Can Neuromuscular Strength and Function in People With Dementia Be Rehabilitated Using Resistance-Exercise Training? Results From a Preliminary Intervention Study

Vince Salazar Thomas¹ and Patricia A. Hageman²

¹Center for the Aging, and Departments of Community & Family Medicine and Medicine, Dartmouth Medical School, Hanover, New Hampshire.
²Division of Physical Therapy Education, School of Allied Health, University of Nebraska Medical Center, Omaha.

Background. Neuromuscular weakness is a prominent symptom among people with central nervous system disorders, such as dementia, typically leading to disability in activities of daily life. We sought to evaluate the potential of resistance exercise to improve neuromuscular strength and function in the lower extremities among community-dwelling people with dementia.

Methods. Twenty-eight subjects, aged 70–88 years and with an average Mini-Mental State Examination score of 17.8 ± 7.2, were recruited from a population of adult daycare facility users. Subjects underwent pre- and postintervention assessment of strength and physical function consisting of determination of bilateral maximum strength of the knee extensor, hip flexor, dorsiflexor muscles, and handgrip; and evaluation of lower-extremity function based on repeated chair stand and gait speed. The intervention consisted of moderate-intensity progressive resistance training of the hip extensors, abductors, knee extensors and flexors, and dorsiflexors using the Theraband resistance system for up to 3 days weekly over a 6-week period.

Results. Subjects completed an average of 11.4 ± 2.5 exercise sessions. Among those who exercised at least twice per week (≥12), they improved an average of 15.6% in quadriceps strength, 10.1% in handgrip strength, 22.2% in sit-to-stand (STS) time, 9.9% in usual gait time, 5.4% in fast gait time (p = .03), and 14.0% in the timed-up-and-go (TUG) test.

Conclusions. Subjects demonstrated improvements in some areas of muscular capacity (quadriceps and handgrip) and most tests of lower-extremity function (STS, gait, TUG), yet declines in other areas (dorsiflexion and iliopsoas strength). Although strength or functional deficits in all domains were not remediable, these results suggest the potential of a resistance-exercise intervention of longer duration and/or greater intensity to produce beneficial effects on the neuromuscular functioning of people with dementia.

LIMITATION or disability in physical function is most prevalent among people with dementia, even after considering a variety of conditions commonly associated with functional disability (1). Though seldom the topic of specific investigation, the loss of physical function is one of the most manifest features of dementing illness and represents an important hallmark under ICD-9 (2) and DSM-IV (3) diagnostic criteria. Neuromuscular weakness is a prominent symptom among people with disorders of the central nervous system, such as dementia, typically leading to functional disability in activities of daily life (ADL), and, as a consequence, increasing the need for personal assistance and/or assistive devices and diminishing the quality of life. Such dependence on assistance has been estimated to increase the cost of Medicare services in the United States by $399 per additional ADL/year for each person with dementia (4). Disability in physical function is not an inherent concomitant of dementia—at least not in the mild to moderate phases of the condition. Deconditioning and consequent insufficiencies in muscular strength and functional limitations frequently appear to be premature and unnecessary initial sequelae of the determination of dementia, perhaps due to the underestimation of residual abilities and decreased expectations by caregivers (5). Exercise training has been proven to be crucial in alleviating muscle weakness and its functional consequences in many populations; however, our knowledge of the potential of training to reduce the consequences of muscle weakness in chronic neurological disorders is very limited, as is information on the activity pattern and physiological responses to exercise in people with disabilities caused by neurological disorders (6). Resistance exercise has increasingly been demonstrated as a method for building muscle strength and recovering function in frail elderly populations (7–10), and limited evidence of its feasibility among people with dementia has been demonstrated in very few studies (11–13). Strength is an important feature of optimal function in the skeletal muscles and the nervous system, and the symptoms related to inadequacies in strength are commonly observed in people with chronic neurological disorders (6). People with dementia have a number of symptoms that might primarily reflect muscular dysfunction (Table 1), likely through changes in the recruitment and activation of motor units or diminution in muscle fiber contractile properties, and may thus be amenable to rehabilitation with resistance training. This
article reports the results from a preliminary study designed to test the potential for resistance exercise of the lower extremities to restore strength and improve function in persons diagnosed with dementia. Given the importance of lower-extremity strength in basic activities such as walking and transferring, as well as the maintenance of balance, demonstrating the ability to intervene and yield improvements in function could lead to reductions in the burden of care and improvements in quality of life.

METHODS

Subjects

The study employed a pretest–posttest design. Thirty subjects with preexisting diagnoses of dementia (of various etiologies) in their records were recruited from a defined population of elderly daycare users in attendance at 1 of 2 adult daycare centers operated by a local hospital. Potential subjects were excluded from participation in the study if they had experienced a heart attack or stroke within the last 6 months, if they had a condition that might be worsened by the exercise, or if they were unable to independently ambulate with or without an assistive device for a distance of 10 meters. Written informed consent was obtained from all subjects or, as necessary, from their legal guardians, in accordance with the Institutional Review Board guidelines of the Alegent Health Center and the University of Nebraska Medical Center. Subjects [2] were excluded from the analyses presented here if they were younger than 70 years.

Measures of Muscle Strength

Maximum strength of the knee extensor, hip flexor, and dorsiflexor muscles was assessed bilaterally using a Microfet2 manual muscle tester (Hogan Health Industries, Inc, Draper, UT). For knee and hip flexor assessment, the subject was seated in a hard chair (on a platform) with knees and hips flexed to 90° and arms crossed. For knee extensor testing, the subject was asked to hold the knee in a position at approximately 80° of knee flexion with the placement of the dynamometer two fingers above the medial malleoli (knee extension). For hip flexor testing, subjects were asked to lift the thigh above the chair while the examiner placed the dynamometer 2 inches proximal to the femoral condyles at the distal thigh. Ankle dorsiflexion strength was measured with the subject seated with the leg fully extended on an 8-inch footrest and the dynamometer placed proximal to the first metatarsal head of the foot. Subjects were asked to push as hard as they could against the dynamometer. Strength was recorded as the peak force, expressed in kilograms force, that the examiner had to apply to break the isometric contraction, moving the subject’s leg in the direction opposite to the voluntary movement. During the test, the subject was allowed to place his/her hands on the front edge of the chair seat but not to lean backward. Subjects completed up to 5 trials on each side for each muscle group—fewer if two measurements within 10% of each other were recorded. The assessments were attempted only on subjects who could first perform the movements against gravity alone. Isometric handgrip strength was also measured bilaterally using a Jamar hand-held Dynamometer (Sammons Preston, Inc., Bolingbrook, IL).

Measures of Function

The evaluation of lower extremity function consisted of 3 performance-based tests that assess (a) walking speed, (b) time to rise from a chair and sit down 5 times (chair stands), and (c) standing balance. Walking speed was assessed by having the participant walk at his/her usual pace over a 6-meter course, and then reassessed at a maximal safe pace. Subjects were instructed to stand with both feet touching the starting line and to start walking after a specific verbal command. Timing commenced when the command was given and the subject started off the line, and the time needed to complete the entire distance was recorded. The average of 2 walks was used to compute a measure of walking speed. The number of steps was also recorded and was used to determine stride length. Assistive walking devices were discouraged for this test, but permitted if necessary. The test of repeated chair stands was performed...
using an armed, straight-back chair with a seat approximately 45 cm high at the front edge. Participants were first asked to stand from a sitting position without using their arms. If they were able to perform this activity, they were then asked to stand up and sit down 5 times as quickly as possible. The time to complete the entire task was recorded. Standing balance was also assessed by asking subjects to maintain balance in 3 positions characterized by a progressive narrowing of the base of support; as results were uniformly poor and failed to discriminate among subjects, they are not discussed here.

The Timed-Up-And-Go (TUG) (14) test was also used to measure the time in seconds that an individual required to stand up from a chair 45 cm high, walk 3 meters, return, and sit down. Subjects were permitted to use assistive devices if needed, and each subject completed 2 trials of this test.

**Other Study Measurements**

Additional assessments included standard measures of standing height and body weight, as well as the computation of Body Mass Index (BMI) as an approximate measure of body fat. Additionally, cognitive function was determined at initial testing by application of the Folstein Mini-Mental State Examination (MMSE) (15). Together with average age and the proportions of males and nonwhites, these descriptive results are reported in Table 2. Functional ability was assessed using a modified version of the Health Interview Survey Supplement on Aging questionnaire, which was administered to primary care givers as well as to capable subjects. Specific measures of gait—the Gait Rating Scale from the Tinetti Performance-Oriented Mobility Scale (16) and the Gait Assessment Rating Scale (GARS) (17)—also were derived from a videotaped recording taken during the administration of the TUG so that subjects’ gait could later be scored, and are reported on elsewhere (18). Somatosensory discrimination also was evaluated—by light touch discrimination using Roylan monofilaments (Smith & Nephew, Inc., Germantown, WI) and performed on the bare foot of the dominant leg with the subject sitting with the foot propped up on a chair—but proved to be relatively insensitive, failing to discriminate between subjects, and thus these results are not presented here. Intraclass correlations were estimated based on test–retest results for 12 subjects (reassessment for the remaining 16 subjects was not performed due to the inability to

**Table 3. Pretest and Posttest Means, Effect Sizes, and Change Estimates (All 28 Subjects)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Effect Size</th>
<th>Change (%)</th>
<th>Expected Direction of Change</th>
<th>Paired Sample t Test p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left iliopsoas (kg force)</td>
<td>34.85 ± 10.75</td>
<td>34.09 ± 10.11</td>
<td>0.15 ± 10.10</td>
<td>-2.19</td>
<td>+</td>
<td>.94</td>
</tr>
<tr>
<td>Right iliopsoas (kg force)</td>
<td>36.43 ± 14.97</td>
<td>34.64 ± 11.62</td>
<td>-1.79 ± 9.38</td>
<td>-4.92</td>
<td>+</td>
<td>.92</td>
</tr>
<tr>
<td>Left quadriceps (kg force)</td>
<td>31.36 ± 13.54</td>
<td>32.79 ± 10.20</td>
<td>1.43 ± 10.01</td>
<td>4.56</td>
<td>+</td>
<td>.46</td>
</tr>
<tr>
<td>Right quadriceps (kg force)</td>
<td>33.75 ± 13.91</td>
<td>35.61 ± 11.21</td>
<td>1.86 ± 12.62</td>
<td>5.51</td>
<td>+</td>
<td>.44</td>
</tr>
<tr>
<td>Left dorsiflexor (kg force)</td>
<td>43.07 ± 15.45</td>
<td>39.41 ± 11.59</td>
<td>-3.67 ± 12.96</td>
<td>-8.50</td>
<td>+</td>
<td>.15</td>
</tr>
<tr>
<td>Right dorsiflexor (kg force)</td>
<td>43.96 ± 16.18</td>
<td>40.65 ± 12.25</td>
<td>-3.07 ± 13.13</td>
<td>-7.53</td>
<td>+</td>
<td>.23</td>
</tr>
<tr>
<td>Left grip (kg force)</td>
<td>14.62 ± 4.33</td>
<td>16.31 ± 4.72</td>
<td>1.61 ± 3.65</td>
<td>11.56</td>
<td>+</td>
<td>.04</td>
</tr>
<tr>
<td>Right grip (kg force)</td>
<td>17.14 ± 7.40</td>
<td>19.5 ± 6.61</td>
<td>2.59 ± 6.34</td>
<td>13.77</td>
<td>+</td>
<td>.05</td>
</tr>
<tr>
<td>Sit-to-stand (s)</td>
<td>26.05 ± 13.43</td>
<td>20.42 ± 8.62</td>
<td>-5.22 ± 9.96</td>
<td>-21.62</td>
<td>-</td>
<td>.02</td>
</tr>
<tr>
<td>Usual gait time (s)</td>
<td>10.99 ± 4.51</td>
<td>11.75 ± 8.66</td>
<td>-0.68 ± 2.61</td>
<td>6.92</td>
<td>-</td>
<td>.19</td>
</tr>
<tr>
<td>Usual gait steps</td>
<td>16.02 ± 3.53</td>
<td>16.86 ± 5.55</td>
<td>0 ± 2.77</td>
<td>5.24</td>
<td>-</td>
<td>.10</td>
</tr>
<tr>
<td>Fast gait time (s)</td>
<td>7.81 ± 3.27</td>
<td>7.49 ± 2.88</td>
<td>-0.54 ± 1.37</td>
<td>-4.10</td>
<td>-</td>
<td>.06</td>
</tr>
<tr>
<td>Fast gait steps</td>
<td>13.94 ± 3.07</td>
<td>13.83 ± 2.83</td>
<td>-0.24 ± 1.74</td>
<td>-0.79</td>
<td>-</td>
<td>.50</td>
</tr>
</tbody>
</table>

**Note:** TUG = timed-up-and-go test.

**Table 4. Pretest and Posttest Means, Effect Sizes, and Change Estimates (13 Subjects Completing ≥12 Exercise Sessions)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Effect Size</th>
<th>Change (%)</th>
<th>Expected Direction of Change</th>
<th>Paired Sample t Test p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left iliopsoas (kg force)</td>
<td>32.08 ± 13.80</td>
<td>33.31 ± 11.48</td>
<td>2.21 ± 11.93</td>
<td>3.83</td>
<td>+</td>
<td>.53</td>
</tr>
<tr>
<td>Right iliopsoas (kg force)</td>
<td>35.15 ± 16.36</td>
<td>35.27 ± 10.88</td>
<td>0.12 ± 12.41</td>
<td>0.34</td>
<td>+</td>
<td>.97</td>
</tr>
<tr>
<td>Left quadriceps (kg force)</td>
<td>28.08 ± 12.79</td>
<td>30.77 ± 8.16</td>
<td>2.69 ± 12.42</td>
<td>9.58</td>
<td>+</td>
<td>.45</td>
</tr>
<tr>
<td>Right quadriceps (kg force)</td>
<td>29.12 ± 10.68</td>
<td>35.42 ± 12.27</td>
<td>6.31 ± 12.99</td>
<td>21.63</td>
<td>+</td>
<td>.11</td>
</tr>
<tr>
<td>Left dorsiflexor (kg force)</td>
<td>42.17 ± 20.14</td>
<td>40.58 ± 11.46</td>
<td>-1.58 ± 17.67</td>
<td>-3.73</td>
<td>+</td>
<td>.76</td>
</tr>
<tr>
<td>Right dorsiflexor (kg force)</td>
<td>41.42 ± 18.91</td>
<td>42.17 ± 14.08</td>
<td>1.5 ± 17.04</td>
<td>1.81</td>
<td>+</td>
<td>.77</td>
</tr>
<tr>
<td>Left grip (kg force)</td>
<td>15.22 ± 3.06</td>
<td>16.22 ± 6.10</td>
<td>1.0 ± 3.39</td>
<td>6.57</td>
<td>+</td>
<td>.33</td>
</tr>
<tr>
<td>Right grip (kg force)</td>
<td>16.54 ± 6.19</td>
<td>18.79 ± 6.45</td>
<td>2.26 ± 7.91</td>
<td>13.60</td>
<td>+</td>
<td>.32</td>
</tr>
<tr>
<td>Sit-to-stand (s)</td>
<td>25.63 ± 13.84</td>
<td>19.94 ± 6.66</td>
<td>-5.69 ± 11.85</td>
<td>-22.20</td>
<td>-</td>
<td>.11</td>
</tr>
<tr>
<td>Usual gait time (s)</td>
<td>11.63 ± 6.03</td>
<td>10.48 ± 5.59</td>
<td>-1.14 ± 2.54</td>
<td>-9.89</td>
<td>-</td>
<td>.13</td>
</tr>
<tr>
<td>Usual gait steps</td>
<td>15.42 ± 3.70</td>
<td>15.31 ± 3.32</td>
<td>-0.12 ± 1.84</td>
<td>-0.71</td>
<td>-</td>
<td>.82</td>
</tr>
<tr>
<td>Fast gait time (s)</td>
<td>8.12 ± 4.44</td>
<td>7.68 ± 3.89</td>
<td>-0.44 ± 1.20</td>
<td>-5.42</td>
<td>-</td>
<td>.03</td>
</tr>
<tr>
<td>Fast gait steps</td>
<td>13.42 ± 3.20</td>
<td>13.23 ± 2.94</td>
<td>-0.42 ± 1.29</td>
<td>-1.42</td>
<td>-</td>
<td>.29</td>
</tr>
<tr>
<td>TUG (s)</td>
<td>24.76 ± 13.29</td>
<td>21.29 ± 10.30</td>
<td>-3.47 ± 14.03</td>
<td>-14.01</td>
<td>-</td>
<td>.41</td>
</tr>
</tbody>
</table>

**Note:** TUG = timed-up-and-go test.
schedule the retesting within a 6- to 9-day window after the initial assessment), and are reported on elsewhere (19).

**Intervention**

The resistance-training program consisted of 6 weeks of exercise using Theraband (The Hygienic Corp., Akron, OH), a brand of elastic resistive band. Each subject was encouraged to complete up to a maximum of 3 sessions per week of training and received one-on-one supervision throughout the exercise period. Following a brief warm-up, each individual completed 12 exercises to target the hip flexors, hip extensors, hip abductors, hip adductors, knee flexors, knee extensors, ankle dorsiflexors, and ankle plantarflexors. The exercises were designed to be completed in sitting and standing positions. Each exercise was performed for 1 set of 15 repetitions. The Theraband was color-coded in the following order of increasing resistance: red, green, blue, black, and silver. Each subject began the program using the red Theraband. As a subject demonstrated the ability to complete 15 repetitions without difficulty, he/she progressed to the next Theraband color. Exercise attendance records were kept to check adherence. Records also noted any progression in the level (i.e., color) of Theraband resistance.

**Statistical Power and Analysis**

Sample size estimates were calculated a priori to determine statistical power. Based on a normal range of performance on each of the strength and function measurements to be employed in the study for somewhat disabled noninstitutionalized elderly people, we computed a range of possible estimates of power and found that we would have approximately a 0.97 chance of detecting change in a mean score of 0.50 standard deviations when the sample size is 25 and the correlation between the pre- and postintervention measurements is 0.75. The correlations between pre- and posttest measurements in our study, in fact, ranged from 0.49 to 0.91, with the correlations among measures of function at the higher end of this range (between 0.68 and 0.91).

An average estimate of the trials for each measure was computed for the pre- and postintervention assessments. Pre- and posttraining estimates of strength and function were compared using a paired sample t test, and effect sizes were calculated from the mean of postintervention minus preintervention estimates. These results are shown in Tables 3 and 4. All estimates were derived using STATA software (Release 5.0, 1997; Stata Corporation, College Station, TX).

**RESULTS**

As depicted in Table 2, subjects were primarily female and two thirds white. Their average age was 80 years and they had an average BMI of 26.2. The average MMSE score, as measured during pretesting, was 17.8.

**Feasibility**

Subjects completed an average of 11.4 ± 2.5 exercise sessions, with only one third of subjects completing less than 11 sessions. Thirteen subjects completed at least 12 exercise sessions. Lack of adherence was influenced primarily by planned absenteeism from the daycare setting and/or the exercise schedule conflicting with other daycare activities. Three of the 28 subjects demonstrated a pattern of repeated refusal, operationally defined as refusing two or more times during the 6-week period. Each participant tolerated increased resistance of the Theraband during the 6-week period with the majority increasing two to three colors (i.e., levels) of resistance.

**Changes in Strength**

As displayed in Table 3 for all 28 subjects, we observed variable strength gains. While strength increased 5.0% on average in the quadriceps muscles (across right and left quadriceps) and 12.7% in handgrip, it declined 3.6% in the iliopsoas and 8.0% in the dorsiflexor muscles. Effect sizes ranged from −3.67 ± 12.96 for left dorsiflexor to 2.59 ± 6.34 for right grip strength among the strength measures.

Among those subjects who exercised at least twice per week (Figure 1 and Table 4), strength gains were more consistently positive and tended to be greater. Strength increased 2.1% on average in the iliopsoas, 15.6% in the quadriceps, and 10.1% in handgrip, but declined 1.0% in the dorsiflexors. The variance in these changes in muscular strength were on average greater than for the entire sample.

**Changes in Function**

Functional performance changes were more uniform in direction. Among all 28 subjects (Table 3), reductions of 21.6% in sit-to-stand (STS) time, 4.1% in fast gait time (t = 0.6), 0.8% in number of steps at fast gait, and 3.1% in TUG time were observed, while increases of 6.9% in usual gait time and 5.2% in number of steps at usual gait were noted. Effect sizes of from 0 to 2.77 for number of steps at usual gait speed to −5.22 ± 9.96 for the repeated chair stand test were noted.

Those subjects who exercised on 12 or more occasions over the 6-week intervention period showed roughly similar changes (Figure 2 and Table 4). Their average STS times declined 22.2%, and usual and fast gait times declined 9.9%.
and 5.4% \((p = .03)\), respectively. Their average TUG times also declined 14.0%.

**DISCUSSION**

In this study, we observed some gains in muscle strength and functional performance among subjects with mild to moderate dementia after a brief resistance-exercise training intervention. The results suggest that implementation of a Theraband-based resistance-exercise program was feasible since the participants averaged approximately 2 sessions of activity per week during the 6-week period. We also observed improvements in the training loads tolerated by all the participants over the 6-week period as they progressed to higher levels of Theraband resistance, but little to no improvement in the maximum isometric force as recorded by hand-held dynamometry. The lack of isometric strength gains in this population might be attributable to a movement specificity or, alternatively, the short duration of the training (6 weeks), or the apprehension of subjects in delivering a maximal effort. Thus, the increased tolerance to greater elastic resistances without any gains in isometric performances probably reflects subjects’ improved capability to perform the Theraband-resisted movements. During the first 4–6 weeks of a progressive resistive exercise program, the majority of gains observed can generally be attributed to a neural mechanism of increased coordination or activation of the muscles as opposed to muscle hypertrophy.

In general, previous research on the benefits of strength training with elderly (even frail elderly) individuals suggest that increases in strength can average 5% per training session and a doubling or tripling of strength after progressive training for a period of 8–12 weeks. We failed to achieve uniform gains in strength that could be periodized (likely due to the brevity of the training intervention). The 6-week duration of the training program used in this study is the minimum time recommended to effect a change when implementing a dynamic resistance-training program for individuals who are novices or not involved in such a study (20).

Although we set a goal of 3 exercise sessions per week for each subject, this also represented an upper limit on frequency, in concordance with well-established guidelines suggesting 48 hours of rest between bouts of resistance exercise. Despite our goal, we recognized at the outset that variability in attendance at the day-care facility and the inability to utilize weekends would likely limit our ability to reach our exercise frequency targets. The suboptimal frequency (rate) of exercise should, therefore, be construed as reflecting a problem with scheduling rather than a lack of adherence. Additionally, while the trainers in the present study strived to keep the subjects on task at the desired intensity level, it is possible that the subjects did not contribute a full effort due to some inherent aspects of dementia. In light of the lack of isometric strength gains yet improvement in tolerance to resistance over the 6 weeks, it is also possible that the outcome measure for strength (i.e., hand-held dynamometry) was not sufficiently specific to detect strength gains.

Disability is costly, and people with disabilities caused by disorders or injuries in the central or peripheral nervous system represent a group of increasing size. Muscle weakness is a critical problem for most people with a chronic neurological disorder, negatively affecting mobility, increasing the risk of falls and injuries, and reducing functional independence (6,21). Resistance training can recover atrophied muscles where the atrophy is not too pronounced and can aid neuromuscular capacity in cases where activation failures are present. People with a newly diagnosed dementia who retain ambulatory or highly physically functional capacities may be best placed to benefit from, and should view, resistance exercise as a means of slowing or preventing the physical consequences of dementia progression. Resistance training also may be useful in staving off secondary medical problems (22). For people with more progressed dementia, muscle hypertrophy gains may fail to achieve levels observed in other frail older populations, but significant benefit is likely to be derived from the neural adaptations that typically result from the training experience. Even small gains in muscular capability
can translate into notable gains in functional performance and, thereby, in quality of life.

Because treatment options to abate the cognitive decline in dementia are currently limited, attention to concurrent physical impairments and functional limitations is warranted. Recent evidence suggests that community-dwelling people with Alzheimer’s disease can attain levels of physical activity, regardless of dementia severity, that are similar to the activity levels of healthy elderly control subjects (23). As exercise and physical activity is increasingly demonstrated to be implicated in reducing or preventing declines in cognition (24), resistance training warranted. Recent evidence suggests that community-dwelling people with Alzheimer’s disease can attain levels of physical activity, regardless of dementia severity, that are similar to the activity levels of healthy elderly control subjects (23). As exercise and physical activity is increasingly demonstrated to be implicated in reducing or preventing declines in cognition (24), resistance training should emerge as a worthy focus of more broad-based therapeutic efforts among people with cognitive impairment and dementia.

ACKNOWLEDGMENTS

This work was supported by a Vada Kinman Oldfield Scholar in Alzheimer’s Disease Research Award and a Claude D. Pepper Older Americans Independence Center Grant to V. S. Thomas. We are grateful to Jill Brown, Ryan McCabe, Jeff Arnold, and Amberlyn Divis for their efforts in helping to conduct the study, and to the staff and clients of the McAuley Bergen Adult Daycare Centers for their gracious help and willing participation.

Address correspondence to Vince S. Thomas, PhD, Center for the Aging, Dartmouth Medical School, 102A Butler Building, Hanover, NH 03755-3852. E-mail: vince.s.thomas@dartmouth.edu

REFERENCES


Received August 15, 2002
Accepted November 26, 2002