have you been exercising at least three days per week for the past three months?

YES NO

_____

5. Are you a resident, student, or work in Auburn, AL? YES NO

_____

*If eligible, set up pre-testing appointment and request email or cell phone number to send pre-testing instructions

Email or cell phone number: _____

*If ineligible, thank participant for their time and request permission to retain information collected during the screening.

APPENDIX D

PRE-TEST APPOINTMENT INSTRUCTIONS AND DIRECTIONS

Thank you for expressing interest in Black Women are F.I.R.E. study! Below are details and directions for your pre-test appointment on *DATE AND TIME*. This appointment will take approximately 60 minutes. Please read these instructions carefully.

Location: Kinesiology Building, Auburn University

Address: 301 Wire Road Auburn, AL 36849

Parking: Please park in the round-about circle at the end of the parking lot. You will see a sign reading "". There will be a research staff member waiting to guide you into the building. If needed, you may call Chloe at 404-510-3946.

No Eating: For the purpose of the finger prick blood draw, you will be asked to arrive to your appointment in a fasted state. Please refrain from food for 8 hours prior to your appointment time. After the blood draw, a light snack will be provided.

Clothing: Please wear clothes that are loose and comfortable for exercise as well a tennis shoes. You will also be taking a body composition assessment which requires you to remove all metal from your body. It is recommended for women to wear a sports bra or wireless bra for this test.

Appointment Details: You will be asked to complete the following assessments:

- Informed consent
- Health and exercise-related surveys
- Blood pressure measurement
- Blood finger prick

- Height, weight, and waist circumference measurement
- Body comopostion scan (DEXA)
- Upper and lower body strength test

APPENDIX E

DATA COLLECTION SHEET

Data Collection Sheet

Visit Date: _____ **Participant ID**: _____

____ Informed Consent

____ PAR-Q

____ Demographics Survey

____ Basic Psychological Needs in Exercise Scale

____ Behavior Regulation Exercise Questionnaire-3

____ Exercise Self-Efficacy

____ Physical Activity Self-Regulation-12

____ Blood Pressure

____ Blood Draw

____ Height, Weight, Waist Circumference

____ DEXA

____ 3RM Tests

____ Directions for Boykin Center ID

BLOOD PRESSURE (mmHg)

Arm circumference _____ cm

Trial 1 SBP _____ DBP _____

Trial 2 SBP _____ DBP _____

Trial 3 SBP _____ DBP _____

Trial 4 SBP _____ DBP _____

BLOOD DRAW

Total Cholesterol: _____ LDL: _____

Triglycerides: _____ Glucose: _____

HDL: _____

HEIGHT _____ (in.) _____ (cm)

WEIGHT _____ (lbs.) _____ (kg)

WAIST CIRCUMFERENCE (cm)

Trial 1 _____ Trial 2 _____ Trial 3 _____

BODY COMPOSITION

Lean mass _____ (kg) % Body Fat _____

Fat mass _____(kg) BMD _____ (g/cm^2)

MUSCULAR STRENGTH TESTS

Squat 3RM: _____

Bench Press 3RM: _____

SET UP SCHEDULE AND PUT ON CALENDAR

APPENDIX F

PHYSICAL ACTIVITY READINESS QUESTIONNAIRE

Physical Activity Readiness Questionnaire

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below.

If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly with response of Yes or No.

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?

   ☐ YES ☐ NO

2. Do you feel pain in your chest when you do physical activity?

   ☐ YES ☐ NO

3. In the past month, have you had chest pain when you were not doing physical activity?

   ☐ YES ☐ NO

4. Do you lose your balance because of dizziness or do you ever lose consciousness?

   ☐ YES ☐ NO

5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?

   ☐ YES ☐ NO

6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?

   ☐ YES ☐ NO

7. Do you know of any other reason why you should not do physical activity?

   ☐ YES ☐ NO

APPENDIX G

DEMOGRAPHICS SURVEY

Demographics Survey **Participant's ID: _____**

Date of Birth: _____

Email: _____

Phone: _____

1. What is your marital status?

☐ Single ☐ Separated (Legally)

☐ Married ☐ Engaged

☐ Widowed ☐ Cohabiting

☐ Divorced

2. How many children/dependents do you have living in your home?

☐ 0 ☐ 3

☐ 1 ☐ 4

☐ 2 ☐ 5 or more

3. Are you employed?

☐ No

☐ Yes, < 30 hours/week

☐ Yes, > 30 hours/week

4. What is your highest level of education completed?

☐ Less than high school degree

☐ High school degree

☐ Some college

☐ Bachelor's degree

☐ Graduate degree

5. What is your yearly gross income (before taxes)?

☐ Under $29,999

☐ $30-$49,999

☐ $50-$74,999

☐ $75-$99,999

☐ $100-$149,000

☐ $150-$199,999

☐ $200,000 or more

APPENDIX H

BASIC PSYCHOLOGICAL NEEDS IN EXERCISE SCALE

Basic Psychological Needs in Exercise Scale

Instructions. The following sentences refer to your overall experiences **in exercise in general** as opposed to any particular situation. Using the 1-5 scale below, please indicate the extent to which you agree with these statements by circling one number for each statement.

	I don't agree at all	I agree a little bit	I somewhat agree	I agree a lot	I completely agree
1. I feel I have made a lot of progress in relation to the goal I want to achieve.	1	2	3	4	5
2. The way I exercise is in agreement with my choices and interests.	1	2	3	4	5
3. I feel I perform successfully the activities of my exercise program.	1	2	3	4	5
4. My relationships with the people I exercise with are very friendly.	1	2	3	4	5
5. I feel that the way I exercise is the way I want to.	1	2	3	4	5
6. I feel exercise is an activity which I do very well.	1	2	3	4	5
7. I feel I have excellent communication with the people I exercise with.	1	2	3	4	5
8. I feel that the way I exercise is a true expression of who I am.	1	2	3	4	5
9. I am able to meet the requirements of my exercise program.	1	2	3	4	5
10. My relationships with the people I exercise with are close.	1	2	3	4	5

11. I feel that I have the opportunity to make choices with regard to the way I exercise	1	2	3	4	5

APPENDIX I

BEHAVIOR REGULATION EXERCISE QUESTIONNAIRE-3

Behavior Regulation Exercise Questionnaire-3

WHY DO YOU ENGAGE IN EXERCISE?

We are interested in the reasons underlying peoples' decisions to engage or not engage in physical exercise. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes.

		Not true for me		**Sometimes true for me**		**Very true for me**
1	It's important to me to exercise regularly	0	1	2	3	4
2	I don't see why I should have to exercise	0	1	2	3	4
3	I exercise because it's fun	0	1	2	3	4
4	I feel guilty when I don't exercise	0	1	2	3	4
5	I exercise because it is consistent with my life goals	0	1	2	3	4
6	I exercise because other people say I should	0	1	2	3	4
7	I value the benefits of exercise	0	1	2	3	4
8	I can't see why I should bother exercising	0	1	2	3	4
9	I enjoy my exercise sessions	0	1	2	3	4
10	I feel ashamed when I miss an exercise session	0	1	2	3	4
11	I consider exercise part of my identity	0	1	2	3	4
12	I take part in exercise because my friends/family/partner say I should	0	1	2	3	4

13	I think it is important to make the effort to exercise regularly	0	1	2	3	4
14	I don't see the point in exercising	0	1	2	3	4
15	I find exercise a pleasurable activity	0	1	2	3	4
16	I feel like a failure when I haven't exercised in a while	0	1	2	3	4
17	I consider exercise a fundamental part of who I am	0	1	2	3	4
18	I exercise because others will not be pleased with me if I don't	0	1	2	3	4
19	I get restless if I don't exercise regularly	0	1	2	3	4
20	I think exercising is a waste of time	0	1	2	3	4

		Not true for me		**Sometimes true for me**		**Very true for me**
21	I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
22	I would feel bad about myself if I was not making time to exercise	0	1	2	3	4
23	I consider exercise consistent with my values	0	1	2	3	4
24	I feel under pressure from my friends/family to exercise	0	1	2	3	4

APPENDIX J

SELF-EFFICACY TO REGULATE EXERCISE SCALE

Self-Efficacy to Regulate Exercise

A number of situations are described below that can make it hard to stick to an exercise routine. Please rate in each of the blanks in the column how certain you are that you can get yourself to perform your exercise routine regularly (most days of the week).

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below:

0 10 20 30 40 50 60 70 80 90 100

Cannot do at all — Moderately can do — Highly certain can do

	Confidence (0-100)
When I am feeling tired	_____
When I am feeling under pressure from work	_____
During bad weather	_____
After recovering from an injury that caused me to stop exercising	_____
During or after experiencing personal problems	_____
When I am feeling depressed	_____
When I am feeling anxious	_____
After recovering from an illness that caused me to stop exercising	_____
When I feel physical discomfort when I exercise	_____
After a vacation	_____
When I have too much work to do at home	_____

When visitors are present _____

When there are other interesting things to do _____

If I don't reach my exercise goals _____

Without support from my family or friends _____

During a vacation _____

When I have other time commitments _____

After experiencing family problems _____

APPENDIX K

PHYSICAL ACTIVITY SELF-REGULATION-12

Physical Activity Self-Regulation-12

People use various techniques to help them exercise on a regular basis. Recalling your exercise activities performed it 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".

	Never	**Rarely**	**Sometimes**	**Often**	**Very Often**
I mentally kept track of my exercise activities.					
I mentally noted specific things that helped me exercise.					
I established short term goals (daily or weekly) related to how often I exercise.					
I established exercise goals that focused on my health (e.g. improved fitness).					
I asked someone for advice or demonstration of exercise activities.					
I asked an exercise expert/health professional for advice or demonstration of exercise activities.					
After I exercised, I focused on how good I felt.					
I reminded myself of positive health benefits of exercise (e.g. lose weight, tone body).					

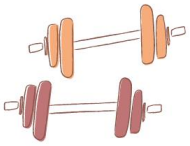
I mentally schedule my time periods to exercise.					
I rearranged my schedule of other activities to ensure I had time to exercise.					
I purposely planned ways to exercise when I was on trips away from home.					
I purposely planned ways to exercise during bad weather.					

APPENDIX L

STUDY FLYER

BLACK WOMEN ARE F.I.R.E.- FITTING IN RESISTANCE EXERCISE

Interested in starting an exercise program? See how you can get a FREE personal trainer for 10 weeks and a gym membership!



Requirements

- Must self-identify as a Black woman
- Must be between 18-34 years of age
- Must be a non-exerciser
- Must be an Auburn resident, student, or worker

Please contact Chloe Jones for more information:
Email: Csj0025@auburn.edu or Phone: 404-510-3946

APPENDIX M

STUDY INFOGRAPHIC

Black Women are F.I.R.E. Fitting in Resistance Exercise

Physical Activity Recommendations

Cardio
30 minutes 5 days/week
MODERATE INTENSITY
OR
25 minutes 3 days/week
VIGOROUS INTENSITY
Resistance Training
2 days/week
all major muscle groups
(legs, chest, back, biceps, triceps, shoulders, abs)

Benefits of Exercise

Physical Benefits

- Reduces risk for high blood pressure, type 2 diabetes, stroke, cardiovascular disease, and some cancers
- Improves body composition
  - decreases fat mass
  - increase muscle mass
  - preserve bone mass

Mental Benefits

- Improved quality of life, sleep, anxiety, depression

Resistance Training Tips!

You MUST increase your weights over time in order to continue improvements!

If you can do more than two reps past your goal on your last set, increase your weight!

Be specific! Choose an exercise that will work each major muscle group.

Strategies to Maintain Exercise

- **Set short and long-term goals**
  - # days/week, duration of workout
  - body weight/appearance, weightlifting goals
- **Monitor your behavior**
  - Use a journal to write down your workouts, your feelings before and after workouts, pros and cons of working out, accomplishments, and setbacks
- **Manage your time**
  - Create a schedule
    - time of day, days of the week, duration of workout
  - Prepare in advance
    - clothing, schedule, types and number of exercises, location, childcare, etc.
  - Be efficient!
- **Recognize current and find social support**
  - Find new friends at your gym
  - Invite others to workout with you
  - Rely on companions, family, friends and exercise professionals for extra support
  - Use online websites, social media platforms, or fitness group for extra support
- **Give yourself feedback**
  - Acknowledge your accomplishments of your goals
  - Give yourself praise and acknowledge praise from others
  - Take photos along your journey
- **Relapse Prevention**
  - Identify high-risk situations
  - Identify coping skills
  - Create back-up plans

An "escape"/ stress reliever
Feeling of accomplishment
Confidence & energy booster
Increased body satisfaction
Fitness network/social support
Role model to family and friends