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## Effects of exercise on mobility in obese and non-obese older adults

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### Abstract

Coupled with an aging society, the rising obesity prevalence is likely to increase the future burden of physical disability. We set out to determine whether obesity modified the effects of a physical activity intervention designed to prevent mobility disability in older adults. Older adults at risk for disability (N = 424, age range: 70-88 years) were randomized to a 12 month physical activity (PA) intervention involving moderate intensity aerobic, strength, balance and flexibility exercise (150 min per week) or a successful aging (SA) intervention involving weekly educational workshops. Individuals were stratified by obesity using a body mass index  $\geq 30$  (n = 179). Mobility function was assessed as usual walking speed over 400 meters and scores on a short physical performance battery (SPPB), which includes short distance walking, balance tests and chair rises. Over 12 months of supervised training, the attendance and total amount of walking time was similar between obese and non-obese subjects and no weight change was observed. Non-obese participants in the PA group had significant increases in 400 meter walking speed (+1.5%), while their counterparts in the SA group declined (-4.3%). In contrast, obese individuals declined regardless of their assigned intervention group (PA: -3.1%; SA: -4.9%). SPPB scores, however, increased following PA in both obese (PA: +13.5%; SA: +2.5%) and non-obese older adults (PA: +18.6%; SA: +6.1%). A moderate intensity PA intervention improves physical function in older adults, but the positive benefits are attenuated with obesity.

### INTRODUCTION

Adults heading into late-life are now more obese than their predecessors and the cumulative effects of excess body mass may lead to increased disability rates.<sup>1</sup> The combination of an aging society and increase obesity levels make the development of interventions for improving the physical independence of an aging society is an issue of high importance. Current recommendations suggest that low functioning obese older adults should receive weight loss treatments that minimizes muscle and bone loss.<sup>2</sup> This recommendation has been empirically supported as obese older adults who follow diet and exercise therapy are able to lose weight while maintaining their muscle mass and improving their physical function.<sup>3</sup> Additionally, obese older adults with osteoarthritis can improve physical function by performing walking and resistance exercise, although the improvements are better when exercise is combined with diet-induced weight loss.<sup>4, 5</sup> Similar results have been found in non-obese older adults enrolled in a strength plus endurance exercise program without weight loss where aerobic capacity, physical function, balance time and lower extremity strength were improved.<sup>6</sup> However, the effects of exercise on physical function without a dietary intervention in obese when compared to non-obese older adults remain equivocal<sup>2, 3</sup>, and thus it is unclear whether a long duration exercise program without weight loss can improve physical function in moderate to low functioning obese older adults.

We aimed to determine whether obese and non-obese older adults have similar changes in mobility function due to increased levels of moderate intensity physical activity. To address this aim, we performed a stratified data analysis of a pilot clinical trial called the Lifestyle Interventions for the Elderly Pilot Study (LIFE-P). LIFE-P tested the effects of a one-year moderate intensity physical activity program that included walking, strength and balance exercise, although the primary mode was walking.<sup>7</sup> Two major outcomes of this trial were the speed needed to complete a 400 meter walk and a score derived from a short duration battery of mobility tasks. Four-hundred and twenty-four low to moderate functioning older adults were enrolled in the study of which 42% were considered obese by current standards (body mass index  $> 30$  kg/m<sup>2</sup>).

## METHODS

The current study is a secondary analysis of the Lifestyle Interventions and Independence for Elders-Pilot (LIFE-P), which was designed to help plan a definitive Phase 3 randomized controlled trial to examine the efficacy of a program of physical activity, compared to attention-control, on the incidence of major mobility disability ([www.ClinicalTrials.gov](http://www.ClinicalTrials.gov) registration #NCT00116194). A complete description of the LIFE-P study design has been reported previously.<sup>8</sup> Briefly, participants were followed for an average of 1.2 years and the major findings from LIFE-P were that the structured physical activity (PA) intervention resulted in improved gait speed during a long distance walk and physical function on a battery of physical tasks when compared to a successful aging (SA) health education control group.<sup>7</sup>

### Participant recruitment

Details about specific study inclusion and exclusion criteria have been reported previously.<sup>7, 8</sup> Briefly, subjects were eligible for the study if they were between the ages of 70-89 yrs, sedentary (as defined as spending less than 20 min per week in regular structured physical activity), Short Physical Performance Battery score  $\leq 9$ <sup>9</sup>, and were able to walk 400 meters within 15 min. Randomization was not stratified by obesity status.

A total of 424 participants were randomized into PA or SA arms at four sites (Cooper Institute, Stanford University, University of Pittsburgh, and Wake Forest University) and followed for at least 12 months. All participants signed an informed consent and the study was approved by the Institutional Review Boards of all participating institutions.

### Successful aging intervention

The SA health education control was designed to provide attention and health education. Study participants attended weekly group presentations for the first 26 weeks and then monthly until the end of the trial. Presentations were given on health topics that were relevant to older adults such as nutrition, medication use, foot care, and preventive medicine. All SA participants received basic information about physical activity participation and each class was concluded with upper extremity stretching. Regular telephone contact was made to encourage participation.

### Physical activity intervention

Participants randomized to the PA intervention performed walking, strength, flexibility, and balance training. The goal for all participants was to walk for 150 minutes at a moderate intensity on 5 or more days of the week, which was approached in three phases. In the adoption phase (weeks 1-8), three supervised center-based physical activity sessions per week were conducted. These sessions were 40-60 minutes in length and used to initiate the walking program and to introduce participants to the strength, stretching, and balance portions of the program in a safe and effective manner. The strength exercises included standing chair squats, toe stands, leg curl, knee extensions and side hip raises with ankle weights. The balance exercises involved a series of dual and single leg standing movements. Participants were instructed to walk at a rating of perceived exertion (RPE) intensity of 13 ("SOMEWHAT HARD", range 12-14) and perform strength training at an intensity of 15-16.<sup>10</sup> In the transition phase (weeks 9-24), the number of center-based sessions was reduced to two times per week and home-based walking/strengthening/flexibility activities were increased. In the maintenance phase (week 25 to the end), participants were encouraged to perform home-based physical activity a minimum of 5 days per week and one weekly center-based session was offered. The maintenance phase was continued until the final closeout assessment visits.

## Measures of adherence

To confirm and objectively validate levels of participation in physical activity, an interview format of the Community Healthy Activities Model Program for Seniors (CHAMPS) physical activity questionnaire was administered at baseline, 6, and 12 months by assessors blinded to the treatment assignment<sup>11</sup>. Participants were asked to report weekly frequency and duration of various physical activities over the prior 4-week period.

We were particularly interested in changes in moderate intensity PA in this group and thus we assessed activities > 3.0 metabolic equivalents using the CHAMPS<sup>11</sup>. Adherence to the interventions was also measured using attendance to center-based physical activity sessions that was computed as the percentage of attended sessions relative to the total number of possible sessions in each study phase, excluding facility closings (e.g. holidays, weather emergencies, etc.). Additionally, the walking time (in minutes) and RPE at the completion of the walking bout was recorded at each center-based session. The total number of minutes of walking and mean RPE during each intervention phase was stratified by obesity.

## Body mass and anthropometry

Body mass was measured with no shoes by a calibrated balance beam scale. Calibration was performed on a monthly basis. Body height was measured on a wall-mounted stadiometer graduated in centimeters. Waist circumference was assessed using a Gulick II tape measure (model 67020) with a spring loaded device to allow precise tension application to the skin. Participants stood with their feet together and the measurement tape was placed at a level midway between the highest point of the iliac crest and lowest part of the costal margin of the mid-axillary line. Measurements were recorded at the end of exhalation.

## Physical function outcomes

The primary outcome for this analysis is the speed at which participants completed a 400-meter walk test. During this test, participants were asked to walk 10 laps of a 20-meter course at their usual pace. Participants were allowed to stop and rest if necessary, but without sitting.

We also assessed physical function using the short physical performance battery (SPPB). This test is based on timed measures of standing balance, walking speed, and ability to rise from a chair.<sup>9</sup> A summary score (range 0-12) was subsequently calculated by adding the three scores.

## Data analysis

Participants were stratified by obesity status using a body mass index cutpoint of greater than or equal to 30 kg/m<sup>2</sup>. Baseline characteristics between obesity groups within each intervention were compared using analysis of variance (ANOVA) for continuous variables and chi-square tests for categorical variables. Body mass and waist circumference were assessed using ANOVA for between group comparisons at each visit. Because values were non-normally distributed, Wilcoxon's rank-sum test was used to compare attendance to physical activity sessions, frequency performing moderate physical activity on the CHAMPS, RPE and total minutes walking across groups of interest. Medians (25<sup>th</sup> and 75<sup>th</sup> percentiles) are reported for these comparisons. Repeated measures analysis of covariance (ANCOVA) was used to investigate differences in 400 meter gait speed and SPPB scores, with baseline values intervention assignment, visit, obesity status, intervention by visit interaction, intervention by obesity interaction, and obesity by time interaction included in the model. The alpha level was set at 0.05 to determine statistical significance. For these analyses, the interaction terms of obesity by intervention group and obesity by time estimates were investigated to determine whether obesity modified the effect of the

intervention over time. When interactions demonstrated clear trends for differences across obesity levels, we further stratified the analysis. In the stratified analysis, baseline values, intervention assignment, visit, and intervention by visit interaction were adjusted in the ANCOVA.

## RESULTS

Forty-two percent of individuals enrolled in the LIFE-P study were considered obese (Body mass index  $\geq 30$  kg/m<sup>2</sup>). Table 1 provides detailed characteristics of intervention assignment stratified by obesity. In general, obese individuals were similar to non-obese individuals in both intervention assignments with the exception that the obese subgroup was younger, had more prevalent health conditions and walked slower on the 400-meter walk test at baseline, but there were no differences in SPPB. The most common health conditions were hypertension and osteoarthritis, but the presence of these conditions did not differ by obesity status in either intervention assignment. Diabetes was more prevalent in obese than non-obese individuals in the PA (37.2% vs. 18.0%,  $p = 0.007$ ), but not the SA (20.8% vs. 13.4%,  $p = 0.088$ ) intervention.

### Adherence

Adherence to the PA intervention was assessed through attendance records taken at each phase of the intervention (Table 2). Attendance in the adoption phase was higher for obese subjects, median of 86.9% vs. 79.2% in non-obese individuals. Obese and non-obese individual had similar attendance rates during the transition phase, but obese subjects' attendance fell 12% lower than non-obese individuals during the optional visit in the maintenance phase. In total, there were no differences in the number of sessions attended for non-obese and obese individuals who reported to 71.4% and 67.0% of the total sessions, respectively.

Total walking time and mean RPE was recorded for each intervention phase to determine whether obese individuals responded differently than non-obese individuals in the PA group (Table 2). For the entire 12 mo intervention, non-obese individuals had 21% more total walking activity recorded at the clinic-based sessions than obese individuals (median: 1910 vs. 1506 walking minutes), but this difference was not statistically significant ( $p = 0.142$ ). Subjects reported RPE levels that matched the goals for the intervention. However, obese individuals reported higher levels of RPE throughout the intervention than non-obese individuals (median: 12.7 vs. 12.0 respectively).

Because subjects randomized to the PA group were encouraged to exercise outside of the clinic-based sessions, the CHAMPS was used to capture both PA performed inside and outside the clinic. Both non-obese and obese individuals responded similarly to the PA intervention through 6 months, which was supervised at the intervention sites (Table 3). However, while non-obese individuals maintained their PA levels, obese subjects demonstrated a striking drop in participation between 6 and 12 months.

### Body mass and anthropometry

Table 4 lists the average change in body mass and waist circumference across obesity groups and intervention assignment. The PA intervention did not induce significant changes in body mass in either non-obese or obese subjects. Non-obese individuals in the SA group lost approximately 1 kg of body mass while obese individuals in the SA group showed no change. Twelve months of physical activity reduced waist circumference by 2 cm in obese with a trend for decrease in non-obese subjects (a 1.4 cm decrease). Non-obese subjects in the SA group lost approximately 2.1 cm in waist circumference.

## Physical function outcomes

**400 meter gait speed**—Prior to separating the body mass groups we performed an analysis to examine whether obese individuals had differential effects due to the PA intervention. For 400 meter gait speed, the obesity by time interaction was not statistically significant ( $p = 0.326$ ), but there was evidence an obesity by intervention interaction ( $p = 0.06$ ). This interaction signified that the intervention effect on 400 meter gait speed had been attenuated in obese participants. Further analysis revealed that non-obese subjects in the PA group had a significant increase in gait speed compared to the SA group (Figure 1A). In non-obese subjects, the adjusted difference between the PA and SA groups was 0.052 m/sec at 6 ( $p < 0.001$ ) and 0.052 m/sec ( $p = 0.003$ ) at 12 months. Obese subjects in the PA group, however, had a decline in gait speed, which was similar to that observed in the SA group (Figure 1B). The adjusted difference between the SA and PA intervention assignments was 0.009 m/sec at 6 months (difference between PA & SA:  $p = 0.544$ ) and 0.014 m/sec at 12 months ( $p = 0.429$ ) in the obese.

**Short Physical Performance Battery**—SPPB scores improved in non-obese subjects in the PA group by 0.59 points at 6 months ( $p = 0.015$ ) and 0.56 points at 12 months ( $p = 0.035$ ) when compared to the SA group (Figure 2A). Obese individuals showed similar trends with the PA group having an adjusted difference with the SA group of 0.98 at 6 months ( $p < 0.001$ ) and 0.66 at 12 months ( $p = 0.042$ ) (Figure 2B). However, there was a significant obesity by time interaction ( $p = 0.032$ ), suggesting that obese individuals had an attenuated increase over time. Although this interaction was likely influenced by an increase in SPPB score in the non-obese in the SA group, further analysis revealed that obese subjects increased their SPPB scores by 13.5% (an SPPB score of 7.53 to 8.55) while their non-obese counterparts had an 18.6% increase (an SPPB score of 7.49 to 8.89) over 6 months of PA. This difference was reduced by the end of the trial (Obese: 11.3% vs. Non-obese: 13.5% increase).

## DISCUSSION

Obesity is an important factor in determining the rate of physical disability among older adults.<sup>1, 12, 13</sup> Considering that improved health care has extended the life of obese individuals<sup>14</sup>, it is becoming clear that the aging obese population will have a significant contribution to future physical disability rates. We sought to determine whether moderate intensity physical activity can improve physical function in moderate to low functioning older adults and whether the effects are modified by obesity. The major findings of this study are that moderate intensity physical activity was: 1) successfully implemented in low to moderate functioning obese and non-obese older adults, 2) obese individuals were less able to sustain the intervention when supervision was reduced, 3) as demonstrated by the ratings of perceived exertion, obese individuals were exerting themselves to an adequate level to induce physiological benefits, 4) obese subjects did not improve their speed while walking long-distances, and 5) obesity blunted the positive effects of physical activity on SPPB scores. The results highlight that increased physical activity without weight loss in obese older adults can promote improvements in short-duration mobility tasks of daily life as measured with the SPPB. However, these benefits do not appear to transfer to long-distance mobility tasks such as walking 400 meters.

Exercise studies on physical function in obese older adults have typically included weight loss interventions<sup>3</sup> and the effect of exercise alone on physical function in obese older adults is not completely understood. These data help to fill an important gap in the literature by suggesting that low to moderate functioning obese older adults have relatively good adherence and exert themselves during the supervised sessions and that this intervention can



induce adaptations to short duration daily tasks such as those performed in the SPPB. However, obese individuals had a substantially attenuated 400 meter walk performance when compared to non-obese older adults in the PA group. To put these changes in perspective, the non-obese individuals had a 5 times greater improvement in long-distance walking speed than obese individuals in the PA group. Because studies that intervene with weight loss plus exercise have had beneficial effects on long-distance walking ability<sup>4</sup>, we believe that weight loss may be an important component to optimize the benefits of moderate intensity physical activity in obese older adults. Other components that could improve these outcomes include different exercise programs that use more vigorous activity, and adding more supervision and individualized training programs due to underlying comorbidities that may deter long-term adherence to PA.

Both the 400-meter walk and SPPB tests are valuable tools for assessing risks of physical disability in the elderly. While these two tests are correlated, they capture different dimensions of physical ability and successful performance depends on different physical reserve capacities. The PA intervention included strength training performed on a chair (i.e. chair squatting), which may have strongly influenced subjects ability to rise from a chair quickly as assessed in the SPPB.<sup>15</sup> Therefore, the strength training aspect of the intervention may have improved muscle power in obese individuals, which would help to increase performance on short duration tasks of the SPPB more effectively. It is also possible that complications related to diabetes may have hindered improvements due to PA alone, but both diabetics and non-diabetics had identical results. Another factor that could partly explain the attenuated effect in obese older adults is due to the adherence to the PA intervention that seemed to be lower in the obese subjects. It remains unclear why obese individuals have reduced adherence, but one factor may be the heightened RPE level indicating that the exercise was more strenuous and difficult than the non-obese group. However, considering that the accumulated walk time during supervised PA sessions through 6 months of the trial was only 154 min less in the obese, which is equivalent to 6.4 minutes per week, we feel that the obese subjects undergoing PA had ample opportunity to demonstrate improved ability to walk 400 meters. Therefore, high body mass may preclude improvements in long distance walking ability due to a physical activity intervention.

The fact that many low functioning older adults are obese permitted an adequate sample size to conduct an appropriate secondary data analysis. This study is limited, however, as it was not statistically powered to detect differences among obese and non-obese individuals. Consequently, we are aware of the potential misinterpretation that can occur while performing subgroup analyses in a clinical trial not designed to investigate the effects PA by obesity status. This strategy is known to lead to false-positive results or statistically significant subgroup differences when none exist.<sup>16</sup> Coupled with analyses from the original report of LIFE-P, a total of 6 subgroup analyses have been performed to date. Thus the false positive rate is 1 out of every 4 hypothesis tests (26%). Therefore, because this analysis was conducted to examine the heterogeneity of a PA intervention for treating mobility limitation it should not be over-interpreted. However, it should be noted that these results are consistent with epidemiologic data showing that obesity blunts the effect of physical activity on the prevention of mobility limitation in similarly aged individuals.<sup>17</sup> Further research with appropriate design methods is needed to confirm these findings.

The strengths of this study are close monitoring of PA levels using data recorded at PA sessions and questionnaires that helped to determine that obese and non-obese older adults both comply and adhere to a PA intervention. In interpreting these findings, this study partially supports the current recommendations in that exercise alone improves some aspects of physical function among obese older adults, but it highlights that these improvements are less in obese older adults.

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- c – Drafting of the article
- d – Critical revision of the article for important intellectual content
- e – Final approval of the article
- f – Provision of study materials or patients
- g – Statistical expertise
- h – Obtaining of funding
- i – Administrative, technical, or logistic support
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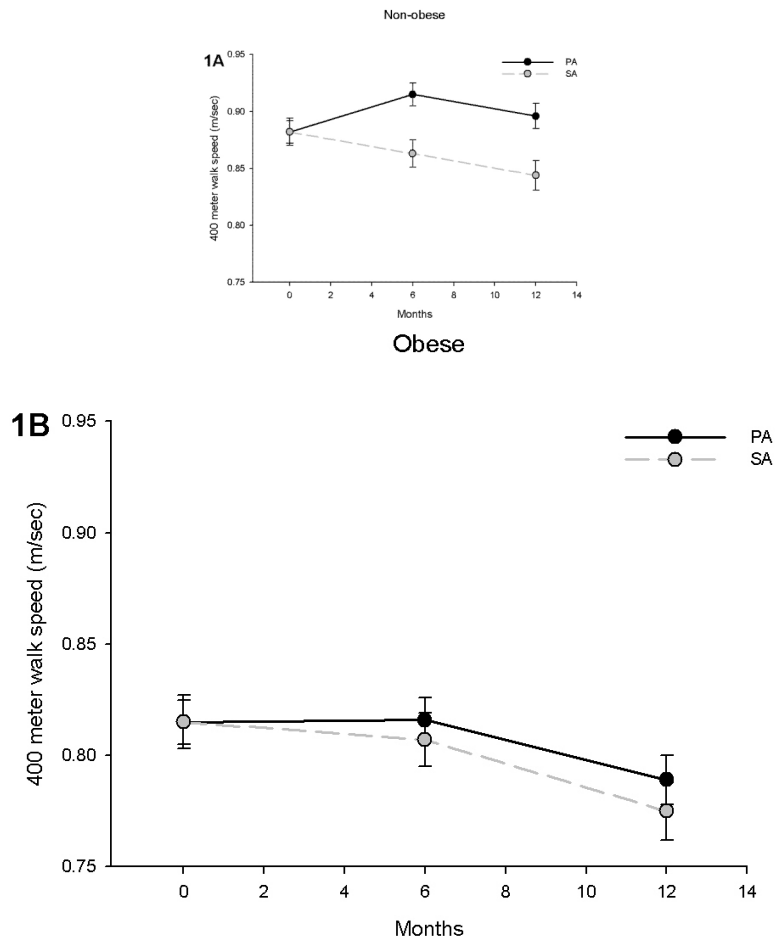
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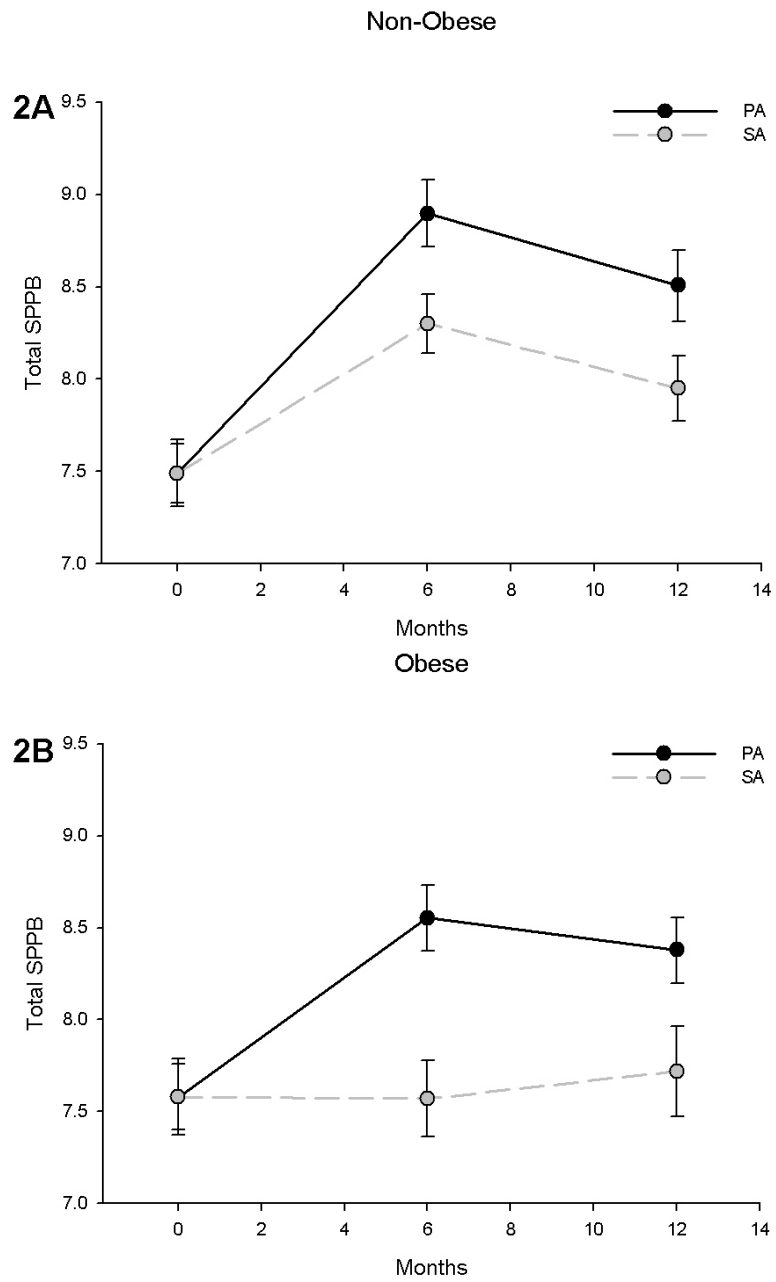
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**Figure 1.** 400 meter walk speed in non-obese (A) and obese (B) participants stratified by physical activity (PA) and successful aging (SA) intervention groups. Obese individuals had an attenuated effect of PA on gait speed during a 400 meter walk test. Values are predicted from ANCOVA models that adjust for baseline levels, intervention, time and intervention by time interaction.



**Figure 2.** Short Physical Performance Battery (SPPB) scores in non-obese (A) and obese (B) participants stratified by physical activity and successful aging intervention groups. Values are predicted from ANCOVA models that adjust for baseline levels, intervention, time and intervention by time interactio



**Table 1**  
 Baseline characteristics of the participants according to randomized groups and body weight.\*

Randomized group	Physical activity (n = 213)		Successful aging control group (n = 211)	
	Non-obese (n = 111)	Obese (n = 102)	Non-obese (n = 134)	Obese (n = 77)
<b>Body weight group</b>				
Age, mean ± SD, y	77.2 ± 4.2	75.7 ± 4.01	77.9 ± 4.4	75.5 ± 3.7
Women	79 (71.2)	67 (65.7)	91 (67.9)	55 (71.4)
Other than Caucasian	25 (22.5)	28 (27.4)	27 (20.1)	29 (37.7)
Body mass index, mean ± SD <sup>†</sup>	26.1 ± 2.6	35.7 ± 5.0	26.3 ± 2.7	35.7 ± 4.7
Education (complete college)	77 (69.4)	72 (70.6)	92 (68.6)	55 (71.4)
Smoking				
Current	5 (5.4)	2 (1.9)	7 (5.2)	0 (0)
Smoke > 100 cigarettes in lifetime	18 (16.2)	21 (20.6)	22 (16.4)	12 (15.6)
Fair/poor health self-rated	22 (19.8)	17 (16.7)	28 (20.9)	19 (24.7)
Prevalent health conditions				
Myocardial infarction	12 (10.8)	12 (11.7)	10 (7.5)	5 (6.5)
Cancer	22 (19.8)	16 (15.7)	24 (17.9)	12 (15.6)
Hypertension	72 (64.8)	76 (74.5)	89 (66.4)	56 (72.7)
Diabetes	20 (18.0)	38 (37.2)	18 (13.4)	16 (20.8)
Depression	16 (14.4)	21 (20.6)	16 (11.9)	19 (24.7)
Stroke	2 (1.8)	6 (5.9)	9 (6.7)	3 (3.9)
Osteoarthritis	22 (19.8)	28 (27.4)	22 (16.4)	21 (27.3)
Lung disease	16 (14.4)	13 (12.7)	16 (11.9)	13 (16.9)
Congestive heart failure	6 (5.4)	5 (4.9)	6 (4.5)	7 (9.1)
Number of health conditions, mean ± SD	1.69 ± 1.1	2.10 ± 1.3	1.56 ± 1.1	1.97 ± 1.2
MMSE score	26.9 ± 2.4	27.3 ± 2.4	27.4 ± 2.1	27.4 ± 2.1
Baseline 400 m gait speed, m/sec	0.88 ± 0.18	0.83 ± 0.17	0.88 ± 0.17	0.80 ± 0.17
Baseline SPPB score	7.6 ± 1.4	7.6 ± 1.4	7.4 ± 1.3	7.5 ± 1.5

Non-obese: BMI = 19-29.9 kg/m<sup>2</sup>

Obese: BMI = 30-55 kg/m<sup>2</sup>

SPPB: Short Physical Performance Battery

\* Values are expressed as number (percentage) unless otherwise indicated.

† Calculated as weight in kilograms divided by height in meters square

**Table 2**

Summary of adherence to center-based physical activity (n = 213) according to obesity and phase of the study.

Body mass group (n = 213)			
	Non-obese (n = 111)	Obese (n = 102)	Between group p-value
<b>Percent attendance (%)</b>			
Adoption phase (weeks 1-8) *	79.2 (63-91)	86.9 (75-95)	<0.001
Transition phase (weeks 9-24) **	74.2 (56-87)	71.4 (43-89)	0.412
Maintenance phase (week 25 to end) ***	60.7 (21-85)	48.2 (7-78)	0.050
Total percent attendance	71.4 (49-82)	67.0 (41-80)	0.467
<b>Total walking time recorded (min)</b>			
Adoption phase (weeks 1-8) *	565 (369-686)	516 (365-696)	0.994
Transition phase (weeks 9-24) **	700 (442-890)	595 (340-803)	0.035
Maintenance phase (week 25 to end) ***	705 (303-1033) <sup>‡</sup>	599 (177-942) <sup>‡</sup>	0.322
Total walking time recorded (min)	1910 (1075-2464)	1506 (902-2403)	0.142
<b>Mean rate of perceived exertion (RPE) at completion of walking session (range 6 – 20)</b>			
Adoption phase (weeks 1-8) *	11.9 (11.2-12.4)	12.3 (11.7-13.1)	0.005
Transition phase (weeks 9-24) **	12.0 (11.5-12.6)	12.6 (11.9-13.2)	<0.001
Maintenance phase (week 25 to end) ***	12 (11.2-13) <sup>‡</sup>	12.7 (11.5-13.8) <sup>‡</sup>	0.061
Mean RPE recorded for all sessions			

Values are expressed as medians (25<sup>th</sup> and 75<sup>th</sup> percentiles)

\* 3 sessions per week

\*\* 2 sessions per week

\*\*\* 1 session per week (optional)

<sup>‡</sup> n = 97 for non-obese, n = 81 for obese

Frequency of moderate physical activity (PA) per week spent in moderate PA per week according to randomized groups and obesity status (median (25<sup>th</sup> – 75<sup>th</sup> percentile)).

**Table 3**

Randomized group	Physical activity (n = 213)		Successful aging control group (n = 211)	
	Non-obese (n = 111)	Obese (n = 102) Between group p-value	Non-obese (n = 134)	Obese (n = 77) Between group p-value
Minutes of moderate PA per wk				
At baseline	30 (0-165)	15 (0-135) 0.282	30 (0-135)	90 (0-120) 0.649
6 Months	165 (30-315)	135 (30-315) 0.589	30 (0-210)	30 (0-165) 0.837
12 Months	135 (30-285)	60 (0-255) 0.019	60 (0-135)	105 (0-225) 0.319
Time effect (p-value)	0.006	0.001	0.429	0.872

**Table 4**  
 Body mass and waist circumference according to randomized groups and obesity status (Mean ± SEM).

Randomized group	Physical activity (n = 213)		Successful aging control group (n =211)	
	Non-obese (n = 111)	Obese (n = 102)	Non-obese (n = 134)	Obese (n = 77)
<b>Body mass group</b>				
At baseline	70.2 ± 1.1	96.3 ± 1.6	72.2 ± 1.0	97.3 ± 1.8
6 Months	69.1 ± 1.4	95.0 ± 1.9	72.0 ± 1.0	95.7 ± 2.3
12 Months	69.9 ± 1.1	94.4 ± 1.9	71.3 ± 1.0	96.3 ± 1.9
Time effect (p-value)	0.160	0.288	<0.001	0.471
<b>Waist circumference (cm)</b>				
At baseline	92.4 ± 1.0	113.5 ± 1.2	94.3 ± 0.97	112.9 ± 1.4
6 Months	91.2 ± 1.2	110.5 ± 1.5	92.8 ± 0.94	111.0 ± 1.6
12 Months	91.0 ± 0.98	111.6 ± 1.4	92.1 ± 0.87	111.5 ± 1.3
Time effect (p-value)	0.086	0.028	<0.001	0.356