THESIS

ASSESSMENT OF PHYSICAL HEALTH, PHYSICAL PERFORMANCE, AND PHYSICAL ACITIVTY IN EXERCISE PROMOTION INTERVENTION FOR OLDER ADULTS

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ABSTRACT

ASSESSMENT OF PHYSICAL HEALTH, PHYSICAL PERFORMANCE, AND PHYSICAL ACITIVTY IN EXERCISE PROMOTION INTERVENTION FOR OLDER ADULTS

This study examined the effects of an intervention program, known as AgingPlus, on indicators of physical health (i.e. systolic and diastolic blood pressure), physical performance (i.e. left- and right-hand grip strength), and physical activity levels (i.e. total steps walked, total kilocalorie expenditure, and total distance). There were 120 older-adult participants who were relatively healthy and community residing. The study used a randomized pretest-posttest control group design. Findings showed that NVOA and self-efficacy beliefs did not mediate the association between the intervention and the outcome variables. We found that participants in the treatment and the control group improved their physical health, physical performance, and physical activity from the baseline assessment to the Week 8 follow-up. Additionally, the results showed that only participants in the treatment condition significantly decreased their systolic and diastolic blood pressure and significantly improved their left- and right-hand grip strength over an eight-week interval. These findings suggest that targeting NVOA and self-efficacy beliefs may be an effective strategy to optimize adults' healthy aging.

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Introduction

From 2007 to 2017, the population in the United States age 65 years or older has increased by 34% (Administration on Aging, 2018). In 2010, an estimated 8 percent of the world's population was age 65 or older and by 2050 it is estimated that 16 percent of the world's population will be age 65 or older (National Institute on Aging, 2011). The proportion of older adults (i.e., individuals age 65 and older) in the U.S. and indeed worldwide is larger than it has ever been in the history of humankind and is expected to continue to grow (Cavanaugh & Blanchard-Fields, 2018). Thus, the health of the aging population is important to consider because of the social and financial impact that the aging population will have. Additionally, it is important to examine the specific factors that affect older adults' quality of life. Physical performance is one of the major factors that can strongly impact physical health and quality of life. There are a variety of ways to assess physical performance, these include measuring grip strength, maximum oxygen capacity, and blood pressure (Friedman et al., 1995; Sayer et al., 2006; Schaie & Willis, 2015). Because of the increasing proportion of older adults, with about half of older adults suffering from a chronic condition (Ward et al., 2014), it is important that research investigates factors that help with the promotion of healthy aging, resulting in more positive developmental outcomes.

Physical activity is important for physical, cognitive, and psychological health (Kohl et al., 2012; Kramer & Erickson, 2007; Lachman et al., 2018; Mirowsky, 2014). Indeed, Lachman et al. (2018) have suggested that physical activity is "the most promising non-pharmacological, noninvasive, and cost-effective method of health promotion" (p. 1), suggesting that the most effective health promoting behavior is consistent engagement in physical activity. However, findings from past studies also suggest that a high percentage of older adults are not getting sufficient amounts of physical activity (Lachman et al., 2018; Ory et al., 2003). It is not that people are unaware of the importance of exercise, in fact 98 percent of older people said that regular exercise is healthy (Ory et al., 2003). However, based on federal physical activity guidelines (i.e. 150 minutes a week of moderate aerobic activity) for both aerobic and muscle-strengthening exercise, only 16% of older adults (65 years or older) met the recommended health guidelines (Ward et al., 2016). Given this situation, some researchers (Nielsen & Reiss, 2012) have suggested that motivational, self-regulatory, and goal-setting deficits may be causes leading to this situation. Recently, specific motivational and self-regulatory factors have received some attention, including individuals' negative views of aging (NVOA) and self-efficacy beliefs.

Negative views of aging is one of the constructs that has been theorized to play a role in people's adherence to health-promoting behaviors, such as physical activity (Brothers & Diehl, 2017). Although the question about the dimensionality of the concept of 'views of aging' is still the topic of an ongoing debate, what is well documented is that negative views of aging are associated with negative behavioral and health related outcomes, whereas positive views of aging tend to be associated with positive outcomes. Past research has shown meaningful relationships between NVOA, in the form of negative stereotypes of aging, and negative long-term health outcomes (Levy et al., 2009; Stewart et al., 2012). For example, individuals with more NVOA show more severe cognitive and physical decline, recover more slowly from heart attacks and disability, and even have a shorter life expectancy compared to individuals with more Positive Views of Aging (PVOA) (Levy et al., 2002; Stewart et al., 2012). Thus, having more PVOA seems to be protective against negative health outcomes for older adults (Levy et al., 2014; Sargent-Cox et al., 2012; Wurm et al., 2008).

Self-efficacy beliefs, which are defined as an individual's beliefs in his or her ability to successfully perform a certain behavior, is a construct that has been shown to be related to adults' exercise behaviors (Schutzer & Graves, 2004). Specifically, individuals with higher levels of self-efficacy are more likely to adhere to recommended physical activity guidelines than individuals with lower levels of self-efficacy. Additionally, higher levels of self-efficacy beliefs have been related to adults' success in a variety of different behavior change interventions (Schwarzer et al., 2011). Thus, self-efficacy is a key construct indicative of individuals' ability to successfully change a behavior.

Even though older adults are aware that physical activity is important for health, most of them are still not engaging in it regularly (Lachman, 2018). This suggests that simply telling people that physical activity is important for their health is not working. Additionally, it has been shown that positive attitudes alone were not sufficient for increasing physical activity (Mobily et al., 1987). Thus, problems on the motivational and self-regulating level need to be addressed. Behavioral change interventions should be targeting motivational mechanisms in order to increase people's physical activity levels. By lessening NVOA and increasing self-efficacy, interventions may be able to get older adults to engage in sufficient amounts of physical activity which will in turn, increase physical performance.

Behavior Change Interventions

Traditional programs developed to increase physical activity typically focus on teaching exercise skills and specific exercises (Lachman et al., 2018). Newer programs have begun using motivational approaches, such as addressing individuals' low control beliefs, negative beliefs, or deficits in self-regulation in order to create lasting behavior change. These motivational programs are designed to help participants develop a meaningful and personalized program that can be integrated into their daily lives (Lachman et al., 2018). Additional research has shown that programs that incorporated a cognitive and behavioral component were the most effective at increasing older adults physical activity (Chase, 2015; King, 2001). There are a few other variables that are related to engagement in physical activity such as social support, attitudes, and beliefs (Lachman et al., 2018). These factors are related more to an individual's personal characteristics as opposed to the characteristics of the intervention type. Thus, it is important to consider these factors because individual characteristics may be related to behavioral outcomes. Moreover, certain types of interventions may prove to be more effective for people with certain characteristics. For example, certain personality characteristics, such as dispositional optimism or being extroverted, may influence how effective an intervention program might be. Because there are a multitude of factors related to physical activity for older adults, interventions should be multifaceted. Designing interventions that integrate elements of cognitive, behavioral, personal, and motivational frameworks may help to increase the efficacy and effectiveness of training programs.

Barriers to Physical Exercise

Any discussion about how to motivate adults to engage in physical activity on a regular basis also needs to understand the factors that prevent people from engaging in regular physical exercise. There is a whole host of factors related to engagement in physical activity. These factors can be external like distance to a gym or poor neighborhood walkability. Alternatively, factors can also be classified as internal barriers, examples of these include beliefs regarding physical activity or goal-planning ability. Older adults most often cite poor health as the main reason why they do not engage in physical activity (Schutzer & Graves, 2004). This is particularly important because it prevents them from doing the very thing that may help to increase their overall health. Other barriers include the physical environment, physician advice, lack of knowledge regarding specific exercise routines, and childhood exercise levels (Schutzer & Graves, 2004).

People also hold beliefs about exercise in general, and these beliefs are associated with their engagement levels. In general, adults view exercise as time-consuming and more of a recreational pursuit rather than a necessary activity that is instrumental in maintaining long-term health and well-being (Chao et al., 2000). Additionally, expectations regarding aging have been shown to be related to physical activity levels in older adults. Research by Sarkisian et al. (2005) showed that adults with more negative age-expectations were more likely to report low levels of physical activity compared to those with more positive age-expectations. When creating interventions, it is important to consider these barriers and help people overcome them, if possible, in order to get the best outcomes.

Targeting Mechanisms in Behavior Change Programs

Although behavior modification programs have a long history in psychological research (Mills, 1998), more recent approaches emphasize the importance of identifying the mechanisms by which an intervention exerts its effects. Indeed, the National Institutes of Health has started a specific Science of Behavior Change initiative that utilizes an experimental medicine approach to intervention and prevention (Nielsen et al., 2017). The experimental medicine approach refers to researchers identifying specific target mechanisms that can be manipulated in real-life settings to achieve particular outcomes. In the context of the current study, there have been two specific target mechanisms identified. These target mechanisms are: Negative Views of Aging (NVOA) and self-efficacy beliefs. The following will discuss each of these mechanisms in more detail.

Views of Aging

Views of Aging (VOA) are conceptualized as beliefs, knowledge, and expectations regarding the process of aging and older adults as a social group in general (Brothers & Diehl, 2017). Although VOA do not necessarily have to be negative, extensive research has shown that the overwhelming majority of VOA tend to be negative (Levy, 2003), and affect adults' behavior and health in negative ways (Levy, 2009).

Past research has shown that NVOA can be decreased and Positive Views of Aging (PVOA) can be increased through interventions (Brothers & Diehl, 2017; Levy et al., 2014, Wolff et al., 2014). In the research study done by Levy et al., (2014), researchers explored the impact of explicit and implicit positive-age-stereotype interventions with a sample of 100 older adults ($M = 81$). The positive-age-stereotype interventions occurred once a week for four consecutive weeks. Participants in the implicit intervention were subliminally exposed to positive age stereotypes using previously established and validated techniques. Participants in the explicit condition where asked to imagine and then write about physically healthy senior citizens. Measurements of PVOA and NVOA were taken at the end of Weeks 2 through 5 and Weeks 6 and 8. The researchers found that implicit-positive-age-stereotype interventions significantly strengthened PVOA (i.e. positive self-perceptions of aging and positive age stereotypes), while simultaneously weakening NVOA (i.e. negative self-perceptions of aging and negative age stereotypes). The explicit-positive-age-stereotype intervention significantly strengthened PVOA (i.e. positive age stereotypes). The implicit manipulations strengthened PVOA and decreased NVOA. Whereas, the explicit manipulations only had an effect on strengthening PVOA. This provides evidence that while implicit manipulations may be more efficacious, both implicit and explicit interventions can be used to increase PVOA.

Another study conducted by Wolff et al., (2014) aimed to examine the effect of prompting positive views on aging within a physical performance intervention for older adults. The experimenters used a randomized control trial with 231 participants total and three groups: intervention with VOA component, intervention without VOA component, and active control intervention. The experimenters found that the intervention with VOA component increased positive attitudes towards older adults compared to the intervention without VOA and control group. Additionally, they found that change in VOA predicted change in physical activity. Such that increases in positive VOA were predictive of increases in physical performance. This study provides evidence that increasing positive VOA in physical performance interventions may increase the effectiveness of the intervention.

Brothers and Diehl (2017) designed a single-group pretest-posttest intervention and administered it to a sample of 62 older adults (M = 64.7, SD = 6.0). During weeks 1-4 participants attended weekly education sessions which taught information about NVOA and control beliefs. The remaining four weeks of the study were an experiential portion in which participants set physical activity goals and completed daily physical activity logs. Participants then filled out a questionnaire at Week 8 (immediate posttest) and Week 12 (delayed posttest). The researchers found statistically significant decreases in NVOA and a corresponding increase in PVOA during the 12-week time interval that the study took place. By targeting these NVOA, the level of self-reported physical activity increased (Brothers & Diehl, 2017) and more rudimentary physical performance improved (Levy et al., 2014). This is promising preliminary evidence of the effectiveness of decreasing NVOA to promote regular engagement in physical activity.

Whereas NVOA can have particularly detrimental effects on health, more PVOA can have protective effects on health outcomes such as physical functioning and longevity (Levy et al., 2002; Sargent-Cox et al., 2012). Sargent-Cox et al. (2012) showed that more positive self-perceptions of aging, at baseline, served as a protective factor to declining physical functioning at a follow up assessment. This evidence suggests a temporal relationship in which VOA precedes physical functioning decline. This highlights the idea that making VOA more positive may help to protect against severe physical functioning decline in adulthood.

Stereotypes of aging. Stereotypes of aging are one of the components that make up individuals' overall VOA. A stereotype is a set of beliefs about a group of individuals (Kanahara, 2006). For example, a stereotype about older adults is: They are weak, slow moving, and less capable than younger people. The prevalence of aging stereotypes in North America often leads to discrimination. In a survey, 84 percent of Americans aged 50 or older reported at least one incident of ageism (Ory et al., 2003). An example of ageism is an older adult was being ignored in a college classroom, solely because of his or her age. There are also more subtle forms of ageism that are often disguised in humor and far more common in our society. An example of this would be getting a birthday card that made fun of older people. Given the prevalence of negative stereotypes of aging, it is not surprising that older people believe them and apply them to their own person (Horton et al., 2007). In a study by Levy et al. (2014), the researchers showed that Facebook, the popular social media platform, contributes to negative age-stereotyping of older individuals because 'Descriptions' of older adults groups are often negative. This is just an example that highlights how negative aging stereotypes are maintained and reinforced even in the 21st century.

Negative age stereotypes can be particularly dangerous when they are internalized and start to unwittingly guide a person's behavior. Negative age stereotypes serve as one component that contributes to individuals overall NVOA. Research in the field of human development has found significant positive relationships between NVOA and negative health outcomes, such as reduced longevity, increased cognitive decline, and poorer cardiovascular health (Horton et al., 2007; Levy et al., 2009; Stewart et al., 2012).

Aging stereotypes develop in early childhood and are constantly being shaped and maintained by life experience (Levy, 2009). It is important to understand how these stereotypes held earlier in life affect aging-related outcomes. For example, in a study by Levy et al. (2009), individuals with more negative age stereotypes held earlier in life were more likely to experience a cardiovascular event in the next 38 years. This finding highlights the specific negative cardiovascular health outcomes that negative age stereotypes are associated with. It shows how negative age stereotypes held early in life can strongly influence health outcomes later in life. Because NVOA are so closely related to negative health outcomes, targeting them in interventions may be efficacious in promoting positive health outcomes.

Self-Efficacy

It is important to examine what factors may enhance motivation to engage in regular physical activity. Self-efficacy has been consistently identified as an important determinant of exercise behavior across different populations (Schutzer & Graves, 2004). One behavior change model that incorporates self-efficacy as a central concept is the Health Action Process Approach (HAPA; Schwarzer et al., 2011). HAPA identifies different forms of self-efficacy, motivational and volitional self-efficacy, and deems both as being important for successful behavioral change, depending on the stage of behavior change a person is in (e.g., pre-intender, intender, or actor). Multiple studies provide strong evidence that support the HAPA model.

One study conducted by Luszczynska (2004) aimed to increase women's breast self-examination using the HAPA approach. Participants were randomly assigned either to an intervention or to a control condition. It was found that HAPA variables, such as action self-efficacy, maintenance self-efficacy, recovery self-efficacy and planning, accounted for 29 percent of the variance in behaviors in the intervention group, suggesting that these variables play a significant role in the adoption of the new health behavior (Luszczynska, 2004). Research also suggests that phase-specific self-efficacy is an important factor throughout motivational and volitional stages of behavior change and is critical for the successful integration of new behaviors (Scholz et al., 2005; Schwarzer et al., 2011). Self-efficacy appears to be one of the mechanisms that bridges the gap between intentions and behavior. Because of the role that self-efficacy plays in relation to engagement in new behaviors, increasing it may be extremely useful for successfully increasing physical activity in older adults.

Physical Performance, Physical Health, and Physical Activity Measures

To assess the efficacy of behavior change interventions, reliable and valid indicators of physical performance, physical health, and physical activity are needed. Valid and reliable measures help researchers to determine if interventions were effective or not. Physical performance, physical health, and physical activity can be measured subjectively, using different types of self-report, or objectively, using activity trackers, strength and agility tests, and physiological measurements such as blood-pressure. Even though subjective measures of physical performance, physical health, and physical activity are cost-effective and relatively easy to use they have several limitations. Some of these limitation include floor effects, participant response bias, different scoring procedures and output units (Tudor-Locke, et al., 2002). Therefore, the use of objective activity measures tends to be preferable.

Physical performance measures serve to assess the physical health of individuals in an objective, performance-based way. The hand-grip strength test is a robust physical performance measurement that is widely used in the health and aging literature (Bohannon, 2008; Rantanen et al., 1999). This test measures muscular strength in the hand and is relatively quick, easy, and cost effective to administer to participants. It has been shown to be a significant predictor for mortality, disability, and length of stay while in a hospital (Bohannon, 2008). Another study demonstrated that the risk of functional limitations and disability increased as grip strength declined, as measured in a 25-year follow-up. (Rantanen et al., 1999). Because measuring grip strength is efficient for experimenters and related to a host of health outcomes, it is an important measurement tool that is used for assessing physical health in the present study.

Blood pressure is an indicator of physical health that is used across all age groups. High resting arterial blood pressure (BP) > 140 mm Hg systolic and/or 90 mm Hg diastolic is one of the most modifiable risk factors that contributes to cardiovascular disease (Cornelissen & Smart, 2013). Thus, measuring any changes in blood pressure over time as a result of an intervention program will provide further physiological evidence that will help with the overall evaluation of the program’s efficacy. Specifically, if systolic and/or diastolic blood pressure significantly decreases for participants that have high blood pressure researchers will be able to identify direct health effects of an intervention program.

Objective markers of physical activity, like the number of steps in a day as measured by a pedometer, eliminate the problems associated with subjective ratings of physical activity and provide a more reliable form of measurement. There are many ways to objectively measure daily activity and they vary in cost and practicality. Pedometers provide a rather simple and inexpensive, yet reliable way to gather accurate measurement of daily activity (Tudor-Locke et al., 2002). Analyzing pedometer data can help researchers to assess the efficacy of behavioral change intervention programs.

Summary

Although the United States is one of the most economically advantaged countries in the world, serious concerns exist regarding the health of the population, in general, and the health of the aging population, in particular. With physical health generally declining as adults get older (Lachman et al., 2018; Mirowsky, 2014), and an increasing proportion of older adults living into advanced old age (Cavanaugh & Blanchard-Fields, 2018), the need for optimizing interventions that can promote healthy aging is critical. Engaging in regular physical activity is one of the best ways to promote healthy aging in adults (Lachman et al., 2018). Interventions that use a cognitive-behavioral framework and incorporate personal and motivational factors may be the most effective ones for increasing activity levels in middle-aged and older adults. NVOA and self-efficacy beliefs are two mechanisms that should be specifically targeted to promote the efficacy of behavior change interventions (Brothers & Diehl, 2017; Locke & Latham, 2002; Scholz et al., 2005; Schutzer & Graves, 2004; Schwarzer et al., 2011).

This study examined the effects of an intervention program, known as AgingPlus, on the indicators of physical health, physical performance, and physical activity levels of older adults. The AgingPlus program specifically targets middle-aged and older adults' NVOA and self-efficacy beliefs as mechanisms for promoting physical health, physical performance and physical activity, because these factors have been shown to represent motivational barriers for a number of health-promoting behaviors, including physical activity. The primary dependent variables in the study are objective indicators of physical health, physical performance and physical activity as measured by blood pressure, hand-grip strength, and a pedometer. Specifically, this study compared participants from the intervention condition to those in a control condition to determine the efficacy of the AgingPlus program for promoting healthy aging. Not only did this study examine how the intervention compares to the control condition in its effects on physical health, physical performance, and physical activity, but it also examined to what extent change in NVOA and change in self-efficacy beliefs mediated the effects of the intervention program on change in participants' physical health, physical performance, and physical activity.

Research Questions and Hypotheses

The first research question focuses on the effect of the intervention on participants' physical health, physical performance and level of physical activity. Specifically, did participation in the AgingPlus program lead to an improvement in indicators of physical health, improved physical performance, and increased physical activity over time? We hypothesized that at the end of the intervention (Week-8 assessment) participants in the AgingPlus program will show significantly ($p < .05$) improved physical health, as assessed by blood-pressure measurements, compared to baseline and compared to participants in the control group. Additionally, it was hypothesized that at the end of the intervention (Week-8 assessment) participants in the AgingPlus program will show significantly ($p < .05$) improved physical performance as assessed by grip strength, compared to baseline and compared to participants in the control group. Lastly, it was hypothesized that at the end of the intervention (Week-8 assessment) participants in the AgingPlus program will show significantly ($p < .05$) higher levels of physical activity, as assessed via the pedometer variables, compared to baseline and compared to participants in the control group. That is, we hypothesized a significant ($p < .05$) Condition × Occasion interaction for these dependent variables.

The second research question addresses whether change in self-efficacy beliefs and change in NVOA mediated the relationship between engagement in the AgingPlus program and improved indicators of physical health, physical performance, and physical activity? That is, we tested whether the effect of the treatment on the outcome variables is mediated by participants' change in self-efficacy beliefs between baseline and Week 4, as assessed in terms of motivational and volitional self-efficacy. Additionally, we tested whether the effect of the treatment on the outcome variables is mediated by participants' change in NVOA between baseline and Week 4, as assessed in terms of age stereotypes. Specifically, using multiple mediator analysis, it was tested whether the effect of the treatment on the outcome variables for physical health, physical performance, and physical activity at Week 8 is mediated by participants' change in self-efficacy beliefs and change in NVOA between baseline and Week 4 of the intervention. We hypothesized that change in motivational and volitional self-efficacy and change in NVOA will significantly mediate the association between the AgingPlus intervention and improved physical health, physical performance, and physical activity.

Method

Participants

This study used convenience sampling to recruit participants. Flyers were posted at senior centers and E-mail announcements were sent out to a general employee listserv at Colorado State University, members of the Aspen Club, and other local civic organizations with adult members. Interested participants called in to the Adult Development and Aging Project research lab and were screened over the phone by trained undergraduate research assistants. Eligibility requirements included: being between 50 –85 years old, fluent in English, not showing any major memory problems, willingness to make a 2-month commitment, engagement in physical activity on less than 3 days a week for 30 minutes each time, and either considering starting or strongly intending to start regular physical activity. Exclusion criteria included non-English speakers, history of substance-use or mental health disorders, cognitive impairment, serious visual impairment (i.e., diagnosed as legally blind), or mobility impairment. The sample was fairly educated, healthy and well-functioning and totaled 120 adults ranging in age from 50-83 years (M = 63.33 years, SD = 7.98). Of the 120 participants, 95 were women and 25 were men. About 60 percent of participants were employed and about 34 percent were retired. Other demographic information is provided in Table 1.

Measures

Views of aging (VOA). To measure VOA, participants completed Kornadt and Rothermund's (2011) Age Stereotype Scale (AS). The AS has a total of 27 items. For each item there is a prompt and then each item is scored on an 8-point scale that indicates a person's opinion between a negative and positive pole. An example item is "Older people…" then on the left side of the Likert scale is the statement "… are lonely and alone." On the right side of the

Likert scale is the statement "… are secure and integrated." The participant fills in one of the eight bubbles that reflects his or her agreement with the statements, the closer the bubble is to the statement the more the participant agrees with it. For the AS higher scores reflected more positive age stereotypes and lower scores reflected more negative age stereotypes. Cronbach's α for this measure at the baseline assessment (i.e., Week 0) was .93.

Motivational and volitional self-efficacy. Following the suggestions of the HAPA model (Schwarzer, 2008), participants' self-efficacy beliefs were assessed in terms of Motivational Self-Efficacy (MSE) and Volitional Self-Efficacy (VSE). The MSE scale consists of 3 items regarding the individual's motivation. Items are scored on a scale of one to six where one equals 'Totally Disagree' and six equals 'Totally Agree.' An example item is "I am certain that I could be physically active on a regular basis in the future even if it is difficult." Cronbach's α for the MSE at Week 0 was .88.

The VSE scale also has three items and is scored the same way as the MSE. An example item is "I am certain that I could be physically active on a regular basis in the future even if I need several tries until I am successful." Cronbach's α for the VSE at Week 0 was .93. For both the MSE and VSE higher sum scores reflect a higher level of self-efficacy.

Indicator of physical health. Both systolic and diastolic blood pressure were used to measure participants' physical health. Systolic and diastolic blood pressure was measured by trained members of the research team. The measurements of both Systolic Blood-Pressure (SPB) and Diastolic Blood-Pressure (DPB) were taken before each exercise session while the participants were at rest. Based on the current American College of Cardiology and American Heart Association standards (Greenland & Peterson, 2017), we created four categories which reflect participants' hypertensive status. The categories of blood-pressure status were coded as normal blood-pressure (coded as 1), elevated blood-pressure (coded as 2), stage 1 hypertension (coded as 3), and stage 2 hypertension (coded as 4), with a higher score being indicative of a more serious hypertension status. These groups will allow us to examine change in blood pressure over the course of the intervention based on the different hypertensive status. Because it is not reasonable to assume any significant intervention-related change in participants with normal blood pressure at baseline, these individuals will not be included in any analyses that use blood-pressure as at outcome variable. DPB did not have significant test-retest reliability (r = .18, p = .05) over an eight-week interval. SPB had significant test-retest reliability (r = .41, p < .01) over an eight-week interval.

Physical performance. Hand-grip strength was used to assess participants' physical performance before and after the structured exercise program. Hand-grip strength was assessed using the JAMAR hydrolic hand dynamometer. The experimenters demonstrated the proper way to hold and squeeze the device and then gave the dynamometer to the participants to do a couple of non-maximal tests on their own to see how the device would move and react. Participants were instructed to comfortably grip the device in whichever hand they preferred to start with and then squeeze as hard as possible. After getting the measurements from one hand, the participant was then instructed to switch hands and measurements were taken on the other hand. The maximum force this device can record is 200 pounds or 90 kilograms. The instrument records the highest force exerted from the participant. Participants completed three trials and an average score for each hands' grip strength was calculated. This measure had a statistically significant (p < .01) test-retest reliability over an eight-week period of .92.

Physical activity. Participants' level of physical activity was measured in terms of total steps walked, total number of aerobic minutes, total number of aerobic steps, total kilocalorie expenditure, and total distance walked (in miles) weekly using the OMRON HJ-323U pedometer (Omron, 2012). Although accuracy and reliability information on this specific model of pedometer is limited, this model had been chosen because previous versions of the Omron HJ pedometers (i.e. 113, 151, 303 and 720) have shown high reliability and predictive validity (Giannakidou et al., 2012; Holobrook et al., 2009; Steeves et al., 2011). Each participant wore a pedometer on his or her hip to track total steps, total aerobic minutes and total aerobic steps, total kilocalorie expenditure, and total distance (in miles) each day for seven consecutive days. In order to obtain accurate measurements of the recorded variables, the pedometer was calibrated using the participant's stride length, height, and weight.

For the purpose of this study we did not include aerobic steps or aerobic minutes because they are both conditional measures. They were only valid if people walked for at least 10 uninterrupted minutes or longer. Because we were working with a primarily sedentary population, walking 10 minutes uninterrupted may be a challenge for this population at first and therefore may not be a reliable measure. The test-retest reliability for average aerobic walking time ($r = .49$) was lower than the test-retest reliability scores for the other three measures we used in our study and further supports us not using the aerobic measurements. The three measures we used had significant test-retest reliability over an eight-week interval: Total number of steps ($r = .73$, $p < .01$), total kilocalorie expenditure ($r = .71$, $p < .01$), and total distance walked ($r = .77$, $p < .01$). Even though the three variables (total steps, total kilocalorie expenditure, and total distance) were highly inter-correlated, ranging from $r = .87$ to $r = .96$ at baseline and $r = .84$ to $r = .92$ for week 8, we decided not to create a linear composite of them. Because each variable has a unique metric which would make the linear composite difficult to interpret.

Procedure

This study applied a randomized pretest-posttest control group design with assessments at baseline (Week 0), Week 4 (i.e., immediate posttest), and Week 8 (i.e., posttest), respectively. This study examined between-group differences before and after the intervention was implemented. Additionally, because of the multiple time points, change over time as a result of the treatment was also be examined. After participants had been recruited for the study, they received a baseline questionnaire packet in the mail. They filled out the questionnaire packet on their own and returned it in person at the first group meeting.

After participants' eligibility had been determined, they were randomly assigned to either the treatment intervention (i.e., the AgingPlus program) or the active control intervention (i.e., a psychoeducational program on successful aging). Participants came in for a two-hour session which marked the start of the intervention component of the study. For the first hour, participants completed a standardized exercise training. Both conditions followed the same standardized exercise protocol throughout the first four weeks. The protocol for each group instructed participants to engage in a group warm-up (10-15 minutes) and then participants were familiarized with specific exercises: Week 1 – Circuits; Week 2 – Free weights; Week 3 – Cardio exercises; and Week 4 – Balance and postural stability. Each week the exercises were concluded with a group cool down of 10 minutes.

The education sessions consisted of four consecutive, weekly meetings that lasted one hour each and were held immediately after the exercise training. The meetings were held on Tuesdays for the treatment group and on Fridays for the control group from 4:00–6:00 pm. The meetings were done in a small-group format which consisted of 8-12 participants. The sessions of the AgingPlus group were led by a trained group facilitator, whereas the sessions of the control group were led by a master trainer who had developed the successful aging program. In the AgingPlus condition the participants learned about negative age stereotypes, myths of aging, and control beliefs. In the control condition, participants learned about the concept of successful aging and what successful aging looks like in the physical, cognitive and social relationships domain. An overview of the educational content for the intervention and control group is provided in Table 2. At the end of the first session, participants were fitted with a pedometer and instructed to wear it for one week. Similarly, participants were instructed on how to record their daily physical activity in an activity log. Participants filled out the daily activity log for the next week and returned it together with the pedometer, in Session 2. At the end of the last group meeting in Week 4, participants then completed again the same questionnaire packet they had completed before the start of the study (i.e., baseline assessment). They also wore a pedometer and filled out the daily activity log again for 7 days.

After the education portion, participants entered the experiential part of the study (Weeks 5-8). During this portion of the study, participants in the treatment group where asked to pursue the physical activity goal that they had defined for themselves in Week 3. To give participants additional practice in self-monitoring, they also filled out a daily activity log in which they recorded the type and duration of their physical activity, the exercise intensity, and how they felt during the exercise (i.e., mood rating). In addition, each participant received a weekly phone call during which he or she was asked about his or her physical activity over the past few days. During the phone call, participants also could talk about any obstacles encountered and how they perceived their progress toward goal achievement. Participants in the active control group also used a daily activity log to record their daily physical activity and received a weekly phone call just as a brief check-in but without any specific questions about their physical activity.

In Week 7, participants again wore a pedometer for 7 days to obtain objective data of their physical activity. The pedometer was returned in Week 8 when participants completed all the assessments again that they had completed at baseline and Week 4.

Statistical Analyses

For each of our analyses that included blood pressure as an outcome variable, participants (n = 27) who had normal blood pressure at baseline were not included because it was expected that involvement in PA would not show a significant effect for these individuals. Thus, in the analyses that included blood pressure as an outcome variable, data of a total of 93 participants were included. For the mediation analyses, change scores for self-efficacy beliefs, NVOA, and all the outcome variables were created to understand the effects that the change in self-efficacy beliefs and NVOA had on the change in the outcome variables. To create these change scores, week 0 scores were subtracted from Week 4 scores on the measures for NVOA and self-efficacy. To create the change scores for systolic and diastolic blood pressure, left- and right-hand grip strength, total steps walked, total kilocalorie expenditure, and total distance walked (in miles), week 0 scores were subtracted from week 8 scores on these measures. Additionally, because the MSE and VSE were significantly correlated at baseline ($r = .71$, $p < .01$) and at Week 4 ($r = .82$, $p < .01$), a linear composite was created as an indicator of participants overall self-efficacy beliefs.

To answer the first research question whether there were any differences between the treatment and the control group due to the treatment, three repeated measures multivariate analyses of variance (RM–MANOVAs) were conducted. Blood pressure (systolic and diastolic), hand-grip strength (left and right), and physical activity (total steps, total kilocalories, and total distance) measures from baseline and Week 8 assessments were the outcome variables for the

RM-MANOVAs examining the effects of the intervention on indicators of physical health, physical performance, and physical activity. We hypothesized that compared to baseline and compared to the control group, participants in the treatment group would show significantly lower levels of blood pressure and higher levels of hand-grip strength and physical activity. That is, we hypothesized a significant ($p < .05$) multivariate Condition × Occasion interaction.

To answer the second research question regarding the mediating effect of change in self-efficacy beliefs and change in NVOA on change in physical health, physical performance and physical activity, multiple mediator analyses were performed using the PROCESS Macro by Hayes (2018) and SPSS Version 25.0. Seven separate mediation analyses were performed using indicators of physical health (systolic and diastolic blood pressure), physical performance measures (left- and right-hand grip strength), and physical activity (total steps, total kilocalorie expenditure, and total distance) as the dependent variables. For the self-efficacy mediating variable, a change score was calculated by subtracting linear composite scores at Week 4 from Week 0 assessments. For the other mediating variable (i.e., NVOA), a change score was calculated by subtracting scores at Week 4 from Week 0 assessments. We hypothesized that change in self-efficacy beliefs and change in NVOA would be significant ($p < .05$) mediators of the effects of treatment on the outcome variables.

Results

Study findings are reported in two parts. In the first part, results from the repeated-measures multivariate analyses of variance (RM-MANOVAs) examining the changes in blood pressure, hand-grip strength, and physical activity, respectively, from pretest to posttest (Week 8) are reported. In the second part, results are reported from the multiple mediator analyses examining the mediating effect of change in self-efficacy and change in NVOA on change in physical health (i.e., systolic and diastolic blood pressure), physical performance (left- and right-hand grip strength), and indicators of physical activity (total steps, total kilocalorie expenditure, and total distance) are reported.

Repeated-Measures Analyses

Blood pressure analyses. To examine if participants who had elevated blood pressure showed significant changes from pretest to posttest (Week 8 follow-up) and to determine if these changes were significantly greater in the treatment group versus the control group, we performed a 2 Condition (treatment vs. control) × 2 Occasion (pretest vs. posttest) repeated-measures multivariate analysis of variance (RM-MANOVA). For all the following RM-MANOVAs, condition was a between-subjects factor, whereas occasion was a within-subjects factor. The dependent variables were participants' systolic and diastolic blood pressure readings at pretest and posttest. This analysis included 90 of the 120 study participants. The significance level was set at $\alpha = .05$.

Findings from the RM-MANOVA showed a non-significant Condition × Occasion interaction, Wilks' $\Lambda = .98$, $F(2, 87) = .82$, partial $\eta^2 = .019$, $p > .05$. This means that participants in the treatment group did not show significantly greater changes in systolic or diastolic blood pressure from pretest to posttest compared with participants in the control group.

The analysis, however, revealed a significant multivariate main effect of condition, Wilks' $\Lambda = .88$, $F(2, 87) = 5.90$, partial $\eta^2 = .120$, $p < .01$, and a significant multivariate main effect of occasion, Wilks' $\Lambda = .92$, $F(2, 87) = 3.80$, partial $\eta^2 = .080$, $p < .05$. This means that (a) there were significant differences in systolic and diastolic blood pressure between participants in the treatment vs. the control group and (b) participants in both groups showed similar significant changes in blood pressure from pretest to posttest. These findings are displayed in the profile plots shown in Figure 2 and Figure 3. The means and standard deviations for systolic and diastolic blood pressure variables are shown in Table 3 by condition and occasion of assessment.

Follow-up tests for the multivariate main effect of condition showed that both systolic and diastolic blood pressure contributed to this effect. For systolic blood pressure univariate $F(1, 88) = 7.82$, partial $\eta^2 = .082$, $p < .01$; for diastolic blood pressure univariate $F(1, 88) = 8.31$, partial $\eta^2 = .086$, $p < .01$. Despite random assignment, independent samples t-tests showed that participants in the control group had significantly lower systolic blood pressure at baseline, $t(88) = -2.84$, $p < .01$, $d = .603$, but not at the Week 8 posttest, $t(88) = -1.44$, $p > .05$, compared with the participants in the treatment group. For diastolic blood pressure, independent samples t-tests showed that participants in the control group had significantly lower diastolic blood pressure at baseline, $t(88) = -2.42$, $p < .05$, $d = .512$, but not at the Week 8 posttest, $t(88) = -1.64$, $p > .05$, compared with participants in the treatment group.

Follow-up tests for the multivariate main effect of occasion showed that both systolic and diastolic blood pressure contributed to this effect. For systolic blood pressure univariate $F(1, 88) = 5.41$, partial $\eta^2 = .058$, $p < .05$; for diastolic blood pressure univariate $F(1, 88) = 4.85$, partial $\eta^2 = .052$, $p < .05$. As can be seen in the profile plots in Figure 2 and Figure 3, participants in the treatment group showed significant decreases in systolic and diastolic blood pressure from baseline to Week 8 follow-up. Paired samples t-tests performed for the treatment group showed that both systolic, $t(45) = 2.41$, $p < .05$, $d = .432$, and diastolic blood pressure, $t(45) = 2.08$, $p < .05$, $d = .393$, were significantly lower at the Week 8 posttest compared to baseline. In contrast, paired samples t-tests performed for the control group showed that neither systolic, $t(43) = .79$, $p > .05$, nor diastolic blood pressure, $t(43) = 1.15$, $p > .05$, were significantly different at the Week 8 follow-up compared to baseline.

Hand-grip strength analyses. To examine if participants showed significant changes in hand grip strength from pretest to posttest (Week 8 follow-up) and to determine if these changes were significantly greater in the treatment group versus the control group, we performed a 2 Condition (treatment vs. control) × 2 Occasion (pretest vs. posttest) RM-MANOVA. The dependent variables were participants' left- and right-hand grip strength measurements at pretest and posttest. This analysis included 116 of the 120 study participants.

Findings from the RM-MANOVA showed a non-significant Condition × Occasion interaction, Wilks' $\Lambda = .98$, $F(2, 113) = 1.07$, partial $\eta^2 = .019$, $p > .05$. This means that participants in the treatment group did not show significantly greater changes in left- or right-hand grip strength from pretest to posttest compared with participants in the control group.

The analysis, however, revealed a significant multivariate main effect of occasion, Wilks' $\Lambda = .87$, $F(2, 113) = 8.13$, partial $\eta^2 = .126$, $p < .01$. This means that participants in both groups showed similar significant changes in hand grip strength from pretest to posttest. These findings are displayed in the profile plots shown in Figure 4 and Figure 5. There was no significant multivariate main effect of condition, Wilks' $\Lambda = .99$, $F(2, 113) = .70$, partial $\eta^2 = .012$, $p > .05$. This means that there were no significant differences in left- and right-hand grip strength between participants in the treatment vs. the control group. The means and standard deviations for left- and right-hand grip strength variables are shown in Table 4 by condition and occasion of assessment.

Follow-up tests for the multivariate main effect of occasion showed that both left- and right-hand grip strength contributed to this effect, univariate $F(1, 114) = 16.34$, partial $\eta^2 = .125$, $p < .01$, for left-hand grip strength and univariate $F(1, 114) = 9.45$, partial $\eta^2 = .077$, $p < .01$, for right-hand grip strength. As can be seen in the profile plots in Figure 4 and Figure 5, participants in the treatment group showed significant increases in left- and right-hand grip strength from baseline to Week 8 follow-up. Paired samples t-tests performed for the treatment group showed that left-hand grip strength, $t(55) = -4.11$, $p < .01$, $d = .204$, and right-hand grip strength, $t(55) = -3.51$, $p < .01$, $d = .148$, were significantly higher at the Week 8 posttest compared to baseline. In contrast, paired samples t-tests performed for the control group showed that neither left-hand grip strength, $t(59) = -1.76$, $p > .05$, nor right-hand grip strength, $t(59) = -1.18$, $p > .05$, were significantly different at the Week 8 posttest compared to baseline.

Physical activity analyses. To examine if participants showed significant changes in physical activity from pretest to posttest (Week 8 follow-up) and to determine if these changes were significantly greater in the treatment group versus the control group, we performed a 2 Condition (treatment vs. control) × 2 Occasion (pretest vs. posttest) repeated-measures multivariate analysis of variance (RM-MANOVA). The dependent variables were participants' total steps walked, total kilocalorie expenditure, and total distance walked at pretest and posttest. This analysis included 113 of the 120 study participants. The significance level was set at $\alpha = .05$.

Findings from the RM-MANOVA showed a non-significant Condition × Occasion interaction, Wilks' $\Lambda = .98$, $F(3, 109) = .88$, partial $\eta^2 = .024$, $p > .05$. This means that participants in the treatment group did not show significantly greater changes in total steps walked, total kilocalorie expenditure, and total distance walked from pretest to posttest compared with participants in the control group.

The analysis, however, revealed a significant multivariate main effect of condition, Wilks' $\Lambda = .88$, $F(3, 109) = 4.97$, partial $\eta^2 = .120$, $p < .01$, and a significant multivariate main effect of occasion, Wilks' $\Lambda = .867$, $F(3, 109) = 5.56$, partial $\eta^2 = .133$, $p < .05$. This means that (a) there were significant differences in total steps walked, total kilocalorie expenditure, and total distance walked between participants in the treatment vs. the control group and that (b) participants in both groups showed similar significant changes in physical activity from pretest to posttest. These findings are displayed in the profile plots shown in Figures 6 to 8. The means and standard deviations for total steps, total kilocalorie expenditure, and total distance variables are shown in Table 5 by condition and occasion of assessment.

Follow-up tests for the multivariate main effect of condition showed that total steps walked, total kilocalorie expenditure, and total distance walked contributed to this effect. For total steps walked, univariate $F(1, 111) = 6.50$, partial $\eta^2 = .055$, $p < .05$; for total kilocalorie expenditure, univariate $F(1, 111) = 6.35$, partial $\eta^2 = .054$, $p < .05$; for total distance walked, univariate $F(1, 111) = 10.604$, partial $\eta^2 = .087$, $p < .01$. Independent samples t-tests showed that participants in the control group had significantly fewer total steps walked at baseline, $t(111) = -2.58$, $p < .05$, $d = .482$, and at the Week 8 posttest, $t(111) = -2.22$, $p < .05$, $d = .416$, compared to the participants in the treatment group. For total kilocalorie expenditure, independent samples t-tests showed that participants in the control group had significantly lower kilocalorie expenditure at baseline, $t(111) = -2.27$, $p < .05$, $d = .397$, and at the Week 8 posttest, $t(111) = -2.41$, $p < .05$, $d = .451$, compared to participants in the treatment group. For total distance walked, independent samples t-tests showed that participants in the control group had walked a significantly shorter distance at baseline, $t(111) = -3.37$, $p < .01$, $d = .630$, and at the Week 8 posttest, $t(111) = -2.79$, $p < .01$, $d = .487$, compared to participants in the treatment group.

Follow-up tests for the multivariate main effect of occasion showed that total steps walked, total kilocalorie expenditure, and total distance walked contributed to this effect. For total steps walked, univariate $F(1, 111) = 13.44$, partial $\eta^2 = .108$, $p < .01$; for total kilocalorie expenditure, univariate $F(1, 111) = 16.78$, partial $\eta^2 = .131$, $p < .01$; for total distance walked, univariate $F(1, 111) = 12.80$, partial $\eta^2 = .103$, $p < .01$. As can be seen in the profile plots in Figures 6 to 8, participants in the treatment group and the control group showed significant increases in total steps walked, total kilocalorie expenditure, and total distance walked from baseline to Week 8 follow-up. Paired samples t-tests performed for the treatment group showed that total steps walked, $t(54) = -2.39$, $p < .05$, $d = .225$, total kilocalorie expenditure, $t(54) = -2.87$, $p < .01$, $d = .268$, and total distance walked $t(54) = -2.18$, $p < .05$ $d = .194$, were significantly higher at the Week 8 posttest compared to baseline. Similarly, paired samples t-tests performed for the control group showed that total steps walked, $t(57) = -2.87$, $p < .01$, $d = .311$, total kilocalorie expenditure, $t(57) = -2.96$, $p < .01$, $d = .336$, and total distance walked $t(57) = -3.02$, $p < .01$, $d = .328$, were significantly higher at the Week 8 posttest compared to baseline.

Multiple Mediator Analyses

To examine if the effect of the intervention on the physical health, physical performance, and physical activity outcome variables was mediated by changes in participants' self-efficacy beliefs and negative views of aging, multiple mediator models were performed separately for each outcome variable. Analyses were performed in SPSS 26.0 using the PROCESS macro provided by Hays (2018).

The findings from the mediation analyses for the two outcome variables assessing changes in physical health (i.e., systolic and diastolic blood pressure) are shown in Figures 9 and 10 and the corresponding estimates from the PROCESS output are shown in Tables 6 and 7. As can be seen in Figures 9 and 10 and the coefficients shown in Tables 6 and 7, for both physical health variables, no support was found for the mediation hypothesis. That is, the estimated coefficients for the mediating associations (i.e., a_1, a_2, b_1, and b_2) were all statistically non-significant, which also meant that their product terms ($a_1 \times b_1$ and $a_2 \times b_2$, respectively) were statistically non-significant. This means that changes in participants' self-efficacy beliefs and negative views of aging did not turn out to be significant mediators of the effects of the intervention on change in systolic and diastolic blood pressure.

Findings from the mediation analyses for the two outcome variables assessing changes in physical performance (i.e., left- and right-hand grip strength) are shown in Figures 11 and 12 and the corresponding estimates from the PROCESS output are shown in Tables 8 and 9. As can be seen in Figures 11 and 12 and the coefficients shown in Tables 8 and 9, for both physical performance variables, no support was found for the mediation hypothesis. That is, the estimated coefficients for the mediating associations (i.e., a_1, a_2, b_1, and b_2) were all statistically non-significant, which also meant that their product terms ($a_1 \times b_1$ and $a_2 \times b_2$, respectively) were statistically non-significant. This means that changes in participants' self-efficacy beliefs and negative views of aging did not turn out to be significant mediators of the effects of the intervention on change in left- and right-hand grip strength.

Finally, the findings from these analyses for the three outcome variables assessing changes in physical activity (i.e., change in total number of steps walked; change in total number of kilocalories burned; and change in total distance walked in miles) are shown in Figures 13 to

15 and the corresponding estimates from the PROCESS output are shown in Tables 10 to 12. As can be seen in Figures 13 to 15 and the coefficients shown in Tables 10 to 12, for all three physical activity variables, no support was found for the mediation hypothesis. That is, the estimated coefficients for the mediating associations (i.e., a_1, a_2, b_1, and b_2) were all statistically non-significant, which also meant that their product terms ($a_1 \times b_1$ and $a_2 \times b_2$, respectively) were statistically non-significant. This means that changes in participants' self-efficacy beliefs and negative views of aging did not turn out to be significant mediators of the effects of the intervention on change in total number of steps walked, change in total number of kilocalories burned, or change in total distance walked in miles.

Discussion

This pilot study compared the efficacy of the AgingPlus intervention in a sample of older adults to the efficacy of an active control group (i.e., generic program on successful aging). It was designed to increase participants' self-efficacy beliefs and decrease their negative views of aging (NVOA). Overall, the AgingPlus program was designed to increase physical activity, physical performance, and physical health. In the following sections, a summary of the findings from this study is provided. Next, these findings are related to the existing literature. Finally, there is a discussion on possible explanations for these current findings and limitations of the current study.

Summary of Findings

This study presents findings regarding physical health, physical performance, and physical activity differences between the intervention and control group in a sample of older adults. Specifically, participants' systolic and diastolic blood pressure were used as the indicators of physical health. For physical performance, measurements of participants' left- and right-hand grip strength were used. For physical activity measurements from participants' pedometers (total steps walked, total kilocalorie expenditure, and total distance walked) were used. Furthermore, the study examined whether the change in self-efficacy beliefs and change in NVOA induced by the intervention mediated the effect the intervention had on participants' change in physical activity, physical performance, and physical health.

With regards to the group differences (intervention vs. control), findings from the RM-MANOVAs showed that there were no significant group differences for changes in physical health, physical performance, or physical activity from baseline to the Week 8 follow-up. That is, both groups changed in very similar ways from baseline to Week 8 in terms of the outcome measures of physical health, physical performance, and physical activity. Thus, these findings did not support the hypothesized Condition × Occasion interactions and the expectation that participants in the AgingPlus group would benefit more from the intervention than participants in the control group. Even though there were not any significant interactions, there were significant main effects and follow-up analyses revealed meaningful differences between the treatment and control group.

Regarding systolic and diastolic blood pressure (BPS and BPD, respectively) as dependent variables, there was both a significant main effect of condition and a significant main effect of occasion. Considering the main effect of condition, follow-up t-tests revealed that although the control group had significantly lower BPS and BPD at baseline than the treatment group, there were no significant differences anymore between the groups at Week 8. Participants in the treatment group had lowered their BPS and BPD to the point of non-significant differences between the groups. This finding is especially noticeable for BPS (see Fig. 2). The main effect of occasion revealed that participants showed significant improvements in BPS and BPD from baseline to the Week 8 follow-up. Follow up t-tests showed that participants in the treatment group significantly lowered their BPS from 134.65 to 128.17 and significantly lowered their BPD from 84.09 to 80.87, whereas the same effect was not observed in the control group. These differences can be seen in Figures 16 and 17. In conclusion, there were significant improvements in BPS and BPD in the treatment group but not in the control group, which indicates an effect in the hypothesized direction. However, this effect was not sufficiently strong to result in a significant Condition × Occasion interaction.

Even though the hypothesized Condition × Occasion interaction was not supported by the data for physical performance (e.g., left- and right-hand grip strength), the analyses yielded a significant main effect of occasion, indicating that participants in both groups showed similar improvements in left- and right-hand grip strength from baseline to the Week 8 follow-up. Follow-up tests showed that improvements were significant in the treatment group, but not in the control group as can be seen in Figures 18 and 19. This finding suggests the treatment group had improved physical performance compared to the control group. Yet, the observed improvement did not rise enough to result in a significant Condition × Occasion interaction.

Regarding physical activity, there was a significant main effect of occasion and a significant main effect of condition. The main effect of condition indicated that participants in the control group had significantly lower levels of total steps walked, total kilocalorie expenditure, and total distance walked, compared to the treatment group at baseline and at the Week 8 follow-up. The main effect of occasion revealed that participants in both conditions showed statistically significant increases in total steps walked, total kilocalorie expenditure, and total distance walked from the baseline session to the Week-8 follow-up. Follow-up analyses showed that participants in the treatment group significantly increased their total steps walked from 39,033 to 44,191 (i.e., an increase of 5,158 steps) and participants in the control group also significantly increased their total steps walked from 30,468 to 35,226 (i.e., an increase of 4,758 steps; see Fig. 20). Similarly, participants in both the treatment and control group increased their total kilocalorie expenditure from 789 to 991 and from 542 to 694, respectively (see Fig. 21). Additionally, participants in the treatment and control group also significantly increased the total distance walked from 16.1 to 18 miles per week (i.e., an increase of 1.9 miles) and from 11.3 to 13.1 miles per week (i.e., an increase of 1.8 miles), respectively (see Fig. 22).

With regards to the mediation analyses, findings indicated that change in NVOA and change in self-efficacy beliefs did not significantly mediate the association between the intervention and the outcome measures of physical health, physical performance, or physical activity. This means the relationship through which the intervention changed physical health, physical performance, and physical activity cannot be explained by changes in NVOA or by changes in self-efficacy beliefs like we had hypothesized.

Relationship of Findings to Existing Literature

Previous research shows that effective intervention programs that promote cognitive and behavioral change focus on reframing negative thoughts and getting rid of negative misconceptions about aging (King, 2001; Lachman 2018). The AgingPlus intervention focused on teaching participants about the many dangers of NVOA and how they can identify and counteract NVOA in order to age in a healthy way (Brothers & Diehl, 2017). Participants in the AgingPlus program did increase their physical activity similar to participants in the study by Brothers and Diehl (2017). However, the Brothers and Diehl (2017) study only used measures of self-reported physical activity whereas in this study we had objective measures of physical activity from pedometer readings. This makes these findings stronger in supporting the efficacy of the AgingPlus program for promoting physical activity in older adults.

Although the original hypothesis of a significant Condition × Occasion interaction was not supported by the data, the results still obtained interesting and promising occasion main effects. On average, participants had significantly improved on objective measures of physical health, physical performance, and physical activity as assessed in terms of blood pressure, hand-grip strength, total steps walked, total kilocalorie expenditure, and total distance walked. This is consistent with findings of a study by Beyer et al. (2019) where they found that participants' self-perceptions of aging changed in the intervention but not the control group and that both groups showed an improvement in physical performance. In the present study, the physical activity outcome measures showed a similar pattern where both the treatment and control group had increased levels at the Week-8 follow-up. Our study reveals that significant improvements in physical performance and physical health occurred only in the treatment group and not in the control group. This result is different from the pattern of findings reported by Beyer et al. (2019) in which both participants in the treatment and the control groups improved their physical performance. This suggests that the treatment program targeting NVOA and self-efficacy beliefs may have been, in general, more effective than the generic program in the control group, but that this difference was not strong enough to result in a significant Condition × Occasion interaction. This conclusion seems also justified based on the fact that the observed power for the present study was in the lower range for finding a Condition × Occasion interaction for a small effect size if it existed.

The findings from the mediation analyses suggest that change in NVOA and change in self-efficacy beliefs were not significant mediators of the effects of the intervention on the outcome measures. In a study by Wolff et al. (2014) the researchers found that change in attitudes towards older adults mediated the effect on change in physical activity. Therefore, the findings from this study are not consistent with the results reported by Wolff et al. (2014). An important distinction to note between these two studies is that the present study measured physical activity four weeks after the intervention occurred whereas the study by Wolff et al, (2014) measured physical activity seven months after the intervention. Wolff et al. (2014) also measured attitudes towards aging multiple times after the intervention took place over the course of seven months. Thus, it may be possible that the effects observed in the Wolff et al. (2014) study represented delayed effects of change in NVOA and self-efficacy beliefs that were not detectable at the Week 4 follow-up when we assessed participants' NVOA and self-efficacy beliefs. A longer experiential period and follow-up may be needed to let changes in NVOA and self-efficacy beliefs become manifested in a more solid way as suggested by the findings from the Wolff et al., (2014) study. To summarize, changes in the mediators and dependent variables in the present study may not have been detected in the study due to the short duration of the assessments.

Overall, the behavior change literature clearly shows a relationship between self-efficacy beliefs and success in behavior change interventions, suggesting that higher levels of self-efficacy are related to increased success in behavioral change interventions (Luszczynska, 2004; Scholz et al., 2005; Schwarzer et al., 2011). The research also shows a clear relationship between more NVOA and poorer health outcomes (Levy, 2009; Stewart et al., 2012). Our research found that participants in the AgingPlus conditions had significant decreases in blood pressure, increases in hand-grip strength, and increased total steps walked, total kilocalorie expenditure, and total distance walked. This pattern of results suggests that targeting NVOA and self-efficacy may be an effective strategy for promoting physical health, physical performance, and physical activity for older adults. However, there were several limitations in our project that may have prevented us from detecting statistically significant mediation. These limitations will be discussed next.

Limitations

Even though we did not find a significant Condition × Occasion interaction for any of the dependent variables, follow-up t-tests indicated that participants in the AgingPlus group did, on average, improve their physical performance and physical health whereas those in the control group did not or to a lesser extent. This suggests, in a tentative way, that the AgingPlus program may have been more effective than the control group at promoting healthy aging. However, the current study may not have had enough statistical power to detect this interaction, especially for lower effect sizes.

Aside from statistical power, there are several other reasons why the effect of the AgingPlus program may not have been as strong as expected. First, for this pilot study, we had reduced the AgingPlus program from a 2-hour program per week to a 1-hour program. This condensation of the program may have reduced the impact of the program because there was less time for group discussions and less time to learn and practice the exercises in the group setting, thus limiting the potential impact of the program. Specifically, this condensing of the program may have made it harder for participants to internalize the content of the program as well as the instructions for the exercise. Additionally, the content of the active control group had been delivered by an enthusiastic master trainer and this person may have inadvertently motivated the participants in the control group more than is usually intended for a control group. The overall purpose of the control group had been to primarily control for the amount of social contact, but both the style of delivery and the class content may have motivated participants in an unintended and unexpected way. This leaves the question open if multiple pathways are possible.

Another limitation of this study is the short time frame in which the intervention occurred, namely a total of 4 weeks. This could help to explain the reason that neither of our specific hypotheses were supported. There may have been a delayed effect of the intervention that was not detectable at the Week 4 and Week 8 follow-up but may have been detectable 6 months after the intervention. We simply do not know. For example, the intervention may actually have increased participants physical health, physical performance, and physical activity over the course of 6 months in ways the control intervention did not, because improvements in NVOA and their self-efficacy beliefs may take longer to manifest in behavioral changes. If researchers were to examine the delayed effects of the intervention, they may find a meaningful interaction between the type of intervention and the dependent variables. Such sleeper effects have been found in other research (Kumkale & Albarracín, 2004; Foos et al., 2016) and it is reasonable to assume that they also may exist in our area of research. Future research may want to examine any delayed effects that can occur in behavior change intervention research. This may help to explain the null findings from this study and inform future research on practical and efficacious ways to study behavior change interventions.

Another possible explanation for the findings in this study is that we may not have had a strong enough dose to effectively change participants' self-efficacy beliefs and NVOA. Because these are both constructs that are related to individuals' deep-rooted beliefs and concepts of self that are formed throughout life, a 4-week, 1-hour long intervention may simply not be a strong enough dose to effectively change these constructs. In the feasibility study of the AgingPlus program, participants received a 4-week, 2-hours per week intervention (Brothers & Diehl, 2017), whereas the participants in the present study received half of that dose (i.e. 4-hours total) over the same 4-week interval. This reduction in "dosage" may have further limited the possibility of finding the intended effects. For example, in the study by Beyer et al. (2019) participants in the intervention condition received information over the course of a 12-week intervention program for 30 minutes each week. Thus, both comparison studies (Brothers & Diehl, 2017; Beyer et al., 2019) incorporated longer total times of the intervention compared to the present study. It may be that a larger dose (e.g., two-hours over more than 4 weeks) of the intervention is needed to more effectively change adults' NVOA and self-efficacy beliefs in a lasting way. Similarly, adults who participate in interventions such as the AgingPlus program may also need a longer period of time to practice their new behavior and to experience that they can be successful so that the new experiences can feed back into their NVOA and their self-efficacy beliefs.

Conclusion

The AgingPlus intervention targeted NVOA and self-efficacy beliefs in a behavioral change intervention for older adults. The data did not support the hypothesized Treatment Occasion interaction with regard to the key outcome variables, or the hypothesized mediation via NVOA and self-efficacy beliefs.

However, findings showed that participants in the AgingPlus condition had significantly decreased their blood pressure and significantly increased their hand-grip strength over the eight week interval. For participants in the treatment condition both systolic and diastolic blood pressure were lower at the follow-up assessment compared to the baseline assessment. Similarly, for participants in the treatment group both left- and right-hand grip strength was increased at the follow-up assessment compared to the baseline assessment. In comparison, the participants in the control group did not significantly change their blood-pressure or hand-grip strength. These findings suggest that the AgingPlus intervention may be effective for promoting physical health, physical performance, and physical activity.

Tables

Table 1

Demographic Information (N = 120)

Variable	***M (SD)***
Education (in years)	17.45 (2.45)
Subjective health	4.82 (.83)
Subjective vision	4.31 (.95)
Subjective hearing	4.57 (.97)
Ethnicity/ Race	**Number (%)**
White	108 (90)
African American	3 (2.5)
Asian American	1 (.8)
Hispanic	7 (5.8)
Other	1 (.8)
Marital Status	
Married/Committed Partnership	81 (67.5)
Non-Married	39 (32.5)
Occupational Status	58 (48.3)
Employed full-time	12 (10.0)
Employed part-time	3 (2.5)
Pursuing a second career	41(34.2)
Retired	6 (5.0)
Unemployed	

Note. Scores for the subjective ratings of health, vision, and hearing ranged from 1-6 with 1 = 'Poor' and 6 = 'Very Good.'

Table 2

Description of the Training Group and Control Group Content

	Aging^{PLUS} **Training Group:** **Changing Negative Views of aging**	**Control Group:** **Successful Aging in the 21**st **Century**
Week #1	• The nature and effects of negative views of aging • The nature and effects of and age stereotypes • Misconceptions/myths about normal aging • Effects of negative self-stereotyping • Immunization against negative self-stereotyping • Homework: Stereotype Watch	• Global population aging • Normal vs. pathological vs. successful aging • What is successful aging? • Reasons why it is meaningful to talk about successful aging? • Successful aging has not only to do with health
Week #2	• What does research tell us about normal aging? • Aging and the plasticity of human behavior • Taking control: It is never too late to make a change • How can we take control? • Homework: Stereotype Watch	• Successful aging in the physical domain • The role of lifestyle factors • The role of physical activity • The role of healthy eating • Psychosocial stress and stress management
Week #3	• The benefits of physical exercise • Physical and mental health benefits • How much physical exercise is needed? • What kind of exercise is most beneficial? • Homework: Stereotype Watch	• Successful aging in the cognitive domain • What are normal age-related changes in cognition? • The aging of human memory • The aging of human intelligence • Findings from intervention research on cognitive aging
Week #4	• How to start being more physically active? • How to set a goal? • How to pursue and achieve a goal? • How to be physically active in the long run? • Graduation from the Aging^{PLUS} program	• Successful aging and engagement with life • Leading an active, engaged, and meaningful life • The importance of meaningful social relationships • Giving is better than receiving: The many benefits of volunteering • Older adults as a "natural resource" in the community

Table 3

Means and Standard Deviations for Systolic and Diastolic Blood Pressure by Condition and Occasion of Measurement

	Occasion of Measurement							
	Baseline-SBP		Week 8-SBP		Baseline-DBP		Week 8-DBP	
Condition	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Treatment (n = 46)	134.65	17.26	128.17	12.32	84.09	8.92	80.87	7.40
Control (n = 44)	126.14	10.04	124.27	13.35	80.14	6.29	77.86	9.84

Table 4

Means and Standard Deviations for Left- and Right-Hand Grip Strength by Condition and Occasion of Measurement

	Occasion of Measurement							
	Baseline-LHGS		Week 8-LHGS		Baseline-RHGS		Week 8-RHGS	
Condition	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Treatment (*n* = 56)	57.12	16.57	60.58	17.38	61.25	18.22	63.94	18.21
Control (*n* = 60)	56.63	15.56	58.27	15.81	59.48	16.33	60.62	15.41

Table 5

Means and Standard Deviations for Total Steps, Total Kilocalorie Expenditure, and Total Distance Walked (in miles) by Condition and Occasion of Measurement

	Occasion of Measurement							
	Baseline-Total Steps		Week 8-Total Steps		Baseline-Total Kilocalorie		Week 8-Total Kilocalorie	
Condition	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Treatment (*n* = 55)	39,032.85	21,442.78	44,191.36	24,240.0	789.35	721.98	991.45	785.34
Control (*n* = 58)	30,648.45	12,067.29	35,360.66	17,714.28	542.09	397.62	694.27	502.41

	Baseline-Total Distance		Week 8-Total Distance	
Condition	*M*	*SD*	*M*	*SD*
Treatment (*n* = 55)	16.07	9.52	17.99	10.27
Control (*n* = 58)	11.35	4.64	13.35	7.25

Table 6

Regression Coefficients, Standard Errors, and Model Summary Information for the Multiple Mediator Model Examining the Effect of the Intervention on Change in Systolic Blood Pressure.

		Consequent Variable										
		M_1: Change in SE				M_2: Change in NVOA				DV: Change in Systolic Blood Pressure		
Predictor Variable		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
Constant	i_{M1}	0.448	0.111	< .001	i_{M2}	2.142	0.710	< .01	i_Y	1.542	2.320	.508
X: Condition	a_1	0.159	0.159	.320	a_2	0.192	1.013	.850	c’	-5.380	3.040	.080
M_1: Change in SE		----	----	----		----	----	----	b_1	-2.393	1.822	.192
M_2: Change in NVOA		----	----	----		----	----	----	b_2	0.232	0.286	.419
	$R^2 = .009$ $F(1, 112) = 0.999, p = .320$				$R^2 = .000$ $F(1, 112) = 0.036, p = .850$				$R^2 = .049$ $F(3, 110) = 1.887, p = .136$			

Note. $N = 114$. SE = Self-efficacy beliefs; NVOA = Negative views of aging.

Table 7

Regression Coefficients, Standard Errors, and Model Summary Information for the Multiple Mediator Model Examining the Effect of the Intervention on Change in Diastolic Blood Pressure.

		Consequent Variable										
		M_1: Change in SE				M_2: Change in NVOA				DV: Change in Systolic Blood Pressure		
Predictor Variable		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
Constant	i_{M1}	0.448	0.111	< .001	i_{M2}	2.142	0.710	< .01	i_Y	-0.717	1.618	.659
X: Condition	a_1	0.159	0.159	.320	a_2	0.192	1.013	.850	c’	-2.487	2.120	.243
M_1: Change in SE		----	----	----		----	----	----	b_1	2.483	1.271	.053
M_2: Change in NVOA		----	----	----		----	----	----	b_2	-0.314	0.199	.119
	$R^2 = .009$ $F(1, 112) = 0.999, p = .320$				$R^2 = .000$ $F(1, 112) = 0.036, p = .850$				$R^2 = .056$ $F(3, 110) = 2.163, p = .097$			

Note. N = 114. SE = Self-efficacy beliefs; NVOA = Negative views of aging.

Table 8

Regression Coefficients, Standard Errors, and Model Summary Information for the Multiple Mediator Model Examining the Effect of the Intervention on Change in Left-hand Grip Strength.

		Consequent Variable									
		M_1: Change in SE				M_2: Change in NVOA				DV: Change in Left-Hand Grip Strength		
Predictor Variable		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
Constant	i_{M1}	0.448	0.111	< .001	i_{M2}	2.142	0.710	< .01	i_Y	1.609	0.993	.108
X: Condition	a_1	0.159	0.159	.320	a_2	0.192	1.013	.850	c’	1.772	1.301	.176
M_1: Change in SE		----	----	----		----	----	----	b_1	-.130	0.780	.897
M_2: Change in NVOA		----	----	----		----	----	----	b_2	.063	0.122	.610
	$R^2 = .009$ $F(1, 112) = 1.000$, $p = .320$				$R^2 = .000$ $F(1, 112) = 0.036$, $p = .850$				$R^2 = .019$ $F(3, 110) = 0.709$, $p = .549$			

Note. $N = 114$. SE = Self-efficacy beliefs; NVOA = Negative views of aging.

Table 9

Regression Coefficients, Standard Errors, and Model Summary Information for the Multiple Mediator Model Examining the Effect of the Intervention on Change in Right-hand Grip Strength.

	Consequent Variable											
		M_1: Change in SE				M_2: Change in NVOA				DV: Change in Right-Hand Grip Strength		
Predictor Variable		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
Constant	i_{M1}	0.448	0.111	< .001	i_{M2}	2.142	0.710	< .01	i_Y	0.928	0.970	.341
X: Condition	a_1	0.159	0.159	.320	a_2	0.192	1.013	.850	c'	1.805	1.271	.158
M_1: Change in SE		----	----	----		----	----	----	b_1	-0.368	0.762	.631
M_2: Change in NVOA		----	----	----		----	----	----	b_2	0.077	0.120	.512
	$R^2 = .009$ $F(1, 112) = 1.000, p = .320$				$R^2 = .000$ $F(1, 112) = 0.036, p = .850$				$R^2 = .023$ $F(3, 110) = 0.836, p = .477$			

Note. $N = 114$. SE = Self-efficacy beliefs; NVOA = Negative views of aging.

Table 10

Regression Coefficients, Standard Errors, and Model Summary Information for the Multiple Mediator Model Examining the Effect of the Intervention on Change in Total Number of Steps.

		Consequent Variable									
		M_1: Change in SE				M_2: Change in NVOA				DV: Change in Total Steps		
Predictor Variable		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
Constant	i_{M1}	0.439	0.113	< .001	i_{M2}	2.020	0.717	< .01	i_Y	4243.891	2078.435	< .05
X: Condition	a_1	0.161	0.161	.319	a_2	0.327	1.024	.750	c'	668.914	2740.210	.808
M_1: Change in SE		----	----	----		----	----	----	b_1	341.951	1631.148	.834
M_2: Change in NVOA		----	----	----		----	----	----	b_2	17.271	257.141	.947
	$R^2 = .009$ $F(1, 110) = 1.000, p = .319$				$R^2 = .001$ $F(1, 110) = 0.102, p = .750$				$R^2 = .001$ $F(3, 108) = 3.000, p = .986$			

Note. $N = 112$. SE = Self-efficacy beliefs; NVOA = Negative views of aging.

Table 11

Regression Coefficients, Standard Errors, and Model Summary Information for the Multiple Mediator Model Examining the Effect of the Intervention on Change in Total Kilocalorie Expenditure.

		Consequent Variable										
		M_1: Change in SE				M_2: Change in NVOA				DV: Change in Total Kilocalorie Expenditure		
Predictor Variable		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
Constant	i_{M1}	0.435	0.115	< .001	i_{M2}	1.983	0.727	< .01	i_Y	147.338	67.536	< .05
X: Condition	a_1	0.166	0.163	.312	a_2	0.364	1.032	.725	c’	61.800	88.937	.489
M_1: Change in SE		----	----	----		----	----	----	b_1	-14.497	52.708	.784
M_2: Change in NVOA		----	----	----		----	----	----	b_2	0.708	8.312	.932
	$R^2 = .009$ $F(1, 109) = 1.034, p = .312$				$R^2 = .001$ $F(1, 109) = 0.125, p = .725$				$R^2 = .005$ $F(3, 107) = 0.177, p = .912$			

Note. $N = 111$. SE = Self-efficacy beliefs; NVOA = Negative views of aging.

Table 12

Regression Coefficients, Standard Errors, and Model Summary Information for the Multiple Mediator Model Examining the Effect of the Intervention on Change in Total Distance Walked in Miles.

		Consequent Variable								
		M_1: Change in SE			M_2: Change in NVOA			DV: Change in Total Distance		
Predictor Variable		Coeff.	*SE*	*p*	Coeff.	*SE*	*p*	Coeff.	*SE*	*p*
Constant	i_{M1}	0.436	0.108	< .001	i_{M2} 2.138	0.713	< .01	i_Y 1.176	0.878	.183
X: Condition	a_1	0.170	0.154	.271	a_2 0.413	1.017	.685	c' 0.325	1.153	.779
M_1: Change in SE		----	----	----	----	----	----	b_1 0.219	0.701	.775
M_2: Change in NVOA		----	----	----	----	----	----	b_2 -0.049	0.106	.644
		R^2 = .010 $F(1, 116) = 1.225$, p = .271			R^2 = .001 $F(1, 116) = 0.165$, p = .685			R^2 = .003 $F(3, 114) = 0.121$, p = .948		

Note. N = 118. SE = Self-efficacy beliefs; NVOA = Negative views of aging.

Figures

Figure 1

Conceptual Mediation Model for Hypothesis 2

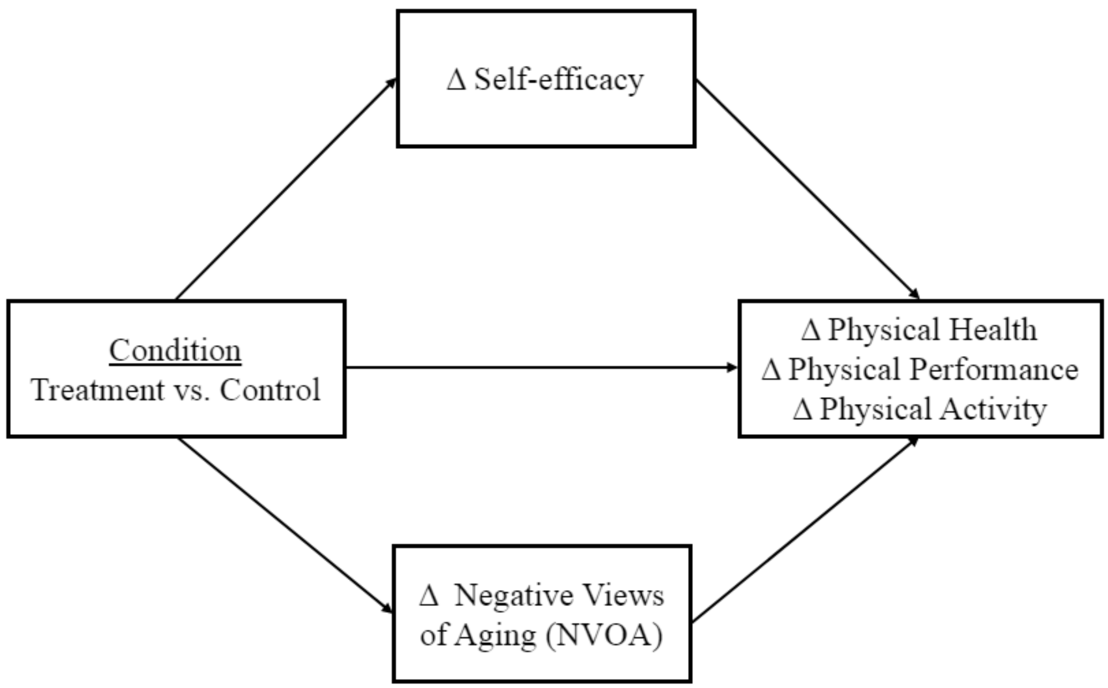


Figure 2

Systolic Blood Pressure at Baseline and Week 8 Assessments

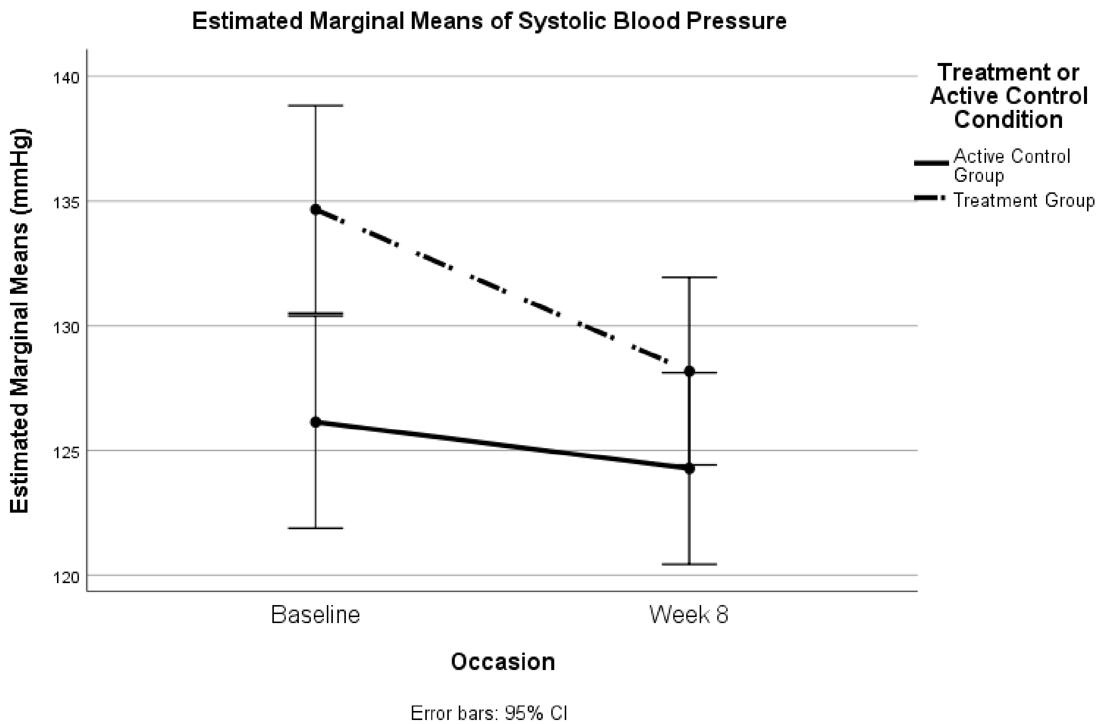


Figure 3

Diastolic Blood Pressure at Baseline and Week 8 Assessments

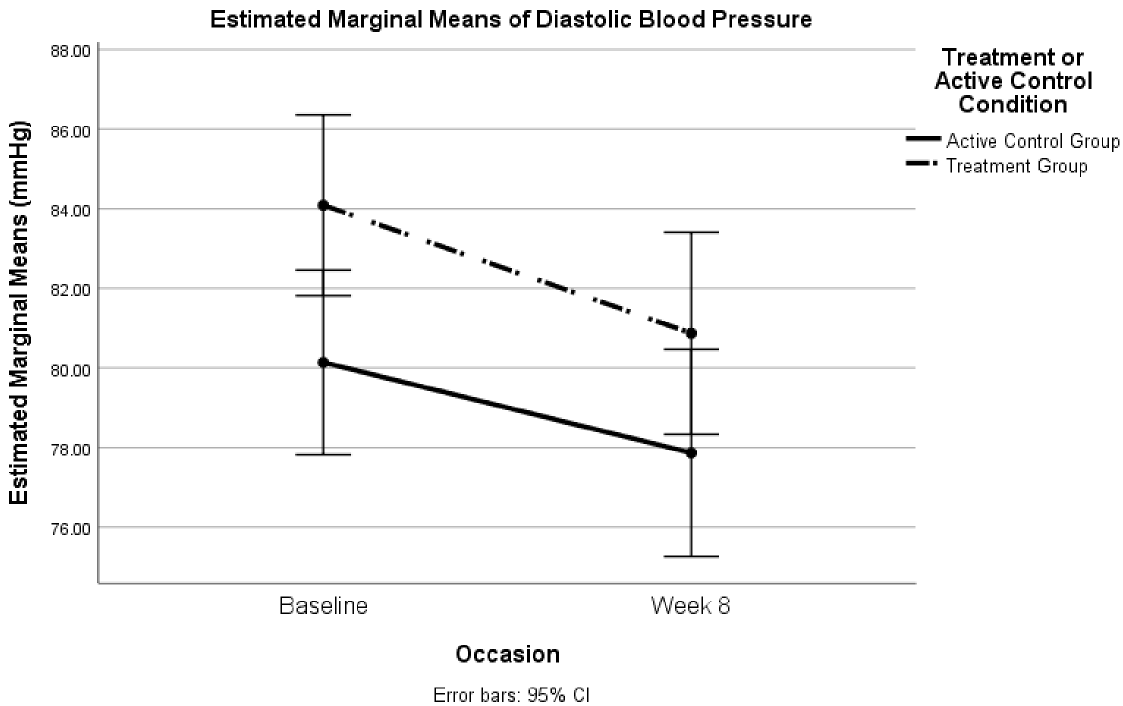


Figure 4

Left-hand Grip Strength at Baseline and Week 8 Assessments

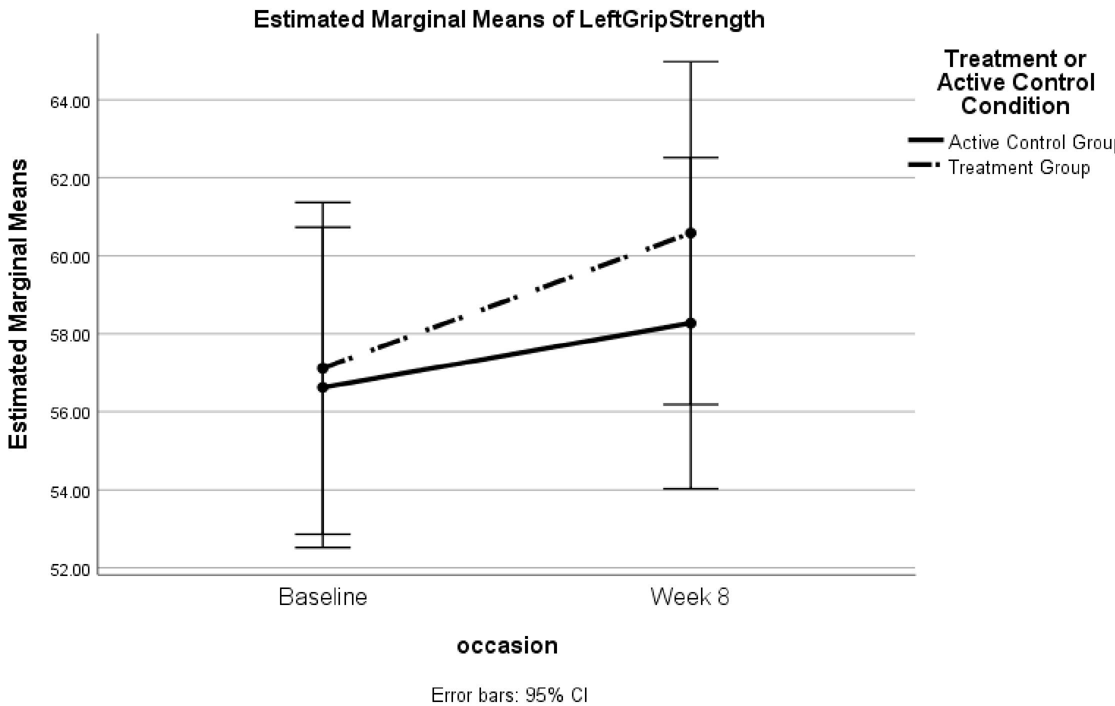


Figure 5

Right-hand Grip Strength at Baseline and Week 8 Assessments

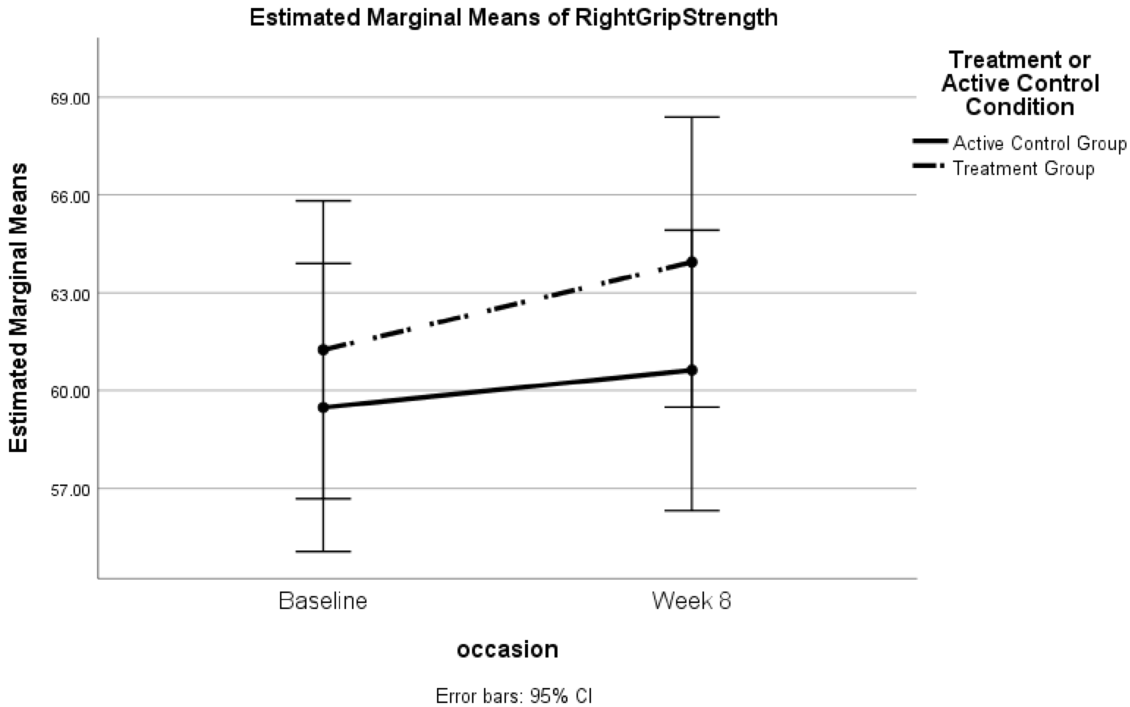


Figure 6

Total Steps at Baseline and Week 8 Assessments

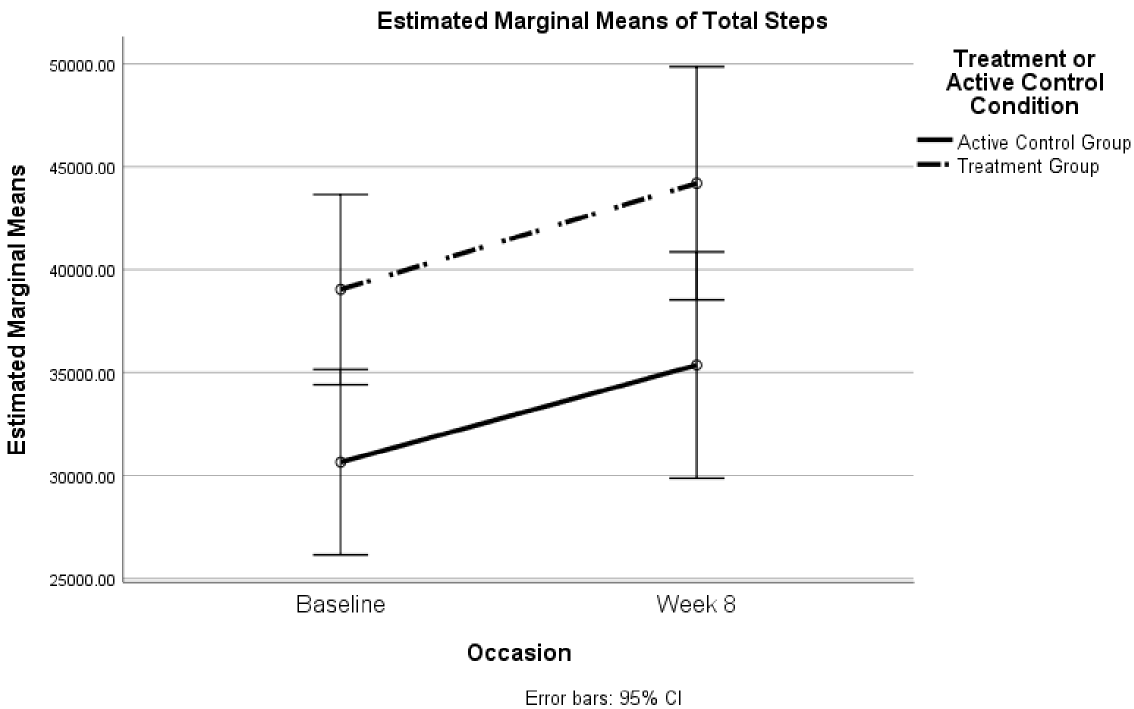


Figure 7

Total Kilocalorie Expenditure at Baseline and Week 8 Assessments

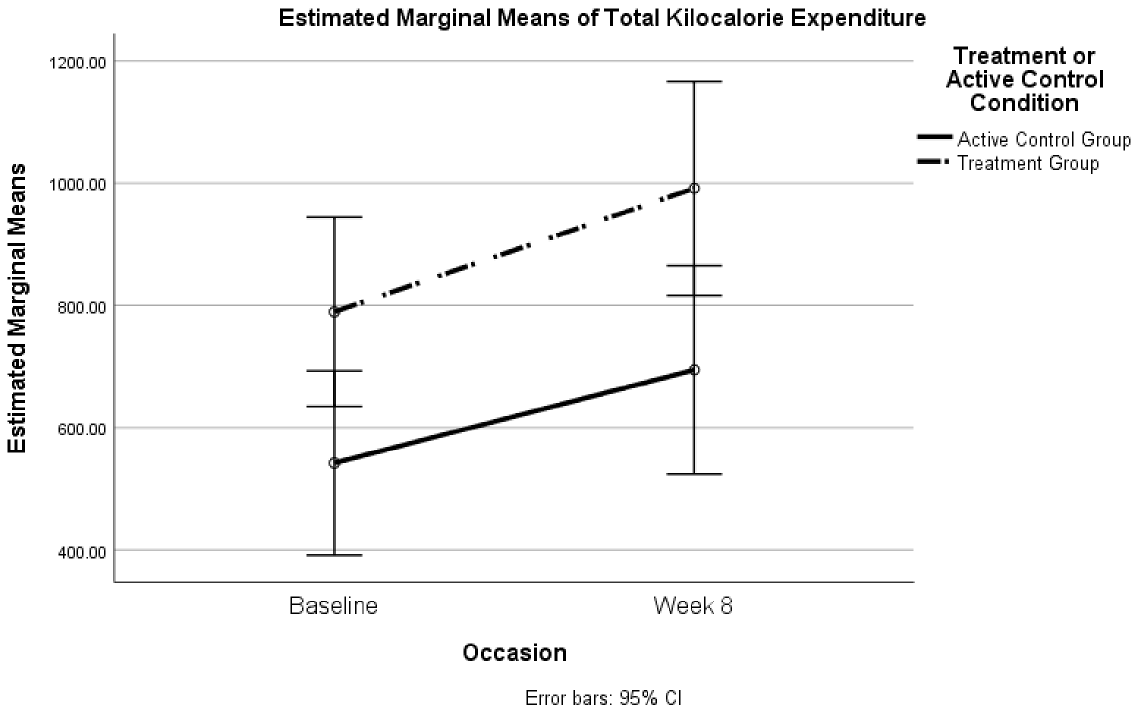


Figure 8

Total Distance (miles) at Baseline and Week 8 Assessments

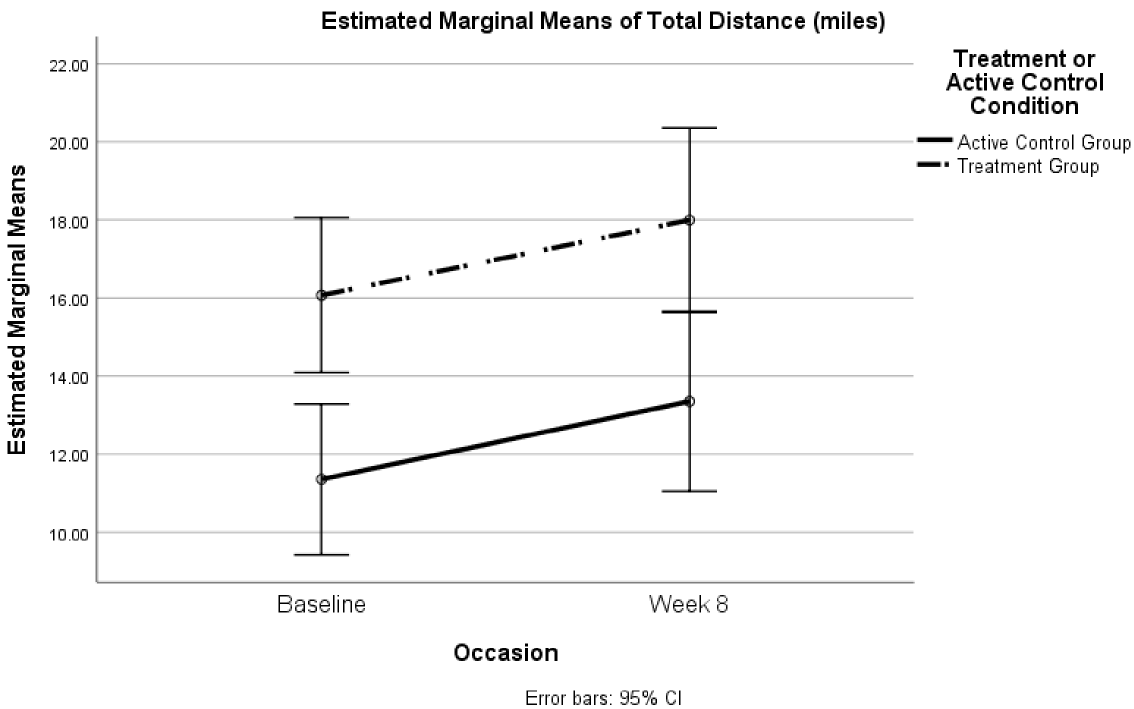


Figure 9

Correlation coefficients for mediation model with change in systolic blood pressure as the dependent variable.

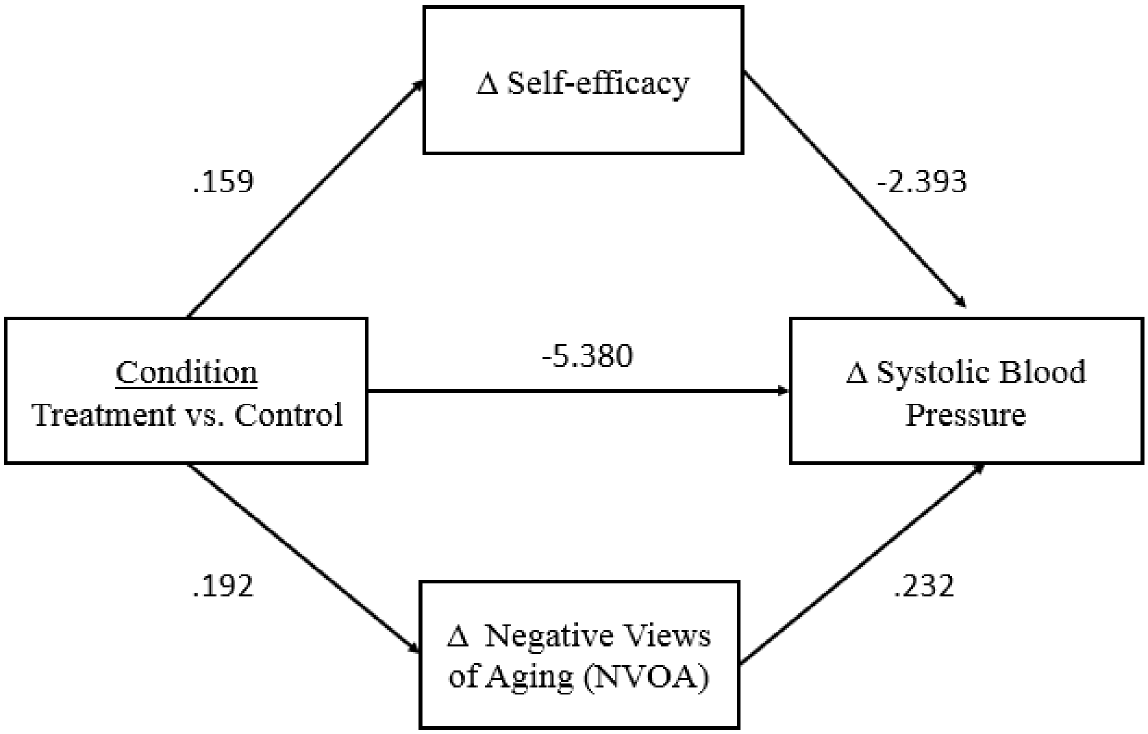


Figure 10

Correlation coefficients for mediation model with change in diastolic blood pressure as the dependent variable.

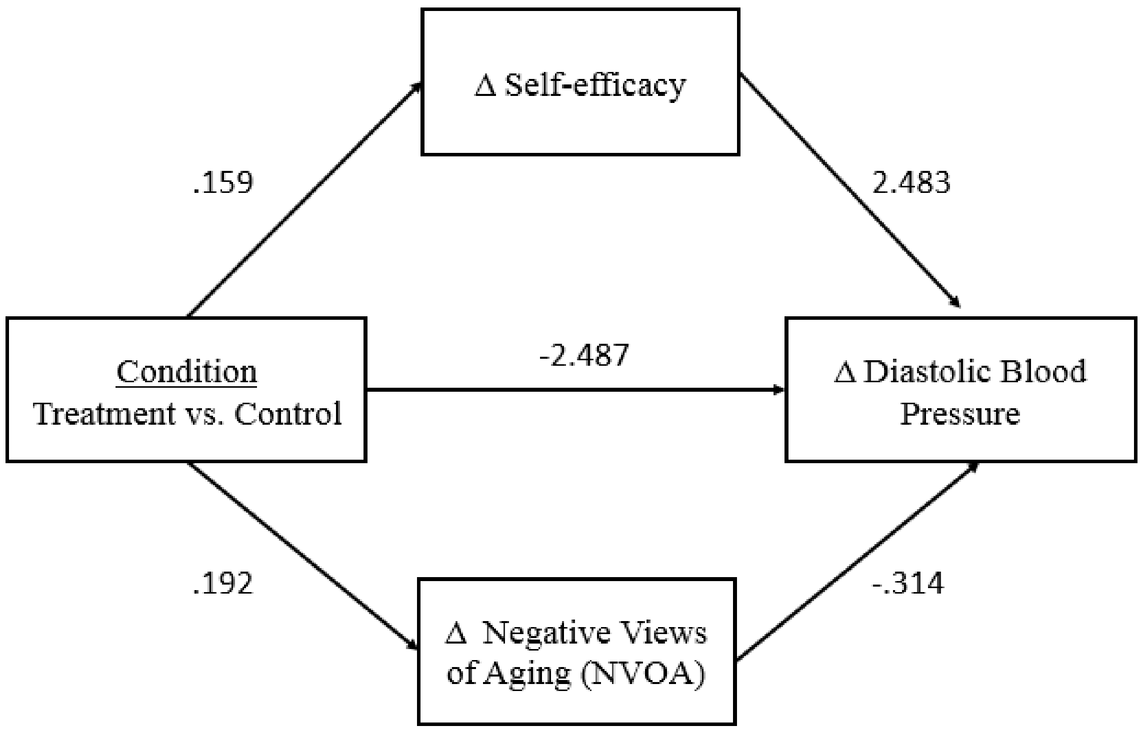


Figure 11

Correlation coefficients for mediation model with change in left-hand grip strength as the dependent variable.

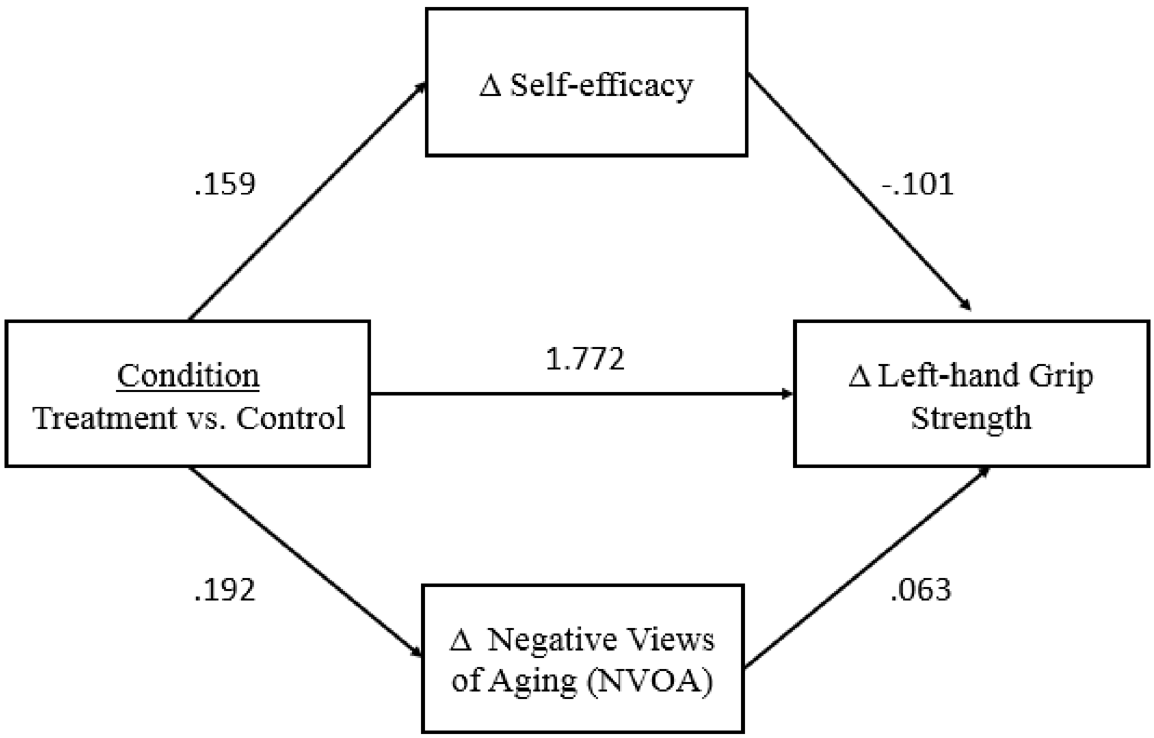


Figure 12

Correlation coefficients for mediation model with change in right-hand grip strength as the dependent variable.

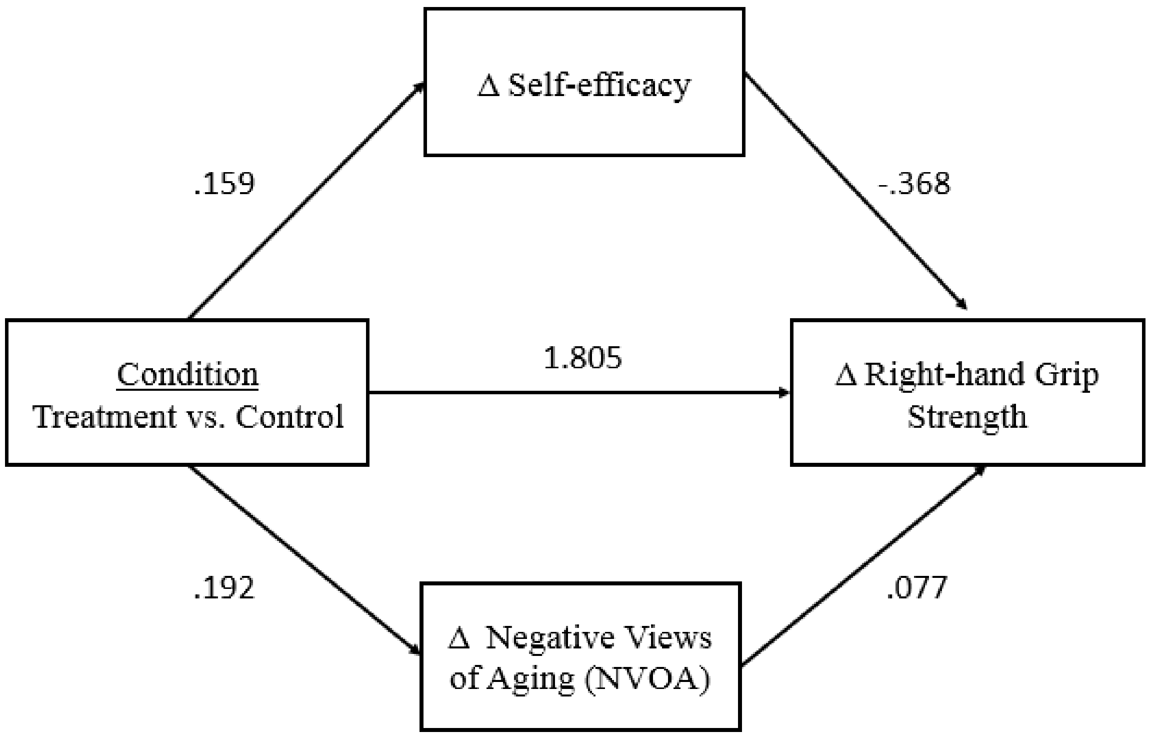


Figure 13

Correlation coefficients for mediation model with change in total number of steps walked as the dependent variable.

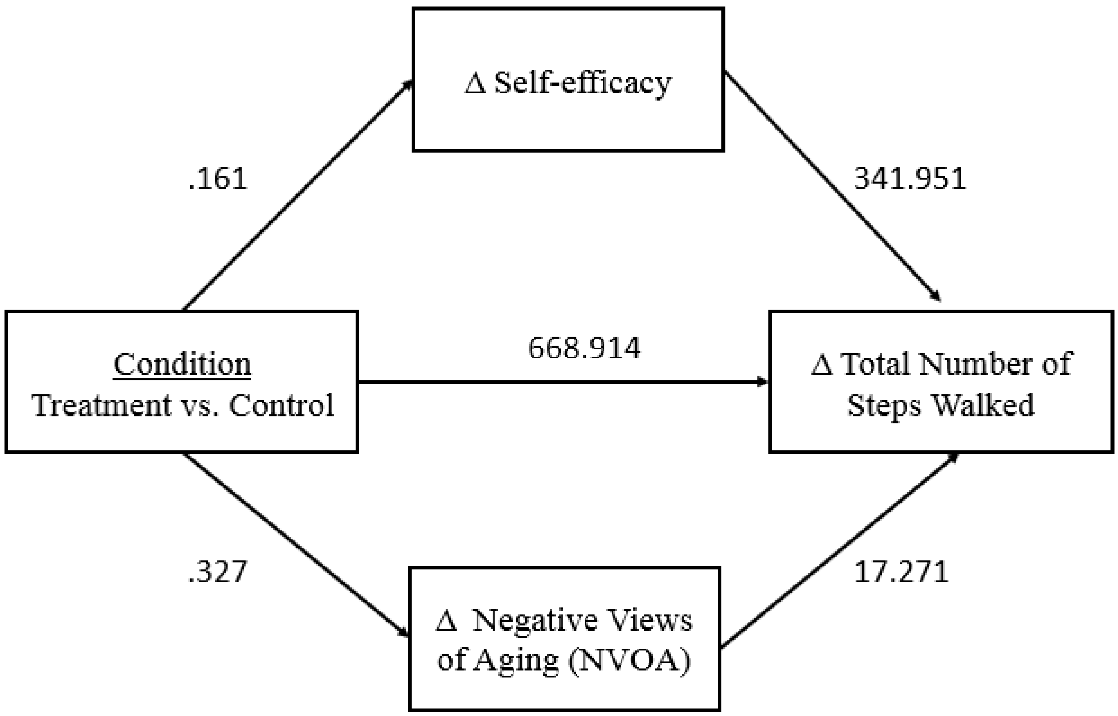


Figure 14

Correlation coefficients for mediation model with change in total kilocalorie expenditure as the dependent variable.

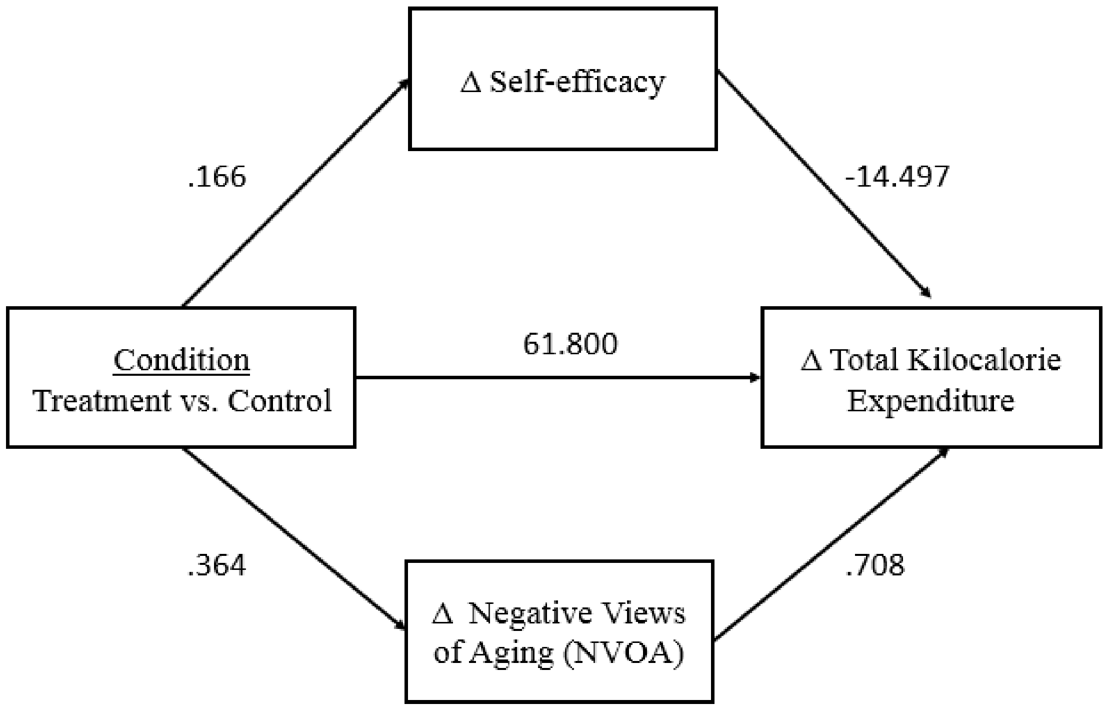


Figure 15

Correlation coefficients for mediation model with change in total distance walked as the dependent variable.

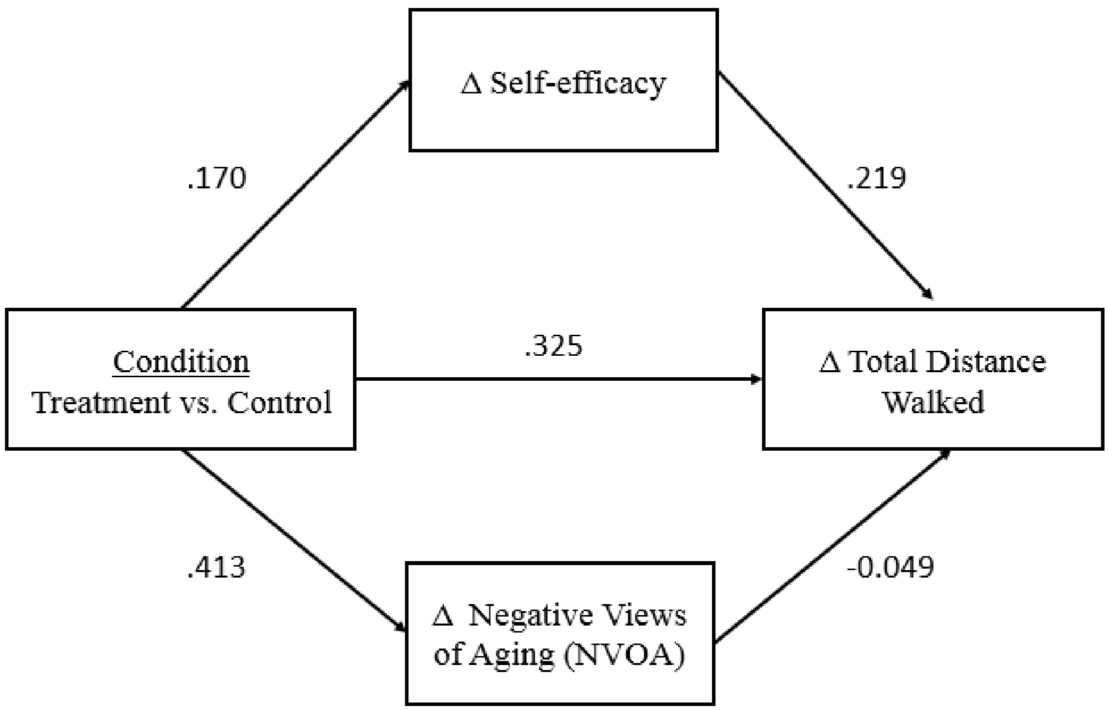
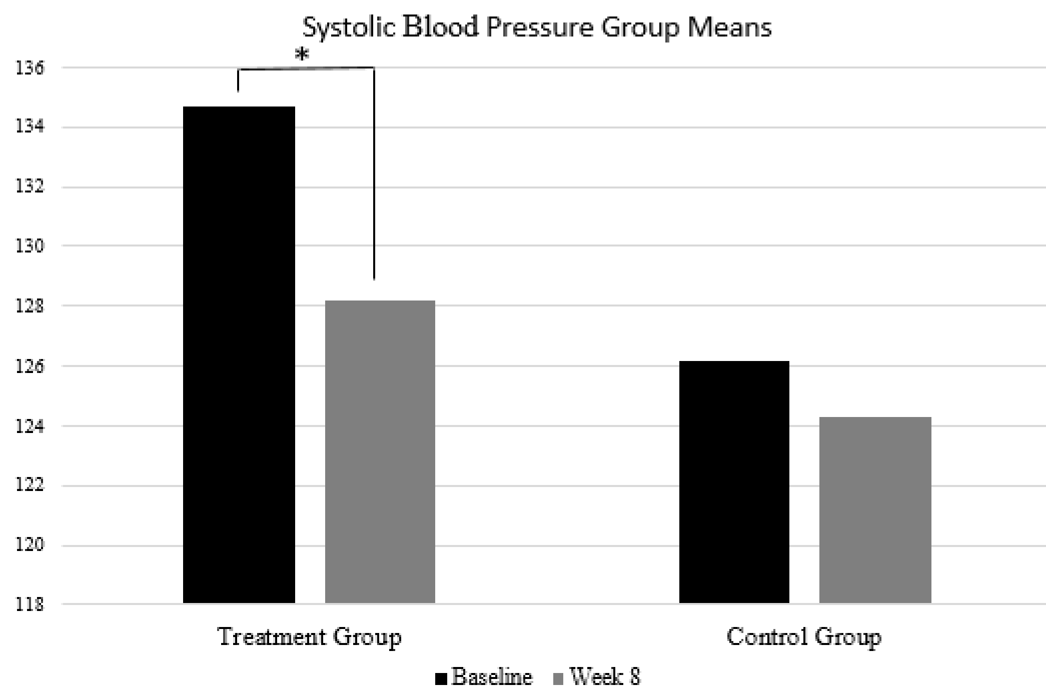


Figure 16

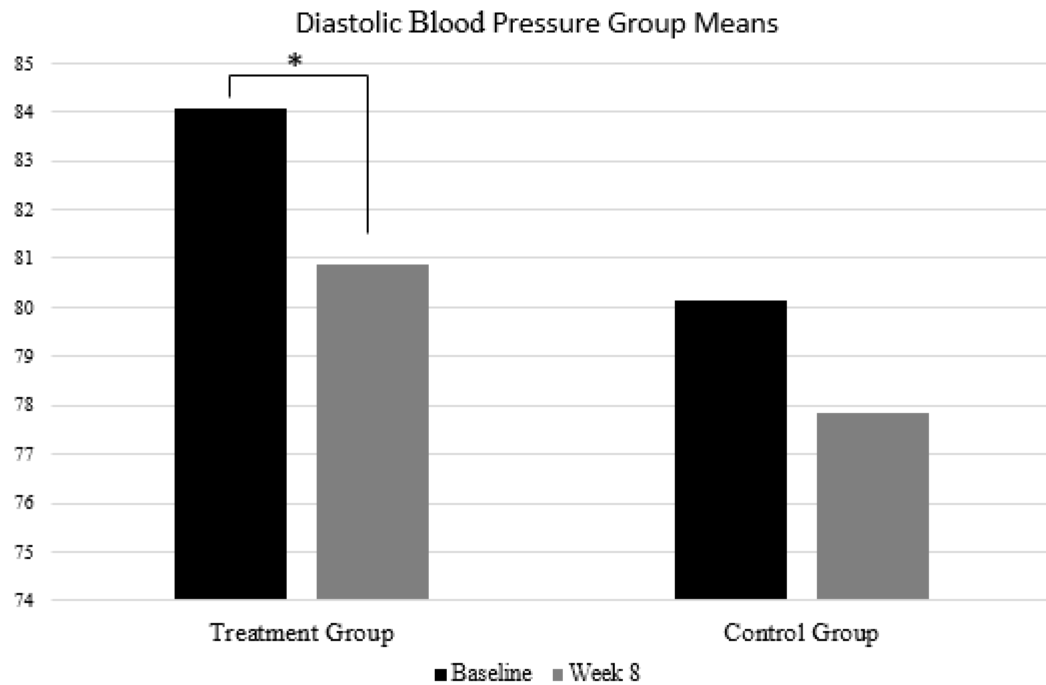
Group means for systolic blood pressure at baseline and week 8.



Note. * = Significant difference at .05 alpha level.

Figure 17

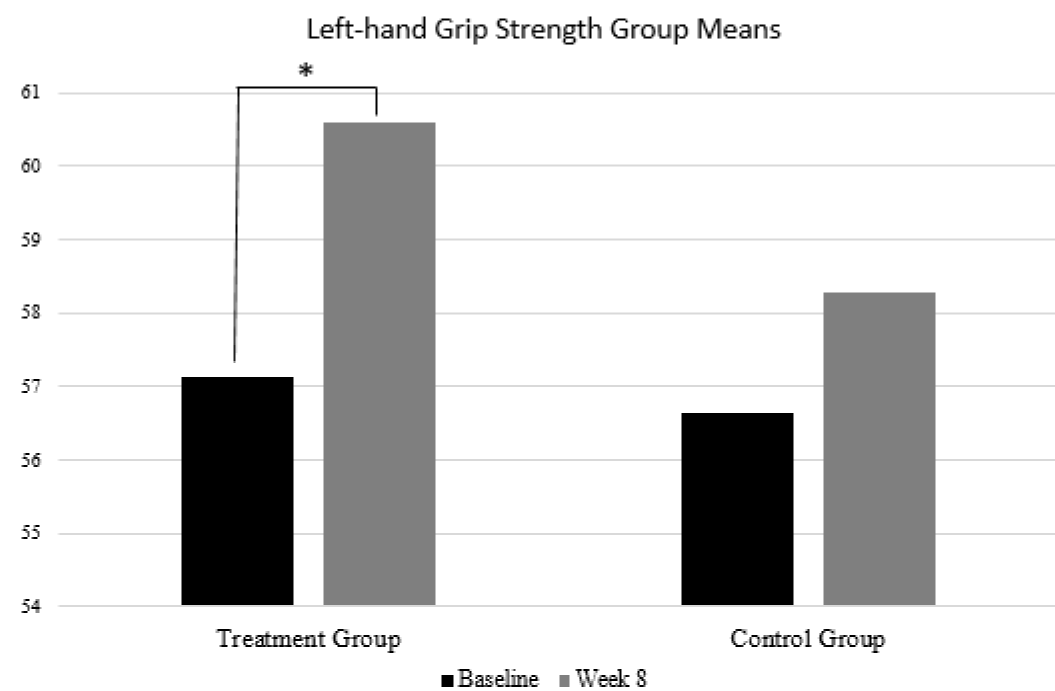
Group means for diastolic blood pressure at baseline and week 8.



Note. * = Significant difference at .05 alpha level.

Figure 18

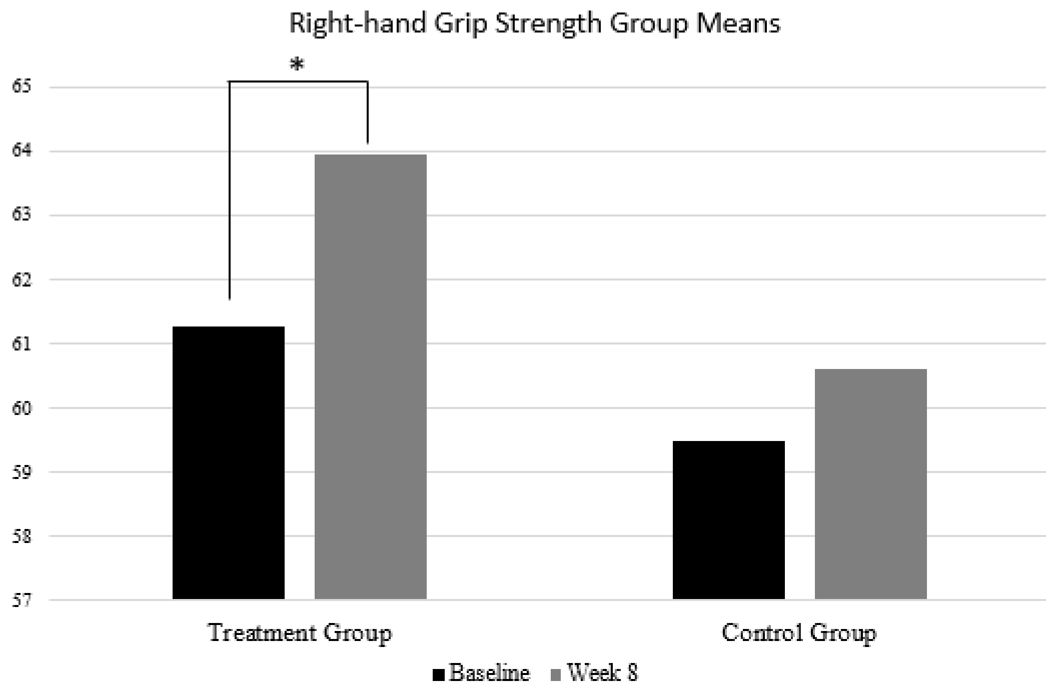
Group means for left-hand grip strength at baseline and week 8.



Note. * = Significant difference at .05 alpha level.

Figure 19

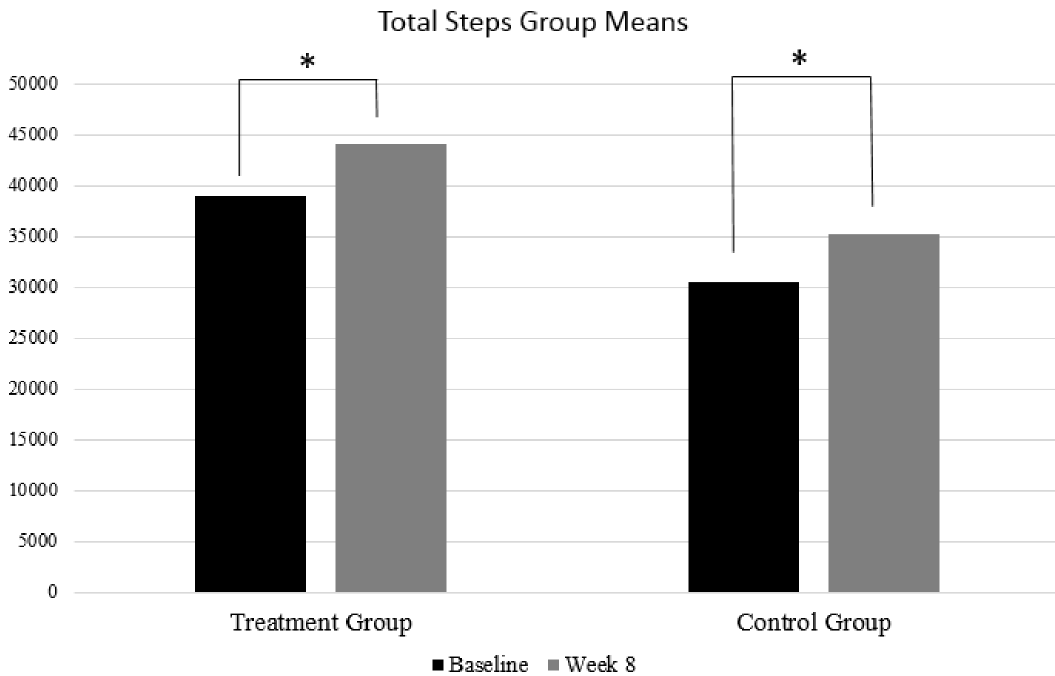
Group means for right-hand grip strength at baseline and week 8.



Note. * = Significant difference at .05 alpha level.

Figure 20

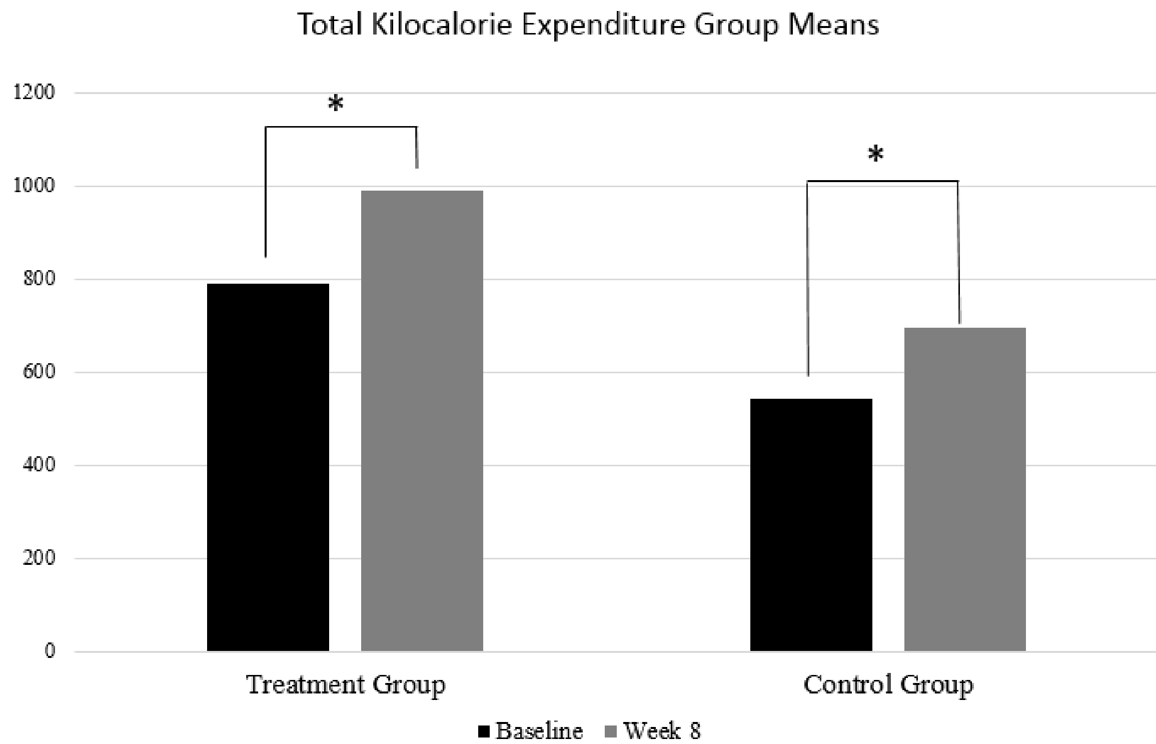
Group means for total steps at baseline and week 8.



Note. * = Significant difference at .05 alpha level.

Figure 21

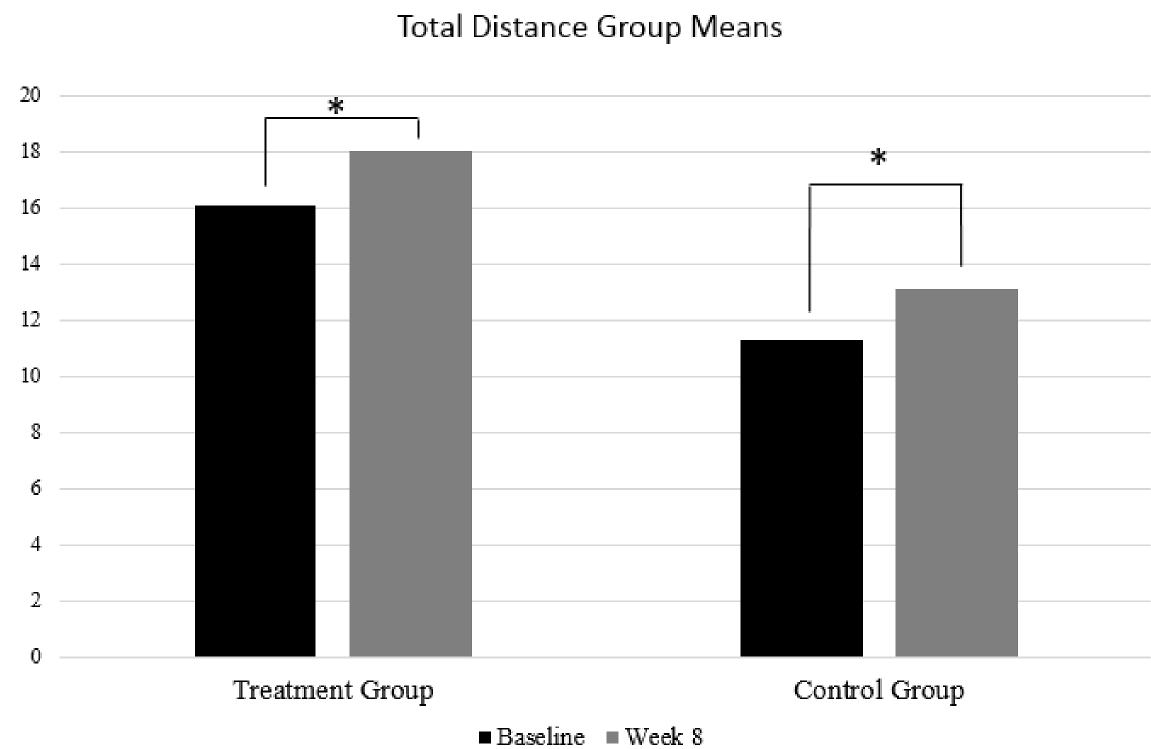
Group means for total kilocalorie expenditure at baseline and week 8.



Note. * = Significant difference at .05 alpha level.

Figure 22

Group means for total distance walked at baseline and week 8.



Note. * = Significant difference at .05 alpha level.

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