Effects of Resistance Training and Dietary Changes on Physical Function and Body Composition in Overweight and Obese Older Adults

Chad R. Straight, Leah R. Dorfman, Kathryn E. Cottell, Julie M. Krol, Ingrid E. Lofgren, and Matthew J. Delmonico

Background: Community-based interventions that incorporate resistance training (RT) and dietary changes have not been extensively studied in overweight and obese older adults. The purpose of this investigation was to determine the effects of a community-based RT and dietary intervention on physical function and body composition in overweight and obese older adults. Methods: Ninety-five overweight and obese (BMI = 33.4 ± 4.0 kg/m²) older adults aged 55–80 years completed an 8-week RT and dietary intervention at 4 Rhode Island senior centers. Participants performed RT twice-weekly using resistance tubing, dumbbells, and ankle weights. Participants also attended 1 weekly dietary counseling session on a modified Dietary Approaches to Stop Hypertension diet. Outcome measurements included anthropometrics, body composition, and physical function. Results: There were small changes in body mass (–1.0 ± 1.8 kg, P < .001), waist circumference (–5.2 ± 3.8 cm, P < .001), and percent body fat (–0.5 ± 1.4%, P < .001). In addition, significant improvements were observed in knee extensor torque (+7.9 ± 19.1 N·m, P < .001), handgrip strength (+1.2 ± 2.5 kg, P < .001), and 8-foot up-and-go test time (–0.56 ± 0.89 s, P < .001). Conclusion: Community-based RT and dietary modifications can improve body composition, muscle strength, and physical function in overweight and obese older adults. Future investigations should determine if this intervention is effective for long-term changes.

Keywords: sarcopenia, aging, obesity, exercise, performance

Sarcopenia, the age-related reduction in skeletal muscle mass, is typically accompanied by declines in physical function and subsequent disability.1 Additional adverse consequences of sarcopenia include difficulty with ambulation, a reduction in muscular strength, and an associated increase in adiposity.2,3 Moreover, the deleterious effects of sarcopenia are exacerbated with obesity.4 Previous investigations have reported a significant and independent association between fat mass and physical disability in postmenopausal women5 and older men.6 While dietary modifications alone may elicit reductions in total body mass and fat mass, weight loss interventions for older adults are typically accompanied by involuntary decrements in muscle mass,7 which is likely detrimental to strength and function.

Resistance training (RT) has been suggested as a safe and efficacious strategy for improving muscle strength in older adults and may be instrumental in the prevention of sarcopenia-related functional limitations.8 Several studies have reported significant improvements in physical function following RT interventions in older adults.9–11 However, these studies have typically used resistance exercise machines and relatively vigorous training intensities. Furthermore, there is a paucity of research investigating the additive effects of RT and dietary education on physical function in overweight and obese older adults. Recently, Fitzpatrick and colleagues12 reported that a community-based physical activity program (ie, chair-based exercises and walking promotion) that also promoted increased consumption of fruits and vegetables resulted in significant improvements in functional performance in older men and women. While this study did provide dietary education focused on the benefits of increasing fruit and vegetable intake, dietary restriction was not controlled and changes in diet were not reported following the intervention. In addition, a 4-week exercise program utilizing hand weights and elastic bands resulted in significantly improved physical function in a cohort of older African-American women.13 Although these interventions improved functional abilities, the above investigations did not incorporate dietary modifications for the purpose of eliciting weight loss and only the study by Fitzpatrick and associates12 involved overweight and obese older adults. Thus, there is a need to establish the effectiveness of community-based interventions that integrate RT and dietary education on physical function and body composition in overweight older adults.

Straight, Dorfman, Krol, and Delmonico are with the Dept of Kinesiology, University of Rhode Island, Kingston, RI. Cottell and Lofgren are with the Dept of Nutrition and Food Sciences, University of Rhode Island, Kingston, RI.
The purpose of this investigation is to assess the effects of RT on physical function, muscle strength, and body composition in overweight and obese, community-dwelling older adults who are receiving concomitant dietary education for intentional weight loss at 4 Rhode Island senior centers. We hypothesized that an 8-week intervention integrating RT and behavioral-based dietary education would facilitate significant improvements in physical function, muscle strength, and body composition in overweight and obese older adults.

Methods

Study Design

The study design was a quasi-experimental, community outreach intervention with baseline and postintervention measurements. The intervention lasted 8 weeks and was comprised of 2 1-hour sessions per week at 2 urban and 2 suburban senior centers. Each participant provided written informed consent before participation and the study was approved by the Institutional Review Board of the University of Rhode Island.

Participants

Overweight and obese, community-residing older adults aged 55–80 years (n = 109) who, by self-report, were not engaged in a regular exercise program were recruited for this study. Participants were recruited via newspaper advertisements as well as flyers, brochures, and word-of-mouth at the participating senior centers. Before participating in this study, all participants underwent phone screening interviews, completed comprehensive medical history questionnaires, and signed informed consent documents. In addition, it was recommended that their primary care physician also provide medical clearance to participate in a diet and RT intervention. Eligibility criteria included a body mass index (BMI) between 25.0–39.9 kg/m², medication-stable (within the last 3 weeks; > 6 months for lipid-lowering medications), and weight-stable (within 5%) during the last 3 months. Exclusion criteria included significant cardiovascular, metabolic, musculoskeletal, or psychological disorders that may have adversely affected the individual’s ability to engage in regular exercise. Fourteen participants did not complete the study for various reasons (6 lost to follow-up, 2 due to time commitment, 5 due to unrelated personal or family health issues, and 1 due to study-related adverse event of a strained muscle), which yielded an analytic sample of 95 participants. No significant differences in age or BMI existed between those participants who did not complete the study and the analytic sample.

Anthropometrics

Body mass was measured to the nearest 0.1 kg and height was measured to the nearest 0.5 cm using a standard balance beam scale (Detecto, model 439, Webb City, MO). Body mass index was calculated via weight (kg) divided by height (m) squared. Waist circumference was measured at the iliac crest using a standard 60” Gulick tape measure (Richardson, Frankfort, IL) with attached tensometer with measurements rounded to the nearest 0.25 cm and hip circumference was measured at the broadest circumference of the hips above the gluteal fold to the nearest 0.25 cm.

Body Composition

Percent body fat, fat mass, and fat-free mass (FFM) were measured using a battery-powered handheld bioelectrical impedance device (Omron, model HBF-306C, Bannockburn, IL) in the morning following a 12-hour fast. This device was chosen because it is portable, safe, and is both a valid and reliable measure of body composition.14 To minimize the risk of an adverse event, individuals with pacemakers were not tested because the device produces a small electrical current during the measurement that may have interfered with the proper functioning of the pacemaker. Fat mass was calculated as percent body fat multiplied by total body weight (kg) divided by 100. Fat free mass was calculated as total weight (kg) minus fat mass (kg).

Physical Function

Physical function was evaluated via the Established Populations for Epidemiologic Studies of the Elderly short physical performance battery (SPPB) and the 8-foot up-and-go test. The SPPB provides an index of lower-extremity physical function and consists of 3 individual subcomponents: a timed 4-meter walk, a timed 5-chair stand test, and multiple standing balance tests.15 The SPPB has been previously reported to be a valid assessment of physical function in older adults.16 The 8-foot up-and-go test requires participants to stand up from a chair, walk around a cone located 8 feet away, and then return to the chair and sit back down.17 It is a modified version of the timed up-and-go test, which has been shown to be a valid and reliable measurement of functional mobility in community-dwelling older adults18 and has been inversely and significantly associated with physical disability.19 The test was modified to 8 feet to increase the feasibility of administration in settings with limited space (ie, senior center), however this modification has not reduced the reliability of the assessment.17 Performance on the 8-foot up-and-go test was evaluated by the duration required by the participant to successfully complete the test and scores were measured to the nearest tenth of a second.20 Each participant completed 2 trials and the shortest time was recorded.

Muscle Strength

Assessments of muscle strength were obtained via measurements of handgrip strength and knee extensor torque. Handgrip strength was measured via handheld
dynamometry (Jamar hydraulic hand dynamometer, model 5030J1, Bolingbrook, IL) and each participant’s dominant hand was tested. To standardize the protocol, all participants completed the test with the dynamometer set at the second handle position. Participants performed each trial with the elbow positioned at −90° of flexion, the forearm in a neutral position, and the wrist positioned between 0°–30° of dorsiflexion and between 0°–15° of ulnar deviation. Values were measured to the nearest kg and maximum handgrip strength was recorded as the peak value of 3 trials. Isometric strength of the dominant leg was evaluated using a handheld manual muscle dynamometer (Lafayette Manual Muscle Test System, model 01163, Lafayette, IN) and measurements were recorded to the nearest 0.1 kg. The manual muscle tester was placed on the anterior surface of the distal tibia and 10 cm above the lateral malleolus. A break test was performed whereby the tester pressed against the lower leg until sufficient force had been applied to overcome the isometric contraction of the quadriceps muscle. Participants completed the assessment while sitting upright on a table so that the quadriceps muscle was working against gravity and with the knee positioned at ~25° of flexion as measured by a goniometer. Leg length was measured from the lateral epicondyle of the femur to the lateral malleolus of the fibula, and 10 cm were subtracted to account for placement of the manual muscle dynamometer. Torque was calculated as the product of isometric knee extensor force (N) and leg length (m). All participants performed 2 trials and the strongest trial was recorded for statistical analyses.

**Physical Activity and Diet**

Physical activity was measured using the Yale Physical Activity Survey (YPAS), which is a valid and reliable instrument for assessing self-reported physical activity levels among older adults. Time spent performing each YPAS checklist activity was multiplied by an intensity code to calculate weekly energy expenditure related to physical activity. In addition, the Dietary Screening Tool (DST) was used to assess dietary intake and nutritional risk. The DST provides a valid and reliable measurement of dietary quality among community-dwelling older adults. Based on DST score (0–100), participants were categorized as 1 of 3 nutritional risk levels: at-risk (< 60), possible-risk (60–75), and not-at-risk (> 75).

**Dietary Intervention**

All participants attended 1 30-minute behavioral-based dietary education session during each week of the intervention. A modified Dietary Approaches to Stop Hypertension (DASH) diet was implemented immediately following baseline testing and participants were instructed to adhere to these recommendations for the duration of the intervention. The DASH diet encourages reduced consumption of saturated fat, increased consumption of fruits and vegetables, reduced consumption of dietary sodium, and the accumulation of ~180 minutes of moderate-intensity physical activity each week. The DASH diet was modified for this investigation by placing an increased emphasis on consumption of monounsaturated fatty acids and limiting total fat intake to less than 35% of daily caloric consumption, rather than the 27% recommended by the original DASH guidelines because unsaturated fatty acids may possess advantageous cardioprotective properties. Additionally, all participants monitored their dietary intake during 3 days of each week. Discussion topics for dietary education classes included reading and understanding food labels, estimating portion sizes, and behavioral strategies for increasing consumption of fruits and vegetables. All dietary education classes were conducted by a registered dietitian.

**Resistance Training Intervention**

All participants completed 2 30-minute sessions of supervised RT on nonconsecutive days of the week for 8 weeks. Participants performed RT exercises using free weights, elastic tubing, and ankle weights. Elastic tubing and ankle weights were transported to each senior center. However, a rack of free weights was purchased and donated to each center following completion of the study. Three upper-body (chest press, shoulder press, and back row) and 3 lower-body (leg press, knee extension, and leg curl) exercises were completed during each training session and 3 sets of 8–12 repetitions were performed for each exercise. This specific repetition assignment was chosen because 8–12 repetitions performed to volitional fatigue is recommended for optimizing muscle strength and is in accordance with physical activity guidelines published by the American College of Sports Medicine. Each participant’s individual progression was monitored and resistance was increased when the participant was able to complete ≥ 12 repetitions for a particular exercise. Participants were instructed to perform a ~1 s concentric phase of each exercise, with a ~2–3 s eccentric phase. Comparable RT protocols have been successfully implemented in similar cohorts and have been shown to be effective at improving strength and function. To monitor intensity, participants were introduced to the rating of perceived exertion scale and were instructed to subjectively monitor the difficulty of each exercise based on this scale. Exercise intensity was designed to be “somewhat hard,” which has been shown to be effective at facilitating increases in physical function. Past studies have indicated this intensity is tolerable in geriatric populations, resulting in greater adherence to exercise programs. Study staff were trained by the PIs and those proficient with the exercise protocol supervised all RT sessions.

**Statistical Analyses**

The Shapiro-Wilk test was conducted to determine normality for all primary outcome variables. Paired samples
Straight et al. conducted t-tests for changes in normally distributed variables for the total group and within site area (i.e., urban or suburban) changes, while the nonparametric Wilcoxon signed-rank test was performed for nonnormally distributed variables. An outlier analysis was performed and values > 3 SD from the mean were identified and considered outliers. While outliers (≤3) were identified for several outcome variables, they were included in all analyses as they did not meaningfully alter the interpretation of the results. Analysis of covariance was conducted for between-group (site area) differences in all change variables and analyses were adjusted for baseline values, BMI (only for physical function assessments), age, and gender. A chi-square test was performed to determine the frequency of categorical variables between suburban and urban senior centers. All analyses were conducted using SAS software (SAS Institute Inc., version 9.2, Cary, NC) and statistical significance was set at \( P < .05 \). Data are presented as mean ± SD.

## Results

Participant characteristics at baseline, postintervention, and change for the analytic sample are presented in Table 1. Our analytic sample consisted of 95 overweight and obese (BMI = 33.4 ± 4.0 kg/m²) adults (80 female, 15 male) with a mean age of 69.1 ± 6.2 years. Following the intervention, a significant reduction was evident in total body weight, BMI, waist circumference, hip circumference, and fat mass (\( P < .001 \)). In addition, a significant change was observed in percent body fat (\( P < .001 \)). Notably, knee extensor torque significantly improved by ~12.6% and SPPB chair stand time decreased by ~6.2% (\( P < .001 \)). No significant changes were observed in FFM or SPPB gait speed time. As described in a previous report from our laboratory,41 diet quality as measured by the DST significantly improved from baseline to postintervention. However, while participants were encouraged to increase leisure-time physical activity, no significant differences were observed in energy expenditure related to physical activity between baseline and postintervention (8726 ± 6513 kcal/wk vs. 9461 ± 8135 kcal/wk, \( P = .194 \)).

Table 2 presents a comparison of suburban and urban sites at baseline, postintervention, and change values. While no significant changes occurred in FFM or SPPB gait speed time, the suburban group demonstrated significant changes in weight, BMI, waist circumference, hip circumference, fat mass, 8-foot up-and-go time, SPPB total score, and SPPB chair stand time (\( P < .001 \)). In addition, significant changes were observed in percent body fat, handgrip strength, and knee extensor torque (\( P < .01 \)). Within the urban group, no significant changes were found in percent body fat, FFM, SPPB total score, SPPB chair stand time, or SPPB gait speed time. However, significant changes did occur in total body weight, waist circumference, hip circumference, 8-foot up-and-go time, handgrip strength, and knee extensor torque (\( P < .005 \)). In addition, significant changes occurred in BMI and fat mass (\( P < .05 \)).

### Table 1 Baseline, Postintervention, and Change Values for the Analytic Sample (n = 95)* for Body Composition, Physical Function, and Muscle Strength Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline</th>
<th>Post</th>
<th>Change</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (cm)</td>
<td>160.3 ± 8.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>86.1 ± 13.9</td>
<td>85.1 ± 13.5</td>
<td>–1.0 ± 1.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>33.4 ± 4.0</td>
<td>33.1 ± 4.1</td>
<td>–0.4 ± 0.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>100.6 ± 12.1</td>
<td>95.4 ± 11.2</td>
<td>–5.2 ± 3.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hip circumference (cm)</td>
<td>115.1 ± 9.6</td>
<td>109.8 ± 8.8</td>
<td>–5.3 ± 4.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Percent fat (%)</td>
<td>43.7 ± 4.8</td>
<td>43.2 ± 4.8</td>
<td>–0.5 ± 1.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fat mass (kg)</td>
<td>37.5 ± 7.3</td>
<td>36.7 ± 7.2</td>
<td>–0.8 ± 1.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fat-free mass (kg)</td>
<td>48.4 ± 9.3</td>
<td>48.2 ± 9.0</td>
<td>–0.2 ± 1.2</td>
<td>0.161</td>
</tr>
<tr>
<td>8-foot up-and-go test (s)</td>
<td>8.94 ± 1.68</td>
<td>8.39 ± 1.64</td>
<td>–0.56 ± 0.89</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Handgrip strength (kg)</td>
<td>28.5 ± 7.2</td>
<td>29.7 ± 7.4</td>
<td>1.2 ± 2.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Knee extensor torque (N-m)</td>
<td>62.8 ± 26.0</td>
<td>70.6 ± 20.4</td>
<td>7.9 ± 19.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SPPB total score (0–12)</td>
<td>10.1 ± 1.6</td>
<td>10.6 ± 1.5</td>
<td>0.5 ± 1.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SPPB chair stand time (s)</td>
<td>12.96 ± 2.94</td>
<td>12.09 ± 1.73</td>
<td>–0.86 ± 2.21</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SPPB gait speed time (s)</td>
<td>3.87 ± 1.25</td>
<td>3.70 ± 0.67</td>
<td>–0.17 ± 1.21</td>
<td>0.112</td>
</tr>
<tr>
<td>DST total score (0–100)</td>
<td>66.7 ± 12.1</td>
<td>73.4 ± 10.4</td>
<td>6.8 ± 10.0</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Abbreviations: SPPB, short physical performance battery; DST, dietary screening tool.

Note. Torque (N-m) was calculated as the product of force (N) and limb length (m).

* Some variables do not have 95 participants (BMI = 94, Percent fat = 82, Fat mass = 82, Fat-free mass = 82, 8-foot up-and-go test = 94, Handgrip strength = 94, Knee extensor torque = 93, SPPB chair stand time = 86, and SPPB gait speed time = 94).
Discussion

This is the first study to investigate the effects of a community-based intervention that integrated RT and dietary changes to facilitate weight loss on physical function and body composition in overweight and obese, community-dwelling older adults. The results of this investigation suggest that community-based RT and concomitant dietary modifications for intentional weight loss is an effective strategy for promoting positive changes in body composition and improvements in physical function and muscle strength in overweight and obese older adults.

The current study supports our hypothesis that community-based RT and dietary education is associated with improvements in muscle strength. In our investigation, knee extensor strength was measured at ~25° of flexion because force production at this joint angle has been identified as important for ambulation.29 Thus, the significant improvement observed in the capacity to generate force at this joint angle may positively affect walking ability in older adults. While a significant improvement was not observed in the SPPB gait speed assessment, the significant reduction demonstrated by our cohort in the 8-foot up-and-go test time may be indicative of improved ambulation. In addition, maximal handgrip strength significantly improved following the intervention. The observed increase corroborates the findings of previous investigations10,24 that have reported improvements following RT with resistance tubing and ankle weights. The current study suggests that an intervention integrating RT and dietary modifications is an efficacious stimulus for improving handgrip strength, which is critical as reduced handgrip strength is a valid predictor of future disability in older adults.42

Performance on the 8-foot up-and-go test significantly improved following the intervention. Mean baseline 8-foot up-and-go test time was 8.94 s and at postintervention it was 8.39 s ($P < .001$). Notably, it has been reported that older adults who require > 8.5 s to complete the 8-foot up-and-go test experience an increased risk of falling.43 Thus, the improvement in 8-foot up-and-go test time to a postintervention value below this cut-point is clinically meaningful as it may result in a substantial reduction in risk of falling in older adults. In addition, the SPPB provides an indication of lower-extremity physical function in older adults16 and our study observed an improvement of 0.5 in SPPB total score. This is important as a previous report suggested that a SPPB total score change of 0.3–0.8 can be interpreted as clinically significant.44 Thus, although the baseline SPPB total score indicated that our cohort was generally high-functioning (10.1 out of 12), they demonstrated a statistically significant and clinically meaningful improvement following the intervention. Likewise, duration required to complete the timed 4-meter walk subcomponent of the SPPB improved by 0.17 s ($P = .112$), and although this value did not achieve statistical significance, it equates to an improvement in walking speed of 0.04 m/s. Kwon and colleagues44 reported that improvements in walking speed between 0.03–0.05 m/s during the timed 4-meter walk are clinically meaningful, which suggests the improvement experienced by our cohort may have important implications on independent ambulation.

In addition to the observed improvements in physical function and muscle strength, the cohort demonstrated improvements in several indices of body composition. Waist circumference decreased by ~5.2 cm, which is similar to the reduction observed in a previous intervention that incorporated RT and dietary modifications in obese older adults.45 The reduction in waist circumference demonstrated by the analytic sample may be of particular importance as centrally-deposited adiposity is associated with the development of metabolic abnormalities in older adults.46

A comparison of the suburban and urban senior centers is provided because research suggests that socioeconomic status is an important predictor of physical activity behavior.47 While socioeconomic status was not directly measured, education level was assessed and has been considered a major determinant of socioeconomic status.48 Past research has indicated that variability in sedentary behavior may be predicated on living environment and educational attainment among women.49 Based on these previously reported differences, we believed it was worthwhile to compare the effectiveness of this intervention between suburban and urban senior centers. However, our analyses suggest that the intervention was equally effective for the suburban and urban senior centers as only the change in SPPB gait speed time was significantly different between sites (Table 2).

Although favorable alterations in body composition and physical function were observed, there are potential limitations to this investigation that should be acknowledged. A primary limitation is that there was not a control group for this study, as it was a community-outreach intervention. The lack of a control group may have resulted in improvements in physical function due to a learning effect from baseline testing. However, a previous investigation from our laboratory showed that those in a weight loss-only control group demonstrated improvements in global physical function measures but not muscle strength.50 Another limitation is that handheld bioelectrical impedance is not capable of measuring percent body fat values > 50%. However, handheld bioelectrical impedance is relatively inexpensive, portable, low-risk and a valid and reliable measurement of body composition44 and was therefore appropriate for a community outreach intervention of this manner. In addition, community-based interventions that involve RT are limited by the type and quantity of exercise equipment available to participants. Participants performed RT using free weights, resistance tubing, and ankle weights and this may have affected the magnitude of improvement in strength and physical function. However, such equipment is cost-effective and feasible for use in community-based settings and other investigations have reported improvements in strength and physical function following interventions that used similar equipment.12,13 Additionally,
Table 2  Comparison of Suburban and Urban Sites at Baseline, Postintervention, and Changes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suburban (n = 54)*</th>
<th>Within-group</th>
<th>Urban (n = 41)*</th>
<th>Within-group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Post</td>
<td>Change</td>
<td>P-value</td>
</tr>
<tr>
<td>Height</td>
<td>160.4 ± 8.5</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>85.6 ± 14.3</td>
<td>84.6 ± 13.9</td>
<td>−1.0 ± 1.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>33.1 ± 3.7</td>
<td>32.7 ± 3.8</td>
<td>−0.4 ± 0.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>99.9 ± 12.0</td>
<td>95.0 ± 11.5</td>
<td>−4.9 ± 3.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hip circumference (cm)</td>
<td>114.7 ± 8.9</td>
<td>109.1 ± 8.2</td>
<td>−5.6 ± 3.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Percent fat (%)</td>
<td>43.5 ± 4.7</td>
<td>42.9 ± 4.8</td>
<td>−0.6 ± 1.2</td>
<td>0.003</td>
</tr>
<tr>
<td>Fat mass (kg)</td>
<td>36.8 ± 6.8</td>
<td>35.8 ± 6.6</td>
<td>−1.0 ± 1.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fat-free mass (kg)</td>
<td>48.1 ± 9.9</td>
<td>47.9 ± 9.6</td>
<td>−0.2 ± 1.2</td>
<td>0.307</td>
</tr>
<tr>
<td>8-foot up-and-go test (s)</td>
<td>8.79 ± 1.51</td>
<td>8.16 ± 1.51</td>
<td>−0.63 ± 0.93</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Handgrip strength (kg)</td>
<td>28.8 ± 8.1</td>
<td>29.6 ± 8.2</td>
<td>0.9 ± 2.6</td>
<td>0.009</td>
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<tr>
<td>Knee extensor torque (N-m)</td>
<td>64.9 ± 27.6</td>
<td>71.4 ± 21.4</td>
<td>6.4 ± 21.5</td>
<td>0.001</td>
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<tr>
<td>SPPB total score (0–12)</td>
<td>10.2 ± 1.5</td>
<td>10.7 ± 1.4</td>
<td>0.6 ± 1.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SPPB chair stand time (s)</td>
<td>13.24 ± 3.00</td>
<td>12.01 ± 1.63</td>
<td>−1.24 ± 2.40</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SPPB gait speed time (s)</td>
<td>3.83 ± 1.55</td>
<td>3.57 ± 0.55</td>
<td>−0.26 ± 1.57*</td>
<td>0.296</td>
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<tr>
<td>DST total score (0-100)</td>
<td>66.8 ± 12.4</td>
<td>74.3 ± 10.6</td>
<td>7.5 ± 10.6</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Abbreviations: SPPB, short physical performance battery; DST, dietary screening tool.

Note. Torque (N-m) was calculated as the product of force (N) and limb length (m). Differences in change variables for physical function and muscle strength tests were adjusted for baseline values, BMI, age, and gender; all other change variables were adjusted for baseline values, BMI, age, and gender.

*Some variables do not have 54 participants (Percent fat, Fat mass, and Fat-free mass = 46, 8-foot up-and-go test = 53, Handgrip strength = 53, Knee extensor torque = 52, SPPB total = 53, SPPB chair stand time = 49, SPPB gait speed time = 53).

*Some variables do not have 41 participants (BMI = 40, Percent fat, Fat mass, and Fat-free mass =36, SPPB chair stand time = 37).

*Significantly different from the urban group (P < .05).
changes in body composition and physical function may have been influenced by the duration of our intervention, which was shorter than those of previous investigations involving older adults. It is likely that the modest weight loss in our study was limited by the length of the intervention and greater reductions in body mass may have been observed with a longer intervention.

The results of this investigation suggest that an 8-week RT and dietary education intervention can be successfully implemented in a community-based setting and is associated with improvements in body composition, physical function, and muscle strength in overweight and obese older adults. While participants were encouraged to accumulate 180 minutes of physical activity each week in accordance with the DASH diet, leisure-time physical activity was not controlled and it is uncertain whether this recommendation was met. Nevertheless, the increase in energy expenditure related to physical activity (~8.4%), although not statistically significant, likely contributed to the reduction in body weight. Thus, it remains unclear whether RT and dietary modifications are sufficient for eliciting health improvements, or if all 3 intervention strategies (RT, diet, and increased leisure-time physical activity) are equally important for precipitating these changes. Lastly, studies of longer duration are needed to facilitate greater weight loss and to determine if this combination of intervention strategies results in long-term behavior changes and reduces the risk of future chronic disease.

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