FREQUENCY OF EXERCISE TRAINING’S EFFECT ON PSYCHOLOGICAL OUTCOMES IN OLDER WOMEN

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OBJECTIVES: Exercise training by older adults has demonstrated many health benefits, including improved cognition and psychological well-being. The optimal frequency of combined aerobic exercise training (AET) and resistance exercise training (RET) is unknown. The purpose of this study was to examine whether exercise improves body image, esteem, depression, and mood, among older women, and whether improvements differ by frequency of exercise. METHODS: Post-menopausal women (N = 64) over the age of 60 (64.79 ± 3.74) were randomly assigned to one of three groups. Group 1 completed two exercise sessions (1 AET, 1 RET) per week, Group 2 completed four sessions (2 AET, 2 RET) per week, and Group 3 completed 6 sessions (3 AET, 3 RET) per week. Body image, esteem, depression, and mood were assessed by survey at pre- and 16-weeks post-training. RESULTS: Results from repeated-measures ANOVA showed that perceptions of appearance, weight, body satisfaction, weight-related anxiety, and valuation of fitness improved with training. Self-esteem and depression did not significantly change. Exercise frequency did not affect results. DISCUSSION: Results suggest 16 weeks of combined AET/RET improves perceptions of appearance and body satisfaction in older women, but there is no advantage to more, versus fewer, training sessions each week.

Keywords: exercise frequency, body image, body satisfaction, older adult
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FREQUENCY OF EXERCISE TRAINING’S EFFECT ON PSYCHOLOGICAL OUTCOMES IN OLDER WOMEN

INTRODUCTION

Routine exercise is a well established and effective strategy to increase functional independence and reduce the prevalence of age-associated diseases and declines (Chodzko-Zajko et al., 2009). Aerobic exercise training (AET) improves cardiovascular fitness, and resistance exercise training (RET) leads to improvement in muscle mass and strength. Regular performance of AET and RET thereby reduces muscle weakness, frailty, and the overall decline that is associated with old age. Regular exercise by older adults has been associated with decreased osteoporosis, reduced metabolic disease, cardiovascular disease, type II diabetes, and reduction in risk of falls (Pollock & Evans, 1999). In addition to physiological benefits, regular exercise by older adults has been linked to cognitive benefits; such as lower prevalence of depression, increased processing speed, decreased occurrence of dementia, and improved driving performance (Colcombe & Kramer, 2003; Heyn, Abreu, & Ottenbacher, 2004; Marmeleira, Godinho, & Fernandes, 2009; Singh, Clements, & Singh, 2001). Despite the known benefits of exercise on mental, physical, and cognitive health of older adults, few studies have attempted to define the amount of exercise necessary to improve overall health. The purpose of this study is to examine whether frequency of exercise training influences outcomes related to psychological health, such as body image, self-esteem, mood, and depression.
Psychological Factors and Exercise

Participation in regular exercise, or lack thereof, can impact factors that are related to overall psychological well-being. Exercise has been positively associated with a variety of factors, including those briefly mentioned below.

Body Image

Body image may have a critical influence in the development of multiple psychological disorders, such as eating disorders, depression, anxiety, and others (Annis, Cash, & Hrabosky, 2004). Numerous studies have examined the relationship between body image and exercise. This relationship has been addressed from both directions: attempting to determine the effect of exercise training on body image, and the effect of body image on exercise behavior. Though most of the research regarding body image has been conducted in adolescent and college aged populations, it is believed that body dissatisfaction remains stable across the lifespan (Tiggemann, 2004). A cross-sectional survey of 175 older adults reported both men and women expressing a desire for a thinner body type, but body image did not play a role in motivation to exercise (Schuler et al., 2004). One study examining the relationship between body esteem and exercise habits found that middle aged women tend to have a positive correlation between esteem and exercise, whereas younger women displayed a negative correlation (Tiggemann & Williamson, 2000). More studies are needed to determine the impact of body image in samples of older adults and how body image may be impacted by exercise, especially considering that body image and self esteem have a positive association (Paxton & Phythian, 1999).
Mood

Participating in regular exercise has been shown to improve overall mood (Byrne & Byrne, 1993). Exercises of varying duration and intensity have overall positive effects on varying aspects of mood, with as little as 10 minutes of moderate intensity exercise increasing vigor while reducing confusion, fatigue, and overall negative mood (Hansen, Stevens, & Coast, 2001). In addition, the positive effects of exercise training on mood remained for at least one year after completion of a 12 week exercise program (DiLorenzo et al., 1999).

Depression

The association between exercise and depression is well documented, with numerous studies reporting a negative relationship between the two. As mentioned previously, individuals who exercise regularly are less likely to suffer from depression or become depressed, and this has been observed in a sample of community-dwelling older adults (Barcelos-Ferreira, Yoshio Nakano, Steffens, & Bottino, 2013). Also, exercise is viewed as a possible treatment for depression, with some studies reporting that exercise is as effective as cognitive therapy, but other studies reporting mixed results (Lawlor & Hopker, 2001; Mead et al., 2008).

Self-Esteem

Most studies show a positive association between self-esteem and exercise participation. This relationship occurs in a variety of populations, including older adults (McAuley, Blissmer, Katula, Duncan, & Mihalko, 2000). This increase in self-esteem
may be related to a number of exercise outcomes, including physical effects, social outcomes, and self-perception items, e.g. body image.

Exercise Frequency

The American College of Sports Medicine (ACSM) currently recommends older adults participate in both cardiovascular and resistance training. The ACSM guidelines suggest a minimum of 30 minutes of moderate level cardiovascular related activity 5 times a week, 20 minutes of vigorous level activity for 3 days a week, or some combination of the two. These guidelines also call for resistance training of the major muscle groups for 2-3 days a week, as well as neuromuscular training in areas such as balance, agility, and flexibility (Garber et al., 2011).

Given the current ACSM guidelines and benefits associated with exercise training, it is important to develop exercise programs that will optimize fitness, strength and functional gains in older adults. However, it is also important to consider that older adults may have an increased need for recovery time following strenuous exercise. Performing high intensities or high volumes of exercise training could impair fitness gains or reduce free living physical activity in older adults (Goran & Poehlman, 1992; Hunter, Bickel, Fisher, Neumeier, & McCarthy, 2013; Hunter et al., 2001), and therefore could potentially have a negative effect on psychological health. Conversely, too few training sessions may not impact psychological health at all. Therefore, a need exists to identify the optimal frequency of training to improve psychological health.

A previous report that examined varying frequencies of AET and RET did not find a significant effect of exercise frequency on measures of aerobic capacity, strength,
and functional tasks. Each exercise frequency resulted in similar improvements in the aforementioned domains (Fisher et al., 2012). However, participants in the group conducting 2 AET and 2 RET per week did show an increase in non-exercise training activity expenditure, while participants in the group conducting 3 AET and 3 RET per week showed a decrease in non-exercise training activity expenditure (Hunter et al., 2013). Therefore, 16 weeks of combined AET and RET for as little as one session each per week or as many as 3 sessions of each per week can increase fitness and function, but may have varying effects on overall energy expenditure. Thus, the ideal amount of exercise training for an older adult may be 2 sessions each of AET and RET, but further study is needed.

When examining psychological benefits of exercise, even less is known regarding the ideal amount for psychological improvement. In addition to previously presented data regarding benefits associated with exercise, data collected from a large population-based sample of people ranging from 25 to 64 years of age suggests that individuals who exercised at least 2 to 3 times per week reported significantly lower levels of depression, anger, distrust, and stress when compared to individuals exercising less frequently or not at all (Hassmén, Koivula, & Uutela, 2000). Another study conducted in a sample of older adults demonstrated exercise frequency to be a significant predictor of satisfaction with life (McAuley, Blissmer, Marquez, et al., 2000). However, research also indicates that too much exercise, or a feeling of exercise dependence, is associated with negative outcomes, such as overtraining, negative mood or behavior, self-esteem, and other psychological issues (Heather & Danielle Symons, 2002). Thus, much is known about the benefits of regular exercise and the negatives of too much exercise, but to our
knowledge, little is known regarding the ideal amount of exercise for psychological improvement. As is the case for measures of aerobic fitness, strength, and function, it is possible that varying amounts of AET and RET could have differing effects on measures of psychological well-being.

Aims

**AIM 1: To further support combined AET and RET as an effective method for improving psychological constructs.**

**Hypothesis 1:** This study will test the hypothesis that 16 weeks of combined aerobic and resistance training improves psychological measures of body image, depression, mood, and self-esteem in a sample of previously sedentary normal to overweight older women. This hypothesis is based on the previously cited research that associates exercise training with positive changes in psychological measures (Chodzko-Zajko et al., 2009; DiLorenzo et al., 1999; Penedo & Dahn, 2005).

**AIM 2: To examine the effect of exercise frequency on psychological outcome measures.**

**Hypothesis 2:** Existing research suggests that as little as 2 sessions per week (one AET and one RET) can result in increased fitness in older adults. Research also suggests that 2 sessions per week of AET and RET may be ideal, and that more frequent exercise may result in side effects such as increased fatigue, over training, or inadequate recovery. Previous data published from this study has indicated no difference in measures of aerobic fitness, strength, or functional capacity between groups, but did indicate a significant difference in energy expenditure, with 2xAET/RET per week increasing and
3xAET/RET decreasing non exercise training activity expenditure (Fisher et al., 2012; Hunter et al., 2013). Due to previous findings that showed increased energy expenditure with 1 or 2 sessions of AET and RET, as well as the current recommendations for exercise by older adults, it is hypothesized that participants performing 1 or 2 sessions of AET and RET per week, will show a greater psychological improvement than individuals performing 3 sessions of AET and RET per week.

**Secondary Aim: To assess if changes in psychological outcomes are associated with physiological improvements in fitness and body composition.**

**Hypothesis 3:** Psychological changes will be associated with physiological improvements in fitness and percent body fat. As previously mentioned, increased participation in exercise programs is associated with positive psychological outcomes (Penedo & Dahn, 2005), and it is expected this association will hold true for physiological and psychological outcomes examined in this study.

**METHODS**

**Participants**

Participants consisted of postmenopausal women over 60 years of age enrolled in an exercise intervention study conducted at the University of Alabama at Birmingham and supported by the National Institute of Aging (R01AG027084). Data for this study were collected at the participant’s start point and at 16 weeks of training. Ninety-one participants completed baseline testing, and of the 91, 83 participants completed 16 weeks of training. Sixty-four participants presented complete data for both time points, and analyses were performed using only participants with complete data.
Prior to enrollment, participants self-reported as sedentary and previously untrained, which was defined as less than or equal to one exercise bout per week. Participants had a Body Mass Index (BMI) less than 30 kg/m² and no prior history of heart disease or diabetes mellitus. Subjects were non-smokers and were not taking medications known to affect energy expenditure, insulin level, heart rate, or thyroid function. Exclusion criteria included prisoners, intellectual disability, special diet, plans to move from the area during the study period, an abnormal EKG at rest or during exercise, or any individual known to have any conflicting illnesses, such as heart disease, cancer, history of eating disorder, or any medications known to affect the study parameters.

Procedure

Participants were randomly assigned to one of three exercise conditions using the baseline adaptive randomization or minimization method to obtain a balance of age, race, and BMI between groups (Hunter, Wetzstein, Fields, Brown, & Bamman, 2000; Pocock & Simon, 1975). Group 1 \( (n = 22) \) performed one Resistance Exercise Training (RET) and one Aerobic Exercise Training (AET) session per week; Group 2 \( (n = 23) \) performed two RET and AET sessions per week; Group 3 \( (n = 19) \) performed three RET and AET sessions per week. Ninety-two\% of the women in group 1, 88\% of the women in group 2, and 90\% of the women in group 3 completed the 16-wks of training without missing a session. If a session was missed due to sickness, injury, or personal reasons the session was made up until 16 wks of training was achieved.
Training sessions lasted 50 minutes in a facility dedicated to research and was conducted under the supervision of exercise physiologists. Each session began with a three to four minute warm-up on a cycle ergometer or treadmill, and three to four minutes of stretching. Participants in Group 2 or Group 3 could perform both an AET and RET on the same day. More details for physiological testing and training have been previously published (Fisher et al., 2012; Hunter et al., 2013)

Aerobic Training

During the first week subjects performed 20 minutes of continuous exercise at 67% of measured maximum heart rate. Each week the intensity and duration were increased so that by 8 weeks, all subjects were working at 80% maximum heart rate for 40 minutes. Exercise modalities included both cycle ergometer and treadmill exercise. At least 50% of the training time was done on the treadmill.

Resistance Training

Strength exercises included leg press, squats, leg extension, leg curl, elbow flexion, lateral pull-down, bench press, military press, lower back extension, and bent leg sit-ups. Each exercise consisted of two sets of 10 repetitions with a 1.5-2-minute rest between sets. The intensity began at 60% of the maximum weight the subject could lift at one time (1RM) and was gradually increased to 80% of 1RM at week 8. Subject 1RM was determined every fifth week to ensure that intensity was increased appropriately.
Measures

Psychometric measures were administered on the first day of testing and again after completion of 16 weeks of training.

Profile of Mood States (POMS)

The Profile of Mood States is a well-tested, clinically validated test (LeUnes, 2000; McNair, Lorr, & Droppleman, 1992). The POMS uses 65 adjectives that are rated on a scale with anchors of 0 (Not at all) and 4 (Extremely) to measure Tension, Depression, Anger, Vigor, Fatigue, and Confusion. Participants are instructed to choose the best answer for how they have felt within the past week. A POMS score for Total Mood Disturbance consists of scores from the test’s six factor-analytically derived subscales: tension-anxiety, depression, anger-hostility, vigor-activity, fatigue, and confusion-bewilderment. Subscales may also be used individually for analysis (McNair et al., 1992).

Beck Depression Inventory, Second Edition

The Beck Depression Inventory-II (BDI-II) was administered to assess the existence and severity of symptoms of depression. It is a 21 item self-report rating inventory measuring characteristic attitudes and symptoms of depression. The test has been reported to have high reliability (split-half reliability of .93, and alpha coefficient for internal consistency of .81) and moderate to high concurrent validity .56-.96. Possible total scores range from 0 to 63 with higher total scores indicating greater levels of depressive symptoms (Beck & Alford, 2008; Beck, Steer, & Brown, 1996).
Rosenberg Self-Esteem Scale

The Rosenberg Self-Esteem Scale was developed in 1965 and is a 10 item Likert scale with responses ranging from Strongly Agree to Strongly Disagree (Rosenberg, 1965). The scale generally has high reliability with test-retest correlations in the range of .82 to .88, and Cronbach's alpha for various samples are in the range of .77 to .88 (Rosenberg, 1986).

Physical Appearance State and Trait Anxiety Scale

The Physical Appearance State and Trait Anxiety Scale (PASTAS) was validated on a sample of 205 college females, and since then the scale has been expanded to other populations (Cronbach’s alpha .82-.92 and reliability of .87) (Thompson, Heinberg, Altabe, & Tantleff-Dunn, 1999). The scale consists of 16 items. Each item lists a different body area or body part, such as the thighs, the stomach, the ears or the lips, and asks the subject to rate his/her feelings of anxiety, tension, or nerves regarding the body area at that very moment on a scale of 0 to 4, with 0 representing “Not at All” and 4 representing “Exceptionally So.” The score from the first 8 items is totaled to compile a Weight-Related Anxiety, and the last 8 items are totaled to compile a Non-Weight Related Anxiety. Higher scores indicate higher anxiety levels. The Weight-Related Anxiety score was shown to correlate with other measures of appearance evaluation, body dissatisfaction, and disordered eating (Reed, Thompson, Brannick, & Sacco, 1991).

Body Comparison Scale

The Body Comparison Scale consists of 25 items and has a Cronbach’s alpha of .78 (Thompson et al., 1999). Each item relates to a specific body part (e.g., ears, cheeks,
chest, thighs) or region of the body (e.g., upper body, lower body) and asks participants to rate from 1 to 5 (1 = Never, 5 = Always) how often he/she compares the listed aspect of his/her own body to those of other individuals of the same sex. These items can be divided into subscales, with items 1-9 representing General appearance, 10-15 Muscular scale, and 16-20 Weight scale. The remaining 5 items remain independent (Thompson et al., 1999).

*Body Esteem Scale for Adolescents and Adults*

The Body Esteem Scale for Adolescents and Adults has high internal consistency and test-retest reliability for representing self-evaluations of one’s body or appearance (Cronbach’s alpha .85) (Thompson et al., 1999). The scale consists of three subscales, Appearance (general feelings about appearance), Weight (weight satisfaction), and Attribution (evaluations attributed to others about one’s body and appearance) (Mendelson, Mendelson, & White, 2001).

*Stunkard Figure Rating Scale*

The Stunkard Figure Rating Scale is a simple method for individuals to assess their own figure (Stunkard, Sørensen, & Schulsinger, 1983). The scale consists of 9 numbered gender and race specific silhouetted figures ranging in body size, with 1 being the thinnest body type and 9 being the largest, most obese type. From these silhouetted images, participants are asked to choose the figure that best represents their own body size and the one that represents their desired body size. Subtraction of the desired body size from the current rating of body size results in a discrepancy score. This discrepancy score indicates a person’s level of dissatisfaction with his/her own figure.
The Multidimensional Body-Self Relations Questionnaire (MBSRQ) (Brown, Cash, & Mikulka, 1990) consists of 69 items in its current revision. The MBSRQ asks the participant to indicate the extent to which each of the 69 statements pertains to him/herself. The participant may choose one of five options ranging from “definitely disagree” to “definitely agree.” Items target a variety of areas such as appearance evaluation, health habits, and physical fitness. Factor analysis of the 69 items has resulted in 7 subscales, which are: Appearance Evaluation, Appearance Orientation, Fitness Evaluation, Fitness Orientation, Health Evaluation, Health Orientation, and Illness Orientation. Subscales entitled Evaluation reflect the person’s feelings regarding that particular area, while Orientation subscales reflect the extent to which one invests in the titled area (Cash, 2000). Cronbach’s alpha for each subscale is at least .72 or greater and reliability is .74 or greater (Cash, 2000).

Data Analysis

Analyses were conducted using the participants with complete data for both time points (N = 64). Prior to conducting the analyses, data was examined for data-entry error and determined to be missing at random. Comparisons of baseline measures were conducted to ensure there were no confounding effects of group assignment and that groups are adequately balanced across a number of factors (e.g., age, weight, etc.). To examine whether any change in the psychometric outcomes differed by frequency of exercise (i.e. exercise frequency X time interaction), a repeated measures analysis of variance (ANOVA) was conducted with frequency and time as the independent variables,
and each psychometric outcome as the dependent variable. To examine whether improvements in fitness, body fat, or strength were related to any statistically significant changes in the psychometric outcomes, simple correlations were conducted. Correlations were run between pre-post change in VO₂ max, total % body fat, 1 repetition max leg press, and the change in the psychometric outcomes. All analyses were performed using SPSS version 21 and a *P* value <0.05 was deemed statistically significant.

RESULTS

Descriptive data stratified by group assignment are presented in Table 1. Eighty-one percent of the sample identified as Caucasian. VO₂ max and 1RM leg press are included to show the physiological response to 16 weeks of combined AET and RET. Complete results of the physiological response to training have been previously published (Fisher et al., 2012; Hunter et al., 2013).

**AIM 2: To examine the effect of exercise frequency on psychological outcome measures.**

Repeated measures ANOVA were conducted for the following measures: POMS, BDI-II, Rosenberg Self-Esteem Scale, PASTAS, Body Comparison Scale, Body Esteem Scale for Adolescents and Adults, Stunkard Figure Rating Scale and MBSRQ. For measures containing subscales (POMS, PASTAS, Body Comparison Scale, Body Esteem Scale for Adolescents and Adults, and MBSRQ) analyses was conducted for each subscale. No exercise frequency by time interactions were observed for any of the measures, indicating that frequency of training did not influence the magnitude or direction of the change in psychometric outcomes during the exercise training.
intervention. Therefore, the hypothesis that groups 1 and 2 would perform better than group 3 was not supported.

**AIM 1: To further support combined AET & RET as an effective method for improving psychological constructs.**

Significant time effects were observed for multiple measures, and these results are presented in Table 2. Because no frequency X time interactions were found for the measures tested, significant time effects are presented for the overall sample. Body image and esteem improved across the intervention, as suggested by statistically significant improvements in the Body Esteem Scale’s Appearance \((p = .002)\) and Weight \((p = .005)\) subscales, and MBSRQ subscales for Appearance Evaluation \((p < .001)\) and Body Satisfaction \((p < .001)\). A significant decrease in the Stunkard Body Dissatisfaction scale \((p < .001)\); the PASTAS Weight Related Anxiety Scale \((p = .001)\); Body Comparison Scales for Non-Muscular Appearance \((p = .053)\), Weight \((p = .016)\), and Overall Appearance \((p = .019)\); and MBSRQ Appearance Orientation \((p = .042)\) and Overweight Preoccupation \((p = .007)\), also support improved body image and esteem as a result of the intervention. Valuation of fitness and involvement in enhancing or maintain fitness significantly improved as exhibited by increases in the MBSRQ Fitness Orientation subscale \((p < .001)\). Significant positive change was also observed for the POMS – Vigor subscale \((p = .008)\). Significant changes were not observed for measures of self-esteem, depression, and mood (except for the POMS – Vigor subscale), or health evaluation and orientation. Since some measures did change as a result of exercise training, while others did not, Aim 1 is partially supported.
Given that previous research has shown a benefit of exercise on depression (Bridle, Spanjers, Patel, Atherton, & Lamb, 2012), we further explored this association by dichotomizing our cohort based on a median split of BDI-II scores at baseline, and examining whether these groups differed in terms of their response to the training intervention. Results of a repeated measures ANOVA, with upper vs. lower baseline depression score as the independent variable, showed a significant group x time interaction $F(1, 58) = 42.90, p < .001$. Follow-up analysis with paired t-tests indicated individuals in the upper depression group significantly decreased depression scores following exercise training, $t(29) = 6.75, p < .001$, while those in the lower depression group did not significantly change, $t(29) = -1.58, p = .125$. See Figure 1.

**Secondary Aim:** To assess if changes in psychological outcomes are associated with physiological improvements in fitness and body composition.

Simple Pearson correlations were conducted to examine whether the change in psychometric outcomes from pre to post training intervention were associated with changes in VO$_2$ max, % body fat, and 1RM leg press, fat free mass, BMI, waist circumference, heart rate on submaximal tasks, and perceived exertion. No statistically significant relationships were observed. Therefore, the hypothesis that psychological changes would be associated with physiological changes was not supported.

**DISCUSSION**

Exercise is beneficial for slowing aging. Older adults who participate in exercise typically show increased physical and cognitive function. While studies have been done to determine the optimal amount of exercise for physical benefits in older adults, it has
yet to be determined if there is an optimal amount of exercise for psychological benefits. This study aimed to fill this current gap in knowledge and determine if there is a dose response for exercise and psychological outcomes.

As hypothesized, 16 weeks of combined aerobic and resistance training improved psychological measures of body image and body esteem in a sample of previously sedentary normal to overweight older women. Significant changes were observed for several measures (see Table 2), particularly scales designed to assess evaluations and feelings of one’s own appearance.

Improvements were observed in body esteem regarding appearance and weight. Participants increased esteem for their overall appearance, as represented by the Body Esteem Appearance subscale, and felt more positively about their weight, represented by the Body Esteem Weight subscale. Decreases were also observed in body dissatisfaction and anxiety regarding weight (Stunkard Body Dissatisfaction, PASTAS Weight Related Anxiety, MBSRQ Overweight Preoccupation). Participants also indicated fewer comparisons between his/her own body to other individuals of the same sex (Body Comparison Scales). Therefore, not only did participants feel better about themselves, but also became less occupied with how she looked in comparison to other women. Involvement in activities to enhance or maintain fitness, as well as vigor, also improved as a result of the combined exercise training. These results suggest that exercise training can be an effective tool in improving perceived appearance in older adults.

One area of concern about exercise for older adults is that they are more susceptible to fatigue or overtraining and will need more time between workouts for
recovery. It was hypothesized that the 3 times per week group may not show as much improvement in psychological outcomes due to overtraining and fatigue. However, observed changes were similar across all three groups; no significant time by frequency interactions were observed. This suggests two exercise sessions per week may be just as effective as four or six. This is consistent with previous findings reported by Fisher et al. (2012), where significant time effects were reported for aerobic fitness, strength, and function, but there were no differences between groups as a result of exercise training frequency. However, this lack of difference may partially be explained by greater energy expenditure by participants in groups 1 and 2 compared to group 3, as reported by Hunter, et al. (2013). Participants in groups 1 and 2 increased their non-exercise training energy expenditure (+68 and +200 kcal/day, respectively) while participants in group 3 decreased (-150 kcal/day). Though participants in group 3 decreased energy expenditure, none of the measures of increased stress or fatigue changed with training (Hunter et al., 2013). These results suggest that frequency of exercise training did not affect psychological outcomes that change with training. Participants performing one aerobic and one resistance training session per week performed just as well as participants performing three aerobic and three resistance training sessions per week.

Overall, progression from a sedentary lifestyle to active exercise training, whether it be as little as 1 session of AET/RET per week or as many as 3 sessions of AET/RET per week, appears to have a positive impact on one’s own body appraisal. To our knowledge, this relationship has not been previously examined in a sample of older adults, as it is believed that body image becomes more stable across the lifespan (Tiggemann, 2004). Previous reports have indicated that older adults express a concern
with their own body, but this did not translate into motivation to exercise (Schuler et al., 2004). Results from this study show that when older adults do begin and maintain exercise training, body esteem and weight related anxiety can be improved, and body dissatisfaction can be decreased. Participants in this sample improved perceptions of herself and became more comfortable with her own appearance.

Considered in whole, these results suggest that 1, 2, or 3 sessions of combined AET and RET per week may be effective in improving body esteem and weight related anxiety, but more sessions confer no advantage over fewer sessions, at least among healthy, previously sedentary, older women. We cannot rule out that briefer, longer, AET alone, or RET alone sessions would result in less psychological improvement. Future work should explore whether one session of either AET or RET is sufficient to improve body esteem and weight related anxiety.

It is possible that no effect of the intervention on mood and self-esteem was observed because the study sample was relatively healthy and reported normal mood and self-esteem at baseline. The overall sample did exhibit a significant increase in Vigor, but this effect was not large enough to influence overall mood, as measured by the POMS. Future studies should include a measure of self-efficacy, as this has also been shown to change with exercise.

As with the measures of mood and self-esteem, an overall effect for depression scores was not observed, but this could also be due to the sample reporting minimal depression at baseline. Due to previous literature (Bridle et al., 2012; Lawlor & Hopker, 2001; Mead et al., 2008) that indicates exercise does improve depression, participants in
this study were dichotomized into an upper and lower depression group based on a median split of BDI-II score at baseline. Participants in the upper depression group still fell within the minimal to mild range of established cut points for the BDI-II (Beck et al., 1996). Exercise training significantly decreased BDI-II scores for the upper depression group, while the lower depression group had little to no change. The lower depression group did slightly increase scores from baseline to 16 weeks, but not enough to be considered a regression towards the mean. These results suggest 16 weeks of combined AET and RET were effective in reducing measures of depression in individuals who are mildly to minimally depressed. Results of a repeated measures ANOVA for only the upper depression group indicated no differences based on the between subjects variable of exercise frequency.

No relationship was observed between changes in physiological and fitness measures (i.e., BMI, waist circumference, VO2max, % body fat, % fat free mass, 1RM leg press, submaximal task heart rate, and submaximal task perceived exertion) with psychometric measures that showed significant time effects. Numerous publications support a relationship between exercise and changes in body image and esteem, but these changes may be due more to perceived changes to the body rather than actual changes (Martin Ginis, McEwan, Josse, & Phillips, 2012). This suggests psychological factors, and not necessarily physical changes, are responsible for the improvements in evaluations of appearance and body satisfaction. It is also possible that associations exist between the physiological changes and other factors that were not measured here, e.g., social aspect or self-efficacy.
It is important to note that this study only included older women aged 60-74 of normal to overweight status, who met the study’s exclusion criteria for health status. Results may vary with the inclusion of men and other age groups. Also, study results may vary if the study sample was extended to include previously active individuals or individuals who are obese. A number of older adults may have existing physical or mental health related diagnoses that could impact study results as well if they were to be included.

In conclusion, current recommendations for older adults are to participate in regular exercise for both physical and psychological health. Questions remain regarding the ideal frequency of exercise for older adults. Results from this cohort suggest that 1 session of AET and RET each week produces comparable improvements as 2 and 3 sessions. This study adds support to existing literature regarding the psychological benefits associated with exercise for older adults, by showing that body image, body esteem, and weight-related anxiety improve with exercise training by older women.
LIST OF REFERENCES


Table 1

Characteristics Stratified by Group for Pre- and Post-training

<table>
<thead>
<tr>
<th>Measure</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Age</td>
<td>65.51 ± 3.85</td>
<td>64.42 ± 3.26</td>
<td>64.83 ± 3.65</td>
</tr>
<tr>
<td>BMI</td>
<td>27.53 ± 3.91</td>
<td>27.24 ± 4.17</td>
<td>27.34 ± 3.53</td>
</tr>
<tr>
<td>Waist Circumference (cm)</td>
<td>92.30 ± 2.76</td>
<td>91.79 ± 2.72</td>
<td>89.21 ± 2.58</td>
</tr>
<tr>
<td>%Body Fat</td>
<td>43.53 ± 6.40</td>
<td>43.03 ± 6.76</td>
<td>43.14 ± 4.13</td>
</tr>
<tr>
<td>% Fat Free Mass</td>
<td>55.37 ± 1.43</td>
<td>56.49 ± 1.49</td>
<td>56.38 ± 1.17</td>
</tr>
<tr>
<td>VO₂ Max (mL/kg/min)</td>
<td>21.74 ± 4.45</td>
<td>22.17 ± 4.65</td>
<td>22.91 ± 4.48</td>
</tr>
<tr>
<td>Leg Press (lbs)</td>
<td>202.19 ± 10.60</td>
<td>242.91 ± 12.98</td>
<td>210.54 ± 7.53</td>
</tr>
<tr>
<td>Submaximal Task Heart Rate</td>
<td>108.47 ± 4.27</td>
<td>97.10 ± 2.33</td>
<td>99.18 ± 3.17</td>
</tr>
<tr>
<td>Submaximal Task Rating of Perceived Exertion</td>
<td>10.47 ± .31</td>
<td>9.33 ± .56</td>
<td>9.53 ± .52</td>
</tr>
</tbody>
</table>
Table 2

*Results from Repeated Measures ANOVA with Significant Time Effect.*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre-Training M ± SD</th>
<th>Post-Training M±SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Esteem</td>
<td>3.43 ± .09</td>
<td>3.59 ± .08</td>
<td>.002</td>
</tr>
<tr>
<td>Appearance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Esteem Weight</td>
<td>2.84 ± .10</td>
<td>3.00 ± .10</td>
<td>.005</td>
</tr>
<tr>
<td>Stunkard Body Dissatisfaction</td>
<td>1.44 ± .14</td>
<td>.93 ± .13</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>PASTAS Weight</td>
<td>21.73 ± .93</td>
<td>19.26 ± .88</td>
<td>.001</td>
</tr>
<tr>
<td>Related Anxiety</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Comparison: Non-Muscle Appearance</td>
<td>15.30 ± 0.64</td>
<td>14.44 ± 0.57</td>
<td>.053</td>
</tr>
<tr>
<td>Body Comparison: Weight</td>
<td>12.55 ± 0.62</td>
<td>11.64 ± 0.54</td>
<td>.016</td>
</tr>
<tr>
<td>Body Comparison: Overall</td>
<td>2.84 ± .14</td>
<td>2.59 ± .13</td>
<td>.019</td>
</tr>
<tr>
<td>MBSRQ Appearance Evaluation</td>
<td>19.92 ± 0.53</td>
<td>21.29 ± 0.55</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MBSRQ Appearance Orientation</td>
<td>42.77 ± 0.89</td>
<td>41.92 ± 0.82</td>
<td>.042</td>
</tr>
<tr>
<td>MBSRQ Fitness Orientation</td>
<td>40.47 ± 0.76</td>
<td>44.34 ± 0.82</td>
<td>&lt;.001</td>
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<tr>
<td>MBSRQ Body Satisfaction</td>
<td>27.22 ± 0.69</td>
<td>29.89 ± 0.66</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MBSRQ Overweight Preoccupation</td>
<td>10.54 ± 0.44</td>
<td>9.79 ± 0.39</td>
<td>.007</td>
</tr>
<tr>
<td>POMS – Vigor</td>
<td>18.15 ± 5.28</td>
<td>20.06 ± 4.93</td>
<td>.008</td>
</tr>
</tbody>
</table>
Figure 1. Mean BDI scores for upper and lower depression groups at Baseline (Timepoint 0) and after 16 weeks of training (Timepoint 1).
APPENDIX

IRB APPROVAL FORM
UAB's Institutional Review Boards for Human Use (IRBs) have an approved Federalwide Assurance with the Office for Human Research Protections (OHRP). The Assurance number is PWA00005660 and it expires on January 24, 2017. The UAB IRBs are also in compliance with 21 CFR Parts 50 and 56.

Principal Investigator: NEUMIEER, WILLIAM HAROLD
Co-Investigator(s): BIASINI, FRED J
                    CHANDLER-LANEY, PAULA C
Protocol Number: EI20509065
Protocol Title: Frequency of Exercise Training's Effects on Psychological Outcomes in Older Women

The above project was reviewed on 5/28/13. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services. This project qualifies as an exemption as defined in 45CFR46.101, paragraph 4.

This project received EXEMPT review.
IRB Approval Date: 5/28/13
Date IRB Approval Issued: 5/28/13

Cari Oliver
Assistant Director, Office of the Institutional Review Board for Human Use (IRB)

Investigators please note:

IRB approval is given for one year unless otherwise noted. For projects subject to annual review research activities may not continue past the one year anniversary of the IRB approval date.

Any modifications in the study methodology, protocol and/or consent form must be submitted for review and approval to the IRB prior to implementation.

Adverse Events and/or unanticipated risks to subjects or others at UAB or other participating institutions must be reported promptly to the IRB.