Pilot Randomized Controlled Trial: Elastic-Resistance-Training and Lifestyle-Activity Intervention for Sedentary Older Adults

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The aim of this study was to determine the efficacy and feasibility of a resistance-training (RT) and lifestyle-activity program for sedentary older adults. Eligible participants (N = 44) were randomized to an 8-wk intervention or a control group. The primary outcome was lower body muscle strength, and participants completed a range of secondary outcomes. There was a significant group-by-time interaction for lower body muscle strength (difference = 3.9 repetitions [reps], 95% CI = 2.0–5.8 reps; p < .001; d = 1.0). Changes in secondary outcomes were generally small and not statistically significant. Attendance and program satisfaction were both high. A combined elastic-tubing RT and lifestyle-activity program delivered in the community setting is an efficacious and feasible approach to improve health in sedentary older adults.

Keywords: strength training, physical activity, fitness, behavior change

Promotion of physical activity among older adults has emerged as an important health priority for a number of reasons. First, physical inactivity is a major risk factor for various lifestyle diseases including cardiovascular disease, hypertension, osteoporosis, diabetes, and obesity (World Health Organization, 2005). Second, life expectancy has increased rapidly over the last century (National Center for Health Statistics, 2011), and the health care costs associated with an aging population are substantial (Coory, 2004; Guralnik, Alecxih, Branch, & Wiener, 2002). Finally, most older adults fail to accumulate sufficient physical activity to accrue the associated health benefits such as maintained muscle strength (Armstrong, Bauman, & Davies, 2000; Centers for Disease Control and Prevention, 2004; Kruger, Carlson, & Buchner, 2007).

Muscle strength declines by 15% every 10 years after the age of 50 and then declines 30% every 10 years after the age of 70 due to sarcopenia (American College of Sports Medicine, 1998). The direct health care costs attributable to sarcopenia in the United States in 2000 was $18.5 billion, which represented about 1.5% of total...
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health care expenditure for that year (Janssen, Shepard, Katzmarzyk, & Roubenoff, 2004). It is therefore not surprising that the physical activity recommendations for older adults include guidelines for aerobic activity and muscle-strengthening activities (U.S. Department of Health and Human Services, 2008).

A review of 62 trials concluded that progressive resistance training (RT) can improve muscle strength in older adults (Latham, Bennett, Stretton, & Anderson, 2004). While these findings are positive, most of the studies were evaluated in tightly controlled and closely supervised settings, which may limit their generalizability to community settings. Many older adults are unable or unwilling to participate in these types of programs due to barriers such as poor health, fear of injury, and lack of transportation (Cyarto, Brown, Marshall, & Trost, 2008). Therefore, designing programs that can be delivered in settings that are convenient for older adults may overcome existing barriers and support exercise adherence.

In a recent study, Van Roie et al. (2010) compared the effects of a lifestyle physical activity program and a structured exercise intervention on physical fitness and cardiovascular risk factors in sedentary older adults. The structured exercise intervention was delivered in a fitness center, while participants in the lifestyle intervention were provided with minimal instruction and were required to complete their training in their homes. Both interventions resulted in improvements in functional performance, but the structured intervention was more effective in improving health-related fitness. Similarly, Cyarto et al. (2008) evaluated the effects of home-based and group-based RT programs for older adults. They found stronger intervention effects among those in the group-based intervention and concluded that identifying strategies to encourage older adults to adopt and maintain RT programs remains a research priority.

Evidence suggests that intervention-based theories of health-behavior change (e.g., theory of planned behavior, social cognitive theory [SCT], and the transtheoretical model) are more successful in changing behavior than atheoretical ones (Dishman, Oldenburg, O’Neal, & Shephard, 1998; Michie & Abraham, 2004). SCT (Bandura, 2004) has emerged as a prominent theory for increasing physical activity in behavior-change interventions (Hillsdon, Foster, & Thorogood, 2005). In SCT, self-efficacy is considered the most important determinant because it influences health behavior both directly and indirectly through its influence on the other determinants (Bandura, 2004). In the context of physical activity, barrier self-efficacy refers to an individual’s confidence to overcome impediments (e.g., lack of time, bad weather) to activity, while task self-efficacy refers to a person’s confidence in his or her skills to complete the actual task (e.g., RT). SCT also includes goals (proximal or distal intentions to perform the behavior), outcome expectations (the perceived costs and benefits of the behavior), outcome expectancies (perceived importance of the potential costs and benefits of the behavior), facilitators, and impediments (social and environmental factors that may support or impede the targeted behavior).

The aim of this study was to report the efficacy and feasibility of a RT and lifestyle-activity program for sedentary older adults that was delivered in the community setting using elastic-tubing RT devices. Most studies designed to improve muscle strength in older adults have used free weights (Peterson, Sen, & Gordon, 2011). Consequently, little is known about the magnitude of training effects that elastic resistance devices can induce with older adults in RT-only programs or in RT
programs combined with aerobic activity, as these devices have typically been used for rehabilitative purposes (Damush & Damush, 1999; Krebs, Jette, & Assmann, 1998). Traditional elastic resistance bands do not provide adequate opportunity for progressive overload, and self-monitoring is problematic due to difficulty in measuring workload. Although more sophisticated elastic resistance devices are currently available (e.g., Gymstick, Bodylastics, and Thera-Band Stretch Strap), evidence for their efficacy is limited. Unlike traditional resistance bands, which may consist of a single length of elastic band, newer devices include handles, bars, and foot straps that allow users to complete a wide range of exercises. Gymsticks also allow individuals to monitor the intensity of their repetitions by recording the number of times they roll the bar. Considering the importance of physical activity for health among older adults and their current levels of inactivity, there is an urgent need to develop and evaluate feasible programs that can be delivered in community settings.

Methods

Study Design

The design, implementation, and reporting of the program closely followed the Consolidated Standards of Reporting Trials (CONSORT) guidelines for randomized trials (Moher et al., 2010). The CONSORT statement is an evidence-based set of recommendations for running and reporting the results of randomized controlled trials. It was designed to ensure complete and transparent reporting to permit critical appraisal and interpretation. Ethics approval for this study was obtained from the University of Newcastle Human Research Ethics Committee. All study participants provided written informed consent. The study was conducted in one retirement home on the central coast of New South Wales, Australia, from May to July 2009. Baseline data were collected 1–2 weeks before the start of the 8-week intervention, and posttest data were collected 1–2 weeks after the program.

Sample Size

Lower body muscle strength was the primary outcome, and a power calculation was conducted to determine the sample size required. Based on normative data (Rikli & Jones, 1999), using an alpha of .05 and power of 80%, it was determined that a sample of approximately 40 participants was needed to detect a difference of 2.5 repetitions between groups for the 30-s chair-stand test.

Participants

Eligible participants were recruited over a 1-month period and included individuals age 60–90 years who were living in the selected retirement home. A member of the research team was allowed to present the project to members of the retirement home. Participants were eligible if they were living independently and reported less than 30 min of physical activity per day. Individuals were ineligible if they had a recent history of major medical problems such as heart disease in the last 5 years or orthopedic or joint problems that would be a barrier to physical activity. To participate in the program, individuals were required to obtain written clear-
ance from their general practitioners. After baseline assessments, participants ($N = 44$) were randomized to one of the two study arms: intervention or control group.

**Treatment Conditions**

The intervention consisted of two face-to-face sessions each week for 8 weeks, and participants were provided with physical activity handbooks and pedometers to encourage goal setting and physical activity self-monitoring. The intervention was developed in reference to SCT (Bandura, 1986, 2004) and involved a variety of behavior-change strategies (Abraham & Michie, 2008). The intervention was based on the following physical activity behavioral strategies, which were introduced in the face-to-face sessions and reinforced in the physical activity handbooks: Monitor your physical activity and set goals using your pedometer, increase your incidental physical activity, reduce your time spent in sedentary pursuits (e.g., watching television), organize opportunities for activity into your day, review your physical activity goals and strategies, identify opportunities for physical activity in your environment, and reward yourself for achieving your physical activity goals. Both barrier self-efficacy and task self-efficacy (i.e., RT skill) were targeted in the intervention. Participants discussed potential barriers and identified strategies to overcome them. To improve task self-efficacy, participants performed the RT sessions with the instructor, who also demonstrated the target behavior and provided feedback on performance. To improve participants’ outcome expectations, they were provided with information on the benefits of RT, and the instructor prompted self-reflection on RT performance and the potential benefits. In the sessions, the instructor provided social support and encouragement to the participants. Participants were encouraged to plan physical activity sessions with their friends and elicit social support from significant others to increase enjoyment and adherence.

The intervention was delivered in groups by a qualified personal trainer who was also a physical education teacher. Each face-to-face session involved an information component focused on the lifestyle physical activity component of the intervention (10–15 min) and participation in resistance exercises (45–60 min) using body weight and elastic-tubing resistance devices (Gymstick). The device consists of a graphite shaft that has elastic tubing with foot straps connected to each end, enabling the user to complete a wide range of resistance exercises. Previous studies have demonstrated that these devices can be used to successfully improve body composition and muscular fitness in youth (Lubans, Aguiar, & Callister, 2010; Lubans, Morgan, Aguiar, & Callister, 2011).

Before commencing each session, participants completed general movement (e.g., walking, jogging on the spot) and dynamic stretching (e.g., leg swings, body weights, squats) to warm up. In each session, participants completed two sets of 10–15 repetitions for 10 exercises targeting the upper body, lower body, and core muscles (i.e., rectus abdominis, obliquus, transverse abdominis, and erector spinae). The five upper body exercises included the biceps curl, triceps extension, bent-over row, front raise, and chest press. Three lower body exercises included the squat, lunge, and calf raise. Exercises targeting the core included reverse crunch, quadruped, and seated chair rotation. The rating of perceived exertion (RPE) was used to determine training intensity and progression (Borg, 1998). The RPE scale
uses a range from 6 (no exertion at all) to 20 (maximum exertion). The scale was explained and examples of exertion were provided for participants, who were encouraged to achieve an RPE of 12–16 for all sets completed. Participants were encouraged to stay hydrated during sessions, and at the completion of each session they were encouraged to perform static stretching.

Behavioral strategies such as goal setting, self-monitoring, and self-assessment are skills that can be learned to support positive health-behavior change. In a recent review of the mediators of behavior change in physical activity interventions, Rhodes and Pfaeffli (2010) concluded that changes in self-regulation constructs have the most effect on changes in physical activity. More specifically, self-monitoring with pedometers has emerged as an effective strategy to increase physical activity and improve weight status in adults (Bravata et al., 2007). To increase participants’ intentions to be active, they were provided with pedometers and encouraged to set physical activity step goals using their baseline values. They were encouraged to increase their physical activity by 10% every 2 weeks until they achieved the step target of 10,000 steps. In the information component of the sessions, participants were encouraged to identify potential rewards for achieving their physical activity goals. These rewards were discussed with the instructor and recorded in participants’ handbooks. The physical activity handbooks were consistent with SCT and included information detailing the benefits of physical activity (i.e., RT and lifestyle activity) and strategies to increase activity levels. The handbooks included weekly challenges designed to reinforce the physical activity behavioral strategies. The physical activity handbook’s behavior-change strategies involved in the RT component of the intervention included providing information about the behavior–health link, prompting self-monitoring of behaviors, and planning social support or social change. Participants in the control group were provided with a pedometer and basic information regarding physical activity self-monitoring. Control group participants received the full intervention at the completion of the study period.

Measures

Assessments were conducted by a member of the research team at the retirement home at baseline and posttest. Baseline assessments were conducted before group allocation, but assessor blinding was not possible at posttest.

**Lower Body Muscle Strength.** The 30-s chair-stand test was used to provide a measure of lower body muscle strength (Jones, Rikli, & Beam, 1999).

**Height and Weight.** Weight was measured in light clothing without shoes using a portable digital scale (Omron, HBF-500, Kyoto Japan) to the nearest 0.1 kg, and height was measured to the nearest 0.1 cm using a portable stadiometer (Design No. 1013522, Surgical and Medical Products, Australia). Body-mass index was calculated as weight (kg)/height (m²).

**Bioelectrical Impedance.** Percentage body fat was determined using the Omron, HBF-500 bioelectrical impedance analyzer.

**Blood Pressure and Resting Heart Rate.** Systolic and diastolic blood pressure and heart rate were measured using a NISSEI/DS-105E digital electronic blood-pressure monitor (Nihon Seimitsu Sokki Co. Ltd., Gunma, Japan). Participants were seated for at least 5 min before blood pressure and resting heart rate were recorded.
**Static Balance.** Balance was measured by recording how long participants could remain standing on their self-reported dominant leg with their eyes open and their free foot 5 cm off the ground (Bohannon, Larkin, Cook, Gear, & Singer, 1984; Ringsberg, Gerdhem, Johansson, & Obrant, 1999). Lower body weakness and balance impairment have been identified as risk factors for the transition in status from nonfaller to faller in community-dwelling older adults (Muir, Berg, Chesworth, Klar, & Speechley, 2010).

**Physical Activity.** Yamax CW200 pedometers (Yamax Corp., Kumamoto City, Japan) were used to provide 7 days (including 2 weekend days) of objectively measured physical activity. Participants were instructed by a member of the research team on how to attach the pedometers (at the waist on the right hand side) and asked to remove them only when sleeping or when the pedometer might get wet. Participants were instructed to record their steps at the end of each day, reset their pedometers to zero, and record if they had removed their pedometer for any reason. Self-reported physical activity type, frequency, and duration were measured using the eight items from the Active Australia survey (Australian Institute of Health and Welfare, 2003). Minutes per week spent in moderate to vigorous physical activity and walking briskly are reported in this article.

**Process Evaluation**

A process evaluation was undertaken to assess the feasibility of the intervention. This included recruitment (achievement of target sample size), retention (retention rates at 2-month follow-up), and program satisfaction with the intervention components. At the completion of the study, participants were asked to rate their satisfaction with the program by responding to the following statements using a 5-point Likert scale from 1 = *strongly disagree* to 5 = *strongly agree*: “The physical activity handbook was easy to understand,” “The physical activity handbook provided me with useful information,” “I enjoyed attending the program sessions,” “I enjoyed the fitness testing components of the intervention,” and “Overall I am satisfied with the program.”

**Analysis**

Statistical analyses were completed using PASW Statistics 17 software (SPSS Inc., Chicago, IL), and alpha levels were set at $p < .05$. All variables were checked for normality and transformed where necessary. Independent-samples $t$ tests were used to compare groups on all primary and secondary outcomes at baseline. Six participants were not available at posttest, and their baseline values were carried forward and used in all analyses (i.e., intention-to-treat principle). Linear mixed models were fitted with an unstructured covariance structure and used to compare intervention and control groups for continuous variables. Mixed models were used to assess primary and secondary outcomes for the impacts of group (intervention or control) and time (treated as categorical—baseline and 2-month posttest) and the group-by-time interaction. Cohen’s $d$ (1988) was calculated using the differences between the mean group change scores divided by the pooled standard deviation of the group ($d = M_1 - M_2/SD_{pooled}$). Effect sizes were interpreted as small, $d < 0.20$; medium, $d = 0.50$; or large, $d = 0.80$ (Cohen, 1988).
Results

Overview of Study Sample

The study included 23 male and 21 female participants (Table 1). They ranged in age from 66 to 91 years, with a mean (SD) of 75.8 (5.8) years. All the participants were White, and most were born in Australia (66%), which is representative of the region of Australia in which the study was conducted. At baseline, 45.5% of participants were considered overweight and 22.7% obese (31.8% healthy weight status). There were no statistically significant differences between groups for any of the outcomes at baseline.

Effects on Outcomes

The intervention effects for the primary and secondary outcomes are provided in Table 2. Significant beneficial treatment effects were found from baseline to 2 months for the 30-s chair-stand test (mean difference = 3.9 repetitions, 95%

Table 1  Baseline Characteristics of Study Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Control (n = 22)</th>
<th>Intervention (n = 22)</th>
<th>Total (N = 44)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), M, SD</td>
<td>75.3 5.6</td>
<td>76.4 6.1</td>
<td>75.8 5.8</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>11 50%</td>
<td>12 54.5%</td>
<td>23 52.3%</td>
</tr>
<tr>
<td>female</td>
<td>11 50%</td>
<td>10 45.5%</td>
<td>21 47.7%</td>
</tr>
<tr>
<td>Weight (kg), M, SD</td>
<td>74.6 13.2</td>
<td>71.1 10.4</td>
<td>72.8 11.9</td>
</tr>
<tr>
<td>Height (cm), M, SD</td>
<td>164.4 7.6</td>
<td>165.8 8.6</td>
<td>165.1 8.1</td>
</tr>
<tr>
<td>BMI (kg/m²), M, SD</td>
<td>27.4 5.4</td>
<td>26.3 3.8</td>
<td>26.9 4.6</td>
</tr>
<tr>
<td>BMI category, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>healthy weight</td>
<td>7 31.8%</td>
<td>7 31.8%</td>
<td>14 31.8%</td>
</tr>
<tr>
<td>overweight</td>
<td>8 36.4%</td>
<td>12 54.5%</td>
<td>20 45.5%</td>
</tr>
<tr>
<td>obese</td>
<td>7 31.8%</td>
<td>3 13.6%</td>
<td>10 22.7%</td>
</tr>
<tr>
<td>BIA (body fat %), M, SD</td>
<td>31.0 10.9</td>
<td>27.9 9.2</td>
<td>29.5 10.9</td>
</tr>
<tr>
<td>Systolic BP (mm Hg), M, SD</td>
<td>136.1 12.9</td>
<td>138.3 11.5</td>
<td>137.2 12.1</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg), M, SD</td>
<td>79.1 8.4</td>
<td>82.7 11.8</td>
<td>80.9 10.3</td>
</tr>
<tr>
<td>Resting heart rate (BPM), M, SD</td>
<td>73.4 9.8</td>
<td>74.4 8.4</td>
<td>73.9 9.0</td>
</tr>
<tr>
<td>30-s chair test (reps), M, SD</td>
<td>12.6 2.9</td>
<td>12.3 3.2</td>
<td>12.4 3.1</td>
</tr>
<tr>
<td>Static balance (s), M, SD</td>
<td>26.4 28.2</td>
<td>24.9 17.0</td>
<td>25.7 23.0</td>
</tr>
<tr>
<td>Physical activity (steps/day), M, SD</td>
<td>6,159 3,204</td>
<td>7,678 3,030</td>
<td>6,919 3,171</td>
</tr>
<tr>
<td>Walking briskly (min/week), M, SD</td>
<td>113.6 105.2</td>
<td>126.7 126.4</td>
<td>119.9 114.5</td>
</tr>
<tr>
<td>MVPA (min/week), M, SD</td>
<td>55.2 78.7</td>
<td>94.7 118.7</td>
<td>74.05 100.55</td>
</tr>
</tbody>
</table>

Note. BMI = body-mass index; BIA = bioelectrical impedance analysis; BP = blood pressure; BPM = beats/min; reps = repetitions; MVPA = moderate to vigorous physical activity. There were no statistically significant differences between groups at baseline for any of the demographic or outcome variables.
Table 2  Intervention Effects for Outcomes at 2-Month Posttest in Older Adults (N = 44)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Control (n = 22)</th>
<th>Intervention (n = 22)</th>
<th>Mean difference between groups (95% CI)b</th>
<th>Group × Time p</th>
<th>Effect size (Cohen’s d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>–0.04 (–4.1, 0.48)</td>
<td>–0.06 (–0.51, 0.38)</td>
<td>–0.03 (–0.65, 0.60)</td>
<td>.936</td>
<td>–0.02</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>–0.01 (–0.18, 0.15)</td>
<td>–0.02 (–0.19, 0.14)</td>
<td>–0.01 (–0.24, 0.22)</td>
<td>.942</td>
<td>–0.03</td>
</tr>
<tr>
<td>BIA (% body fat)</td>
<td>0.59 (–0.70, 1.87)</td>
<td>–0.01 (–1.30, 1.27)</td>
<td>–0.60 (–2.42, 1.21)</td>
<td>.507</td>
<td>–0.20</td>
</tr>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>1.0 (–3.1, 5.2)</td>
<td>–1.8 (–5.9, 2.3)</td>
<td>–2.8 (–8.7, 3.0)</td>
<td>.332</td>
<td>–0.30</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>2.2 (–2.6, 6.9)</td>
<td>–2.2 (–7.0, 2.5)</td>
<td>–4.4 (–2.4, 11.1)</td>
<td>.196</td>
<td>–0.39</td>
</tr>
<tr>
<td>Resting heart rate (BPM)</td>
<td>1.0 (–1.8, 3.7)</td>
<td>–2.2 (–4.9, 0.6)</td>
<td>–3.1 (–7.0, 0.7)</td>
<td>.111</td>
<td>–0.48</td>
</tr>
<tr>
<td>30-s chair test (reps)</td>
<td>–0.3 (–1.6, 1.1)</td>
<td>3.6 (2.3, 5.0)</td>
<td>3.9 (2.0, 5.8)</td>
<td>&lt;.001</td>
<td>1.04</td>
</tr>
<tr>
<td>Static balance (s)c</td>
<td>–0.0 (–0.1, 0.0)</td>
<td>0.0 (–0.1, 0.1)</td>
<td>0.1 (–0.1, 0.2)</td>
<td>.377</td>
<td>0.29</td>
</tr>
<tr>
<td>Physical activity (steps/day)</td>
<td>641 (–283, 1,564)</td>
<td>561 (–363, 1,484)</td>
<td>–80 (–1,386, 1,226)</td>
<td>.920</td>
<td>–0.04</td>
</tr>
<tr>
<td>Walking briskly (min/week)</td>
<td>90.9 (6.4, 175.4)</td>
<td>103.1 (17.5, 188.7)</td>
<td>12.2 (–108.1, 132.5)</td>
<td>.839</td>
<td>0.15</td>
</tr>
<tr>
<td>MVPA (min/week)</td>
<td>4.4 (–46.6, 55.4)</td>
<td>80.1 (28.7, 131.5)</td>
<td>75.7 (3.2, 148.1)</td>
<td>.04</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Note. BMI = body mass index; BIA = bioelectrical impedance analysis; BP = blood pressure; BPM = beats/min; reps = repetitions; MVPA = moderate to vigorous physical activity.

aTime differences were calculated as 2 months minus baseline. bBetween-groups differences at 2 months (intervention minus control). cData were log-transformed due to nonnormal distribution.
CI = 2.0–5.8, *p* < .001, *d* = 1.0). Weight, body-mass index, and percent body fat remained relatively stable over the study period. Intervention effects for blood pressure, heart rate, and static balance were in the hypothesized direction but were not statistically significant. The intervention had a medium-size effect on self-reported moderate to vigorous physical activity minutes per week (mean difference = 75.7 min/week, 95% CI = 3.2–148.1, *p* = .041, *d* = 0.7). Effects on physical activity (pedometer-measured steps per day and self-reported brisk walking) were not statistically significant.

### Process Evaluation

The target sample size of 40 was achieved in the one month that was available for recruitment. Retention rate after 2 months was 86% in both intervention and control groups. Participants attended 90% of the face-to-face RT sessions. Most participants found that the physical activity handbook was easy to use (76%) and provided useful information (94%). All enjoyed the program sessions (23% agreed, 77% strongly agreed), and most enjoyed the fitness-testing component of the intervention (24% agreed, 59% strongly agreed). Finally, all the participants were satisfied with the program (35% agreed, 65% strongly agreed).

### Discussion

Our purpose in this study was to evaluate the efficacy and feasibility of an RT and lifestyle-activity program for older adults conducted in a retirement community. The intervention produced statistically significant changes in the primary outcome of lower body muscle strength. Changes in lower body muscle strength were large (*d* = 1.0) and compared favorably with improvements in lower limb muscle strength reported in Latham et al.’s (2004) meta-analysis (standardized mean difference = 0.68). The improvements were also larger than those observed in the recent studies by Cyarto et al. (2008) and by Van Roie et al. (2010); however, the latter study was evaluated over a considerably longer period (i.e., 11 months). There was also a general trend toward improvements in the secondary outcomes including body composition, resting heart rate, and blood pressure. These findings are encouraging because most of the studies in the review were conducted in a gym or clinic, using specialized machines to perform RT. Our finding, that similar effects can be realized in a community setting with relatively low-cost equipment (i.e., elastic-tubing resistance devices), suggests that this type of intervention may be a cost-effective method to promote meaningful improvements in the muscle strength and waist circumference of older adults.

One outcome that did not show any between-groups difference over time was walking behavior as measured by pedometers and self-reported brisk walking. Our intervention was designed to promote RT and general lifestyle activity. While the experimental group participants appeared to increase overall moderate to vigorous activity levels more than those in the control group (*d* = 0.7, *p* = .04), interventions designed to specifically target walking behavior may be needed to promote this specific type of activity. Lifestyle interventions have demonstrated promise in promoting sustainable long-term behavior change among older adults (Opdenacker, Boen, Coorevits, & Delecluse, 2008; Stevens, Lemmink, de Greef,
Elastic Resistance Training & Rispens, 2000). For example, Opdenacker et al. found significant long-term (i.e., 12-month) intervention effects among a sample of older adults who participated in a lifestyle physical activity intervention.

Positive results were also found in the process evaluation. A high proportion of participants in both arms of the trial completed the study. Furthermore, participants in the experimental group enjoyed the program sessions, found physical activity handbooks useful, and were satisfied with their involvement in the program. These results suggest that the training program may be sustainable over a longer time than the 2-month period of this study. However, an important limitation of our study was the lack of medium- or long-term follow-up assessment to determine if physical activity behaviors and improvements in outcome measures were maintained beyond the end of the intervention. Previous studies have shown that participants in structured exercise classes held in gym settings often do not continue their physical activity after the end of the intervention, perhaps because of barriers such as the costs of gym membership and feelings of intimidation associated with exercise in a facility populated mainly by younger and healthier clients (Opdenacker et al., 2008). Future studies should include follow-up assessments to determine if basing programs in community settings, using low-cost equipment, and employing social cognitive theory–based promotion strategies can increase long-term adherence to RT programs. These studies could also assess the long-term impact of strength gains on risk of injury, quality of life, and possible reductions in costs that could be associated with the attenuation of declines in strength that are usually observed in older adults.

The strengths of this study include the high level of participant compliance and our adherence to the CONSORT guidelines in the design, implementation, and reporting of the study. However, some limitations should be noted. Due to the relatively small sample size, we were not able to detect significant effects for many of the secondary outcomes. Future trials may need to extend the recruitment period, recruit from larger residential facilities, or consider multiple sites, none of which was possible in the current study. Recruiting across multiple sites and employing a cluster randomized design may also be advisable because of the potential risk of contamination effects when all participants are recruited from the same facility. Indeed, it is possible that some participants in the control group of our study increased their physical activity behavior after coming in contact with experimental group participants who lived in the same facility, thereby reducing our treatment effects.

Despite these noted limitations, the current study adds to the current literature in a number of ways. Most important, our findings demonstrate that an 8-week elastic-RT program for older adults is feasible in a community-based setting. In addition, it appears that this intervention can produce muscle-strength gains that are comparable to those achieved in gym-based studies employing more expensive equipment (Latham et al., 2004). The elastic resistance devices used in this study allowed participants to effectively self-monitor their workloads to facilitate progressive overload. Self-monitoring is a central tenet of behavioral approaches to changing health behavior and may predict long-term exercise adherence (Bandura, 1997). Finally, older adults in this study found RT to be enjoyable. Further investigation with larger samples to investigate trends seen in the data with greater statistical power is warranted.
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References


Elastic Resistance Training


