A Randomized Outcome Evaluation of Group Exercise Programs in Long-Term Care Institutions

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Background. Physical activity programs in nursing homes typically consist of seated, range of motion (ROM) exercises, regardless of resident abilities. The Functional Fitness for Long-Term Care (FFLTC) Program was designed not only to maintain ROM, but also to improve strength, balance, flexibility, mobility, and function. In addition, it was tailored to meet the needs of both high and low mobility residents.

Methods. The feasibility and efficacy of the FFLTC Program were evaluated with 68 residents (mean age 80) from five institutions. Persons were classified as low or high mobility and randomized into either the FFLTC program or a seated ROM program. Classes were conducted in groups of 4 to 10 residents by trained facility staff for 45 minutes, three times per week. Assessments at baseline and 4 months consisted of mobility, balance, gait, flexibility, functional capacity, and several upper and lower extremity strength measures.

Results. Attendance averaged 86% for the FFLTC and 79% for the ROM classes. Four months of exercise led to significant improvements in mobility (16%), balance (9%), flexibility (36%), knee (55%), and hip (12%) strength for the FFLTC group. Shoulder strength was the only improvement found for the ROM group. The ROM group significantly deteriorated in some areas, particularly hip strength, mobility, and functional ability.

Conclusions. Institutionalized seniors, even those who are physically frail, incontinent and/or have mild dementia, can respond positively to a challenging exercise program. The FFLTC program demonstrated clear benefits over typical, seated ROM exercises. Moreover, with minimal training, the program can be safely delivered at low cost by institutional staff and volunteers.

Immobility has serious pathophysiological consequences, including muscle atrophy, impaired balance, orthostatic hypotension, cardiorespiratory, and gastrointestinal problems; susceptibility to pressure sores and urinary tract infections; as well as psychological consequences, including apathy, depression and cognitive decline (1). Immobility precipitates institutionalization and contributes to further decline after admission to a long-term care (LTC) facility (1–6). Residents capable of independent ambulation spend most of their time either lying down or sitting (2). Many residents become dependent on wheelchairs due to fear of falling or staff concerns about risk of falling (5,7). Frequently, residents are not given the opportunity to dress themselves, make their beds, or walk to the dining room due to liability concerns, time constraints, or underestimation of capabilities (3). Rehabilitation therapists recognize the importance of mobilizing or activating LTC residents (2,6–10). Although residents may receive physical therapy (PT) following an acute event (such as hip fracture or stroke), most LTC residents do not routinely receive PT (8). Institutions often must rely upon recreation staff, nurses, aides, and volunteers to address the mobility needs of residents.

A number of exercise studies have targeted this population (4,5,7–18). These interventions have ranged from flexibility, range of motion, walking, and balance control to strength training. Intervention durations have ranged from 6 weeks (15) to one year (11,18). Frequency has ranged from two times per week (5,14) to several sessions per day (7,9,17), but the majority of interventions have been three times per week. Variations in participant selection, format, and outcome measures make it difficult to draw comparisons across this body of literature. Most of the studies have small sample sizes (typically 8 to 15 subjects). Many studies did not have a control group (4,5,9,10,12,15,16) or the control group consisted of regular programming for this population.

High-intensity, individualized, one-on-one strength training using machines has been shown to produce dramatic strength gains (12,13,15). Group-based classes using low-cost equipment and existing staff, however, may be more practical and cost-effective for long-term care institutions (8,10,16). Only one of the 14 interventions (reviewed above) was actually delivered by nursing home staff (9); the rest have been led by research staff, exercise specialists, or physical therapists. About half the studies used a potentially more efficient group-based format (4,5,10,14,16,18); the remainder were delivered on an individual basis.
Several practical lessons have been learned with respect to delivery of exercise programs in LTC facilities. Time and personnel are necessary to porter many of the residents to and from each session (4,5). Close supervision, particularly for residents with cognitive impairment, is required (5,10). Small class sizes have been suggested, with a 4:1 ratio of participants to instructors/assistants for group-based programming (10). The exercises need to be structured and repetitive, with constant cueing—both verbal and visual (5,10,16). Less costly, portable materials such as soft weights and elastic resistance bands (Theraband) require less supervision and assistance and have been used successfully with this population (8,10,16). Challenges inherent in exercise programming for residents of LTC facilities require ongoing commitment and support from frontline staff, administrators, and medical directors (4,5,9).

To examine the status quo with respect to physical activity programming in LTC, we conducted a needs assessment of 27 facilities in the London, Ontario region. The vast majority (98%) of these facilities reportedly offered an exercise program for their residents. Group-based, seated range of motion exercises delivered by recreational staff were the norm. Frequency of exercise classes ranged from three times per week to once or twice per month. Although all these facilities had ambulatory residents, only 35% of programs incorporated any weight-bearing exercises or walking. In general, participation rates were low; only 10–15% of all residents took part in these exercise classes. Limited funds for exercise equipment and personnel, lack of exercise training, safety concerns, diversity in physical and cognitive abilities of residents, and difficulty motivating participants were cited as barriers to exercise programming. These findings support previous observations (4,5,9).

We believe that frail elderly residents of long-term care institutions are capable of more than range of motion exercise programs. Based on the physiological overload principle, to gain improvements in strength, muscle tissue must be trained at a level greater than it is accustomed to performing. We hypothesized that an exercise program based on this principle, that encompassed not only strength training, but also balance, flexibility, and mobility training, would be safe and feasible to deliver to frail elderly residents. Further, such a program should result in greater benefits than a seated range of motion exercise program.

Based on extensive experience in exercise programming and instructor training (19), The Centre for Activity and Ageing (CAA) designed a standardized program called Functional Fitness for Long-Term Care (FFLTC). This group-based program requires only simple equipment and is delivered by non-exercise specialists. An accompanying 16-hour workshop (the Long-Term Care Physical Activity Workshop) was developed to educate LTC staff concerning the negative effects of immobilization, and to provide training on specific exercises and safety issues and motivational techniques. This article presents the evaluation of the FFLTC Program in comparison with a seated, group-based program limited to range of motion exercises, subsequently referred to as the ROM condition.

METHODS

Recruitment

Residents from five LTC institutions were recruited for the evaluation study. Exclusion criteria were recent cardiovascular event or vestibular disorder; uncontrolled hypertension or epilepsy; recent fracture (within past 4 months); total blindness or deafness; recent admission to the facility (within past 3 months); and scheduled surgeries or holidays in the next 4 months. Participants had to be able to stand with minimal assistance (such as cueing, supervision, or a hand to steady them) and to follow simple instructions/demonstrations (such as raising the arms, extending the knee, or marching) or mimic the actions of the instructor. Use of walking devices or wheelchairs, dementia, and incontinence were not reasons for exclusion. A total of 96 residents (80 women, 16 men), who met the above criteria, agreed to participate.

DESIGN

Subjects were stratified into two levels of mobility based on their scores on the Timed Up & Go (TUG) test (20). Individuals taking less than 20 seconds to do the TUG were classified as high mobility (HM); those taking 20 seconds or longer as low mobility (LM). This cut-off has been shown to distinguish persons who are independently mobile from those who require gait aids and/or personal assistance for safe ambulation (20).

Within each mobility category, at each site, residents were randomly assigned to either the FFLTC or ROM condition using a table of random numbers. Research assistants administering the outcome measures were blind to study condition. Program deliverers and participants were told that the study objective was to compare two different exercise programs.

Participants

Of the 96 residents from the five sites who completed baseline assessments, there were a total of 55 HM and 41 LM subjects. Twenty-eight residents (mean age 81.3 ± 5.3; 23 women) assessed at baseline either never started the program, discontinued, or refused to be assessed at follow-up. Of these 28, 19 came from the FFLTC condition (HM = 12, LM = 7) whereas 9 came from the ROM condition (HM = 5, LM = 4). Reasons for dropping out were similar for the FFLTC and ROM conditions, and included changing their mind or being too busy (n = 15); medical reasons such as pneumonia, influenza, or arthritis flare-up (n = 8); cognitive inability to follow the exercises (n = 3); and moving out of the facility (n = 2). There were no deaths, hospitalizations, or exercise-related injuries over the 4-month period. No significant differences were found between dropouts and completers in terms of age or baseline scores on the outcome measures.

Sixty-eight residents (mean age 80.0 ± 9.9; 57 women) completed the study. There were 36 (29 women) in the FFLTC condition (HM = 22, LM = 14) and 32 (30 women) in the ROM condition (HM = 17, LM = 15). Average age was comparable: FFLTC (79.7 ± 7.9); ROM (80.4 ± 7.6). Half the participants normally used a walking aid (FFLTC = 50%, ROM = 52%). A slightly higher percentage of the ROM group (48% vs 34%) used a walker. None of the participants scoring <20 seconds on the TUG test (HM) used a wheelchair or required assistance with transfers. Of the LM participants, 36% of the FFLTC group and 45% of the ROM group used a wheelchair; the proportion requiring assistance with transfers was 6% and 21%, respectively. Most residents had multiple chronic conditions (ranging from 0 to 9). The most common diagnoses were arthritis (51%), hypertension (40%), dementia (25%), bladder incon-
FINANCE (23%), heart failure (23%), stroke (21%), falls (19%), osteoporosis (18%), angina (18%), bowel incontinence (10%), and cancer (8%). The average number of chronic conditions was 3.6 ± 1.8 for FFLTC and 3.7 ± 2.1 for ROM.

**Intervention**

Recreation staff employed at each of the five participating facilities completed the CAA’s Long-Term Care Physical Activity Workshop. Staff, in turn, trained aides and volunteers at their respective sites to assist with the exercise classes. Both the FFLTC and ROM programs were conducted at each site for 45 minutes, three times per week, for the 4-month evaluation period. Separate classes were tailored to HM and LM residents in the FFLTC condition. Because mobility was not a factor in the seated ROM program, HM and LM residents participated together. Class size varied from 4 to 10 participants.

Components of the three class types are outlined in Table 1. The FFLTC Program included: (i) progressive strengthening exercises (using soft weights and Theraband) performed in both open (seated) and closed (weight-bearing) kinetic chain positions; (ii) balance training exercises; (iii) flexibility exercises; and (iv) walking. Strengthening exercises were performed in functional positions. For example, hip strengthening exercises were performed in a standing position so that the joint positions and muscle lengths were similar to those used for walking. Strengthening exercises and standing exercises to promote balance were also incorporated into group “games” (such as balloon volleyball, tossing bean-bags into a basket, and throwing, catching, or kicking a ball).

Strengthening exercises were begun with one set of five repetitions and progressed to two sets of 10. Weighted bullets were progressively added to the soft weights to a maximum of 2 pounds for the wrist weights and 4 pounds for the ankle weights. Elastic resistance was progressed by using a heavier grade of elastic material. The participants began with red Theraband (The Hygenic Corporation, Akron, Ohio), yellow if they were very weak, green if they were weak. They progressed to blue and then red as they were able. A 24-inch (60 cm) length of Theraband was equivalent to a pull of 2.5 lbs (11 N) for yellow, 4.5 lbs (20 N) for red, 5 lbs (22.5 N) for green, and 7.5 lbs (35.25 N) for blue. Only one participant progressed beyond blue to black (9 lbs/40 N).

The program was not individualized per se; however, it was self-paced. At each session, participants were encouraged and given the opportunity to use more resistance and to do more repetitions. They were also encouraged to decrease assistance (progress from holding a chair with both hands, to one hand, to fingers, to no hands), spend more time standing, decrease number and duration of rest periods, and walk for longer (15 minutes instead of 10 in the FFLTC HM group or progressing from a few steps to walking for 30-60 seconds to walking for 5-10 minutes in the FFLTC LM group) and at an increased pace.

The ROM condition was modeled after existing programs typical of many LTC facilities (4,5,9). Participants were seated in chairs for the entire session. About half of each 45-minute session was devoted to range of motion exercises for the fingers, hands, arms, and legs (Table 1).

**Assessments**

Participants were assessed prior to beginning their program and after 4 months. **Mobility** was assessed using the TUG (20). A standard chair (seat height 46 cm) with arms was used, residents were allowed to use their usual gait aid, and were given one practice trial prior to performing the test. In approximately 20% of cases, more than one practice trial was necessary when a test subject forgot what they were supposed to do, stopped to talk, or were distracted. **Functional balance** was assessed with the Berg Balance Scale (21). Gait speed was assessed at both self-selected normal pace and fast pace (22), again using usual gait aids. Due to the frailty of the residents, gait speed was determined over a distance of 7 m with no practice trials. If, however, a resident stopped to talk or deviated from the path, the protocol was repeated. Subjects walked a total distance of 13 m at each speed; the middle 7 m were timed using photoelectric cells set at shoulder height. This protocol eliminated acceleration/deceleration effects and allowed all participants to complete the test.

**Stair climbing power** (23) was based on the time required to climb three steps. Some subjects used the handrail or a gait aid, but all were able to complete the task even though many had not climbed stairs for years. Most people in the LM group required close supervision and/or minor assistance. The following formula was used to calculate stair climbing power (SCP):

\[
SCP (W) = \text{body weight (kg)} \times 9.8 \text{ (m/s²)} \times \text{step height (m)} \times \text{number of steps} \times \text{time}^{-1} (s^{-1})
\]

**Functional ability** was assessed, by specially trained personnel, using the Functional Independence Measure (FIM) (24,25). Degree of assistance was rated from 1 = total assistance to 7 = complete independence for self-care (feeding, dressing, bathing), sphincter management, mobility/transfers (bed, chair, toilet, tub), locomotion (walking, stairs), communication, and social cognition. FIM scores can range from 18 to 126; higher scores are indicative of higher functioning (24,25).

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**Table 1. Description of Exercise Program Components and Time**

<table>
<thead>
<tr>
<th>Program</th>
<th>Component</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFLTC-HM</td>
<td>Warm up/stretching</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Walking</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Lower body strengthening</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Upper body strengthening</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Balance</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Cool down/stretching</td>
<td>5</td>
</tr>
<tr>
<td>FFLTC-LM</td>
<td>Warm up/stretching</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Walking</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Lower body strengthening</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Upper body strengthening</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Balance</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Cool down/stretching</td>
<td>5</td>
</tr>
<tr>
<td>ROM</td>
<td>Introduction/discussions</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Vocal exercises</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Word/memory games</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Range of motion</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Relaxation exercises</td>
<td>5</td>
</tr>
</tbody>
</table>

FFLTC-HM = Functional Fitness in Long-Term Care—High Mobility; FFLTC-LM = Functional Fitness in Long-Term Care—Low Mobility; ROM = Range of Motion.
Lower body flexibility was assessed using a modified Sit and Reach test (26). This test was performed in a standard chair (46 cm) or wheelchair, with feet fully extended and feet resting on a table approximately the same height as the chair. With the soles of the feet abutted against the cross bar of a Wells and Dillon flexometer (27), the person reached forward with both hands as far as possible and held this position for three seconds. The mean of three trials was calculated.

Upper body flexibility was assessed by measuring shoulder flexion in a supported sitting position. A Leighton Flexometer (28) was attached at the midpoint of their dominant upper arm. The person was asked to raise their arm as far as possible. The mean of three trials was calculated.

Isometric strength was measured with a hand-held dynamometer (HHD; Microfet, Hoggan Health Industries, Draper, Utah) using the belt-resisted method with the joint in a functional position (29-31). Peak force exerted over a 6-second maximal voluntary contraction was assessed. A practice trial was used to ensure correct muscle contraction and that the position was comfortable and pain free. Each person then performed three trials of each test with a minimum of 60 seconds rest between contractions; readings were averaged. The following muscle groups were assessed: (i) elbow flexion with the elbow at 90° and the HHD on the volar aspect of the wrist at the level of the wrist creases; (ii) shoulder abduction with the shoulder at 90° of abduction, neutral rotation, and the HHD placed on the distal end of the humerus, just proximal to the elbow joint; (iii) knee extension with the knee in 20° of flexion and the HHD placed on the anterior aspect of the ankle, 2 cm proximal to the lateral malleolus; (iv) hip abduction and adduction in supine with the hip in neutral and the HHD on the lateral (abduction) and medial (adduction) sides of the distal portion of the femur, respectively, just proximal to the knee joint; (v) hip flexion and extension in side-lying with the hip in neutral and the HHD placed on the anterior (flexion) or posterior (extension) aspect, respectively, of the distal end of the femur just proximal to the femoral condyles.

Grip strength (average of two trials) was assessed using a hand grip dynamometer with the subject sitting in a standard chair with the elbow at 90° (16), measured in kilograms of isometric force, and expressed as newtons (N).

Upper extremity strength (UES) was calculated by combining measurements of hand grip, elbow flexor, and shoulder abductor strength. Total hip strength (THS) was calculated by combining measurements of hip flexor, extensor, abductor, and adductor strength. Lower extremity strength (LES) was calculated by combining total hip strength and measurements of knee extensor strength. For all measures, the average of left and right sides was calculated.

Isotonic strength of knee extensors was also assessed in a single standard armchair (46 cm) using soft free weights (16). Prior to strength testing, available range of motion for each person was determined using a standard goniometer. The one-repetition maximum (IRM) was determined to be the maximum weight a person could lift once through their full available range. A 90-second rest period was given between successive trials. Number of trials for IRM was recorded (and did not exceed five).

Statistical Analyses
Analyses were performed using SPSS (Statistical Package for Social Sciences). Data from the FFLTC and ROM groups, respectively, were pooled across sites for analysis. Analysis of covariance was performed for each outcome measure with exercise category (FFLTC vs ROM) and mobility level (HM or LM) as factors, and age and the baseline scores as covariates. F values presented in Tables 2 and 3 represent the test statistic for comparing the exercise categories after adjusting for mobility level, age, and pretest values.

**RESULTS**

Attendance averaged 86% for the FFLTC exercise sessions (87% and 85% for the HM and LM conditions, respectively), and 79% for the ROM sessions. Individual attendance rates ranged from 54% to 98% in the FFLTC-HM, 66% to 100% in the FFLTC-LM, and 45% to 100% in the ROM classes.

Tables 2 and 3 show the mean scores and 95% confidence intervals (CI95) on all outcome measures for each condition at baseline and after 4 months of exercising. The F values shown in the tables denote the main effect (Pre vs Post) for exercise category (FFLTC vs ROM). There were no significant effects of mobility level for any of the variables measured. Despite randomization, the ROM group scored lower on several of the measures at baseline. This is likely due to the fact that the final sample of FFLTC participants had a higher proportion of HM residents relative to the ROM sample (61% vs 50%). There was, however, considerable variability within condition on all measures, and baseline CI95 of the FFLTC and ROM overlapped for most measures.

As shown in Table 2, the ROM group had poorer average TUG scores at baseline; however, the range of scores was comparable (FFLTC: 9-69 seconds; ROM: 11-70 seconds). Mobility significantly improved over 4 months for the FFLTC group, averaging a 16% decrease in TUG scores. Conversely, the ROM group took 23% longer, on average, to perform the TUG 4 months later. Similarly, the FFLTC group significantly improved on functional balance, by an average of 9%, whereas the Berg Balance scores of the ROM did not change.

Lower body flexibility (sit and reach) significantly improved, by 36%, in the FFLTC group and did not change in the ROM group. Similarly, upper body flexibility (shoulder flexion) significantly improved by 12% in the FFLTC group. On this measure the ROM group improved by only 3.5%.

As shown in Table 2, both groups improved slightly, but not significantly in normal and fast gait speed after the intervention. Stair climbing power could only be assessed in 20 subjects because there were no stairs at two of the facilities. There was no significant change in this measure after either intervention. Baseline functional ability scores were high in both FFLTC and ROM conditions (within the top quintile). FIM scores were maintained in the FFLTC, and significantly declined by 5% in the ROM condition.

Table 3 presents the results of strength assessments for the upper and lower extremities. Both left and right sides were measured three times and the mean of the three trials was used in analyses. The values presented in the table are averages of the left and right sides and are expressed in newtons (N).

There was no significant change in hand grip strength in either group. The only statistically significant group difference in upper extremity strength occurred at the elbow (Table 3). Elbow flexion strength improved by 10% in the FFLTC group.
Table 2. Functional Outcome Scores at Baseline and 4 Months for the Functional Fitness in Long-Term Care (FFLTC) and Range of Motion (ROM) Participants

<table>
<thead>
<tr>
<th></th>
<th>FFLTC</th>
<th></th>
<th>ROM</th>
<th></th>
<th>F§§</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Pre Post</td>
<td>n</td>
<td>Pre Post</td>
<td></td>
</tr>
<tr>
<td>Mobility†</td>
<td>36</td>
<td>22.0 ±15.2 18.3 ±11.9</td>
<td>30</td>
<td>26.8 ±17.4 33.0 ±35.1</td>
<td>4.23*</td>
</tr>
<tr>
<td>CL0</td>
<td>16.8-27.2</td>
<td>14.3-22.3</td>
<td>20.3-33.3</td>
<td>20.0-46.0</td>
<td></td>
</tr>
<tr>
<td>Balance‡</td>
<td>36</td>
<td>43.7 ±10.6 47.6 ±8.4</td>
<td>32</td>
<td>35.9 ±13.1 35.4 ±12.0</td>
<td>11.23**</td>
</tr>
<tr>
<td>CL0</td>
<td>40.3-47.1</td>
<td>44.8-50.4</td>
<td>31.2-40.6</td>
<td>31.1-39.7</td>
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<tr>
<td>Sit and reach§</td>
<td>25</td>
<td>13.1 ±9.2 17.8 ±8.8</td>
<td>19</td>
<td>9.6 ±8.4 10.0 ±8.3</td>
<td>4.50*</td>
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<tr>
<td>CL0</td>
<td>9.3-16.9</td>
<td>14.2-21.4</td>
<td>5.6-13.6</td>
<td>6.0-14.0</td>
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<tr>
<td>Shoulder flexibility¶</td>
<td>36</td>
<td>129.0 ±27.4 145.0 ±27.5</td>
<td>29</td>
<td>122.8 ±28.6 127.1 ±34.1</td>
<td>6.16*</td>
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<tr>
<td>CL0</td>
<td>119.7-138.3</td>
<td>135.7-154.3</td>
<td>111.9-133.7</td>
<td>114.2-140.0</td>
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</tr>
<tr>
<td>Gait (normal¶¶)</td>
<td>35</td>
<td>0.69 ±0.28 0.73 ±0.33</td>
<td>29</td>
<td>0.57 ±0.27 0.61 ±0.31</td>
<td>0.00</td>
</tr>
<tr>
<td>CL0</td>
<td>0.59-0.79</td>
<td>0.61-0.85</td>
<td>0.47-0.67</td>
<td>0.51-0.71</td>
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<tr>
<td>Gait (fast)</td>
<td>35</td>
<td>0.91 ±0.39 0.94 ±0.41</td>
<td>30</td>
<td>0.70 ±0.36 0.73 ±0.34</td>
<td>0.05</td>
</tr>
<tr>
<td>CL0</td>
<td>0.77-1.05</td>
<td>0.80-1.08</td>
<td>0.56-0.84</td>
<td>0.59-0.87</td>
<td></td>
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<tr>
<td>Stair climbing††</td>
<td>11</td>
<td>15.1 ±9.8 13.4 ±6.2</td>
<td>9</td>
<td>12.8 ±8.7 11.7 ±9.1</td>
<td>2.15</td>
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<tr>
<td>CL0</td>
<td>8.6-21.6</td>
<td>9.3-17.5</td>
<td>6.4-19.2</td>
<td>3.1-20.3</td>
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<tr>
<td>Functional capacity‡‡</td>
<td>34</td>
<td>114.7 ±8.9 114.8 ±8.4</td>
<td>31</td>
<td>110.4 ±15.4 105.2 ±15.4</td>
<td>4.17*</td>
</tr>
<tr>
<td>CL0</td>
<td>111.6-117.8</td>
<td>111.9-117.7</td>
<td>104.8-116.0</td>
<td>99.6-110.8</td>
<td></td>
</tr>
</tbody>
</table>

Note. Values are means ± SD.
*p < .05; **p < .001.
†Mobility = measured using the Timed “Up and Go” test (s).
‡Balance = measured using the Berg Balance Scale (score/56).
§Sit and reach = flexibility measured using the modified Sit and Reach test (cm).
¶Shoulder flexibility = shoulder flexion measured using a flexometer (degrees).
¶¶Gait = measured using the self-paced walk test at a normal and fast pace (m-sec−1).
††Stair climbing = Watts (see text for method and calculation).
‡‡Functional capacity = measured using the Functional Independence Measure (score/126).
§§F = the test statistic for comparing the exercise categories after adjusting for mobility level, age, and pretest values.

Whereas the ROM group did not change, shoulder abduction strength improved by 20% in the FFLTC group and 21% in the ROM group. The aggregate score for upper extremity strength improved by 8% and 2% in the FFLTC and ROM groups, respectively.

The FFLTC intervention had a significant effect on both knee and hip strength. Knee extensor strength improved both isometrically (46%) and isotonically (55%). ROM participants, on the other hand, improved by 9% when measured isometrically, but declined by 18% using the 1RM test to measure isotonic strength. Various indicators of hip strength improved in the FFLTC group (flexion 2%, extension 11%, abduction 18%, adduction 18%) and decreased in the ROM group (flexion –24%, extension –13%, abduction –3%, adduction –21%). Total hip strength improved by 12% in the FFLTC group and declined by 17% in the ROM group. These changes are reflected in the total lower extremity aggregate score (combined hip and knee extensor strength) which improved by 18% for the FFLTC group and declined by 13% for the ROM group.

Discussion

As previously reported in the literature (4,5,9) and supported by our regional survey, non-weight-bearing, range-of-motion (ROM) exercises represent the status quo in nursing home programming. Programs of this nature are not challenging enough for frail residents, much less for higher functioning residents (5), and will not prevent or reverse the pattern of decline associated with institutional living. One study found that 2 years following cessation of a strength training intervention, there were cumulative decreases in mobility, fast pace walking speed, and knee-extensor strength in a nursing home sample (6). Our findings suggest that participating in a seated, ROM program, three times a week, may improve shoulder-abduction strength, but will not prevent declines in lower body strength, mobility, and balance.

Mobilization through walking is important, however, walking alone will not improve balance or strength (32). Furthermore, increasing ambulation without concomitant exercises to address muscle weakness and postural instability may increase fall risk or flare arthritic joints (32).

The FFLTC program model examined in the present study addresses total body conditioning—through range of motion, flexibility, ambulation, balance control, endurance, and upper and lower body strengthening exercises. In contrast to the ROM exercise regimen, conducted over the same 4-month period, the FFLTC program led to significant improvements in mobility, balance, flexibility, and various measures of strength. Functional capacity was maintained in the FFLTC group and significantly declined in the ROM group.

Two areas that did not show improvement were gait speed...
Table 3. Strength Scores at Baseline and 4 Months for the Functional Fitness in Long-Term Care (FFLTC) and Range of Motion (ROM) Participants

<table>
<thead>
<tr>
<th></th>
<th>FFLTC</th>
<th>ROM</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Hand grip</td>
<td>33</td>
<td>147.4 ± 61.2</td>
<td>149.4 ± 63.9</td>
</tr>
<tr>
<td>Elbow flexion</td>
<td>32</td>
<td>120.9 ± 48.5</td>
<td>126.7 ± 60.0</td>
</tr>
<tr>
<td>Shoulder abduction</td>
<td>31</td>
<td>53.1 ± 20.4</td>
<td>63.6 ± 25.1</td>
</tr>
<tr>
<td>UE§</td>
<td>31</td>
<td>322.1 ± 114.5</td>
<td>346.4 ± 129.7</td>
</tr>
<tr>
<td>Knee extension</td>
<td>31</td>
<td>97.4 ± 44.2</td>
<td>141.7 ± 62.8</td>
</tr>
<tr>
<td>Hip flexion</td>
<td>31</td>
<td>145.4 ± 55.7</td>
<td>148.0 ± 62.8</td>
</tr>
<tr>
<td>Hip extension</td>
<td>31</td>
<td>114.3 ± 39.9</td>
<td>124.8 ± 54.3</td>
</tr>
<tr>
<td>Hip abduction</td>
<td>33</td>
<td>129.6 ± 54.7</td>
<td>154.3 ± 59.4</td>
</tr>
<tr>
<td>Total hip‡</td>
<td>31</td>
<td>480.2 ± 156.1</td>
<td>537.8 ± 204.1</td>
</tr>
<tr>
<td>LE§</td>
<td>29</td>
<td>581.0 ± 192.4</td>
<td>684.7 ± 266.5</td>
</tr>
<tr>
<td>Quads 1RM‖</td>
<td>29</td>
<td>81.9 ± 35.7</td>
<td>127.4 ± 65.8</td>
</tr>
</tbody>
</table>

Note. Values are means ± SD; average of left + right sides; expressed in newtons.

* p < .05, ** p ≤ .001.
† UE (upper extremity) aggregate score = hand grip + elbow flexion + shoulder abduction.
‡ Total hip = hip flexion + hip extension + hip abduction + hip adduction.
§ LE (lower extremity) aggregate score = total hip strength + knee extensor strength.
‖ Quads 1RM = quadriceps 1 repetition maximum.

F = The test statistic for comparing the exercise categories after adjusting for mobility level, age, and pretest values.

and stair-climbing power. Previous studies have reported comparable ranges in normal (0.20 to 0.82 ms⁻¹) and fast (0.80 to 1.12 ms⁻¹) gait speeds for this population (6,7,10,13,16,17,30). Although large increases in leg strength have been shown after strength training (10,13,16), no studies have demonstrated change in normal or fast walking ability. In the institutional setting, where gait speeds are normally <1.0 ms⁻¹ (2,6,10,13,16,17,30), gait speed may, in part, be affected by psychological and environmental, in addition to physical factors.

One important feature of this model is the importance of tailoring the exercise class to different levels of resident abilities. The TUG is a simple method for classifying residents into two levels. Our findings suggest that both high and low mobility residents may derive comparable benefits from a program like the FFLTC model. Although exercise should be self-paced and progressive, the overload principle, described earlier, suggests that higher mobility individuals require a different level of challenge than lower mobility individuals. The same exercise components can be used for both groups, however, tailoring the intensity minimizes frustration and boredom, while optimizing the level of challenge.

Institutional populations comprise residents of varying physical and cognitive abilities. Our sample of low mobility residents is typical of residents who may be considered “nonambulatory.” Many of our participants had conditions affecting mobility (such as stroke [21%] and arthritis [51%]). Although they were often in wheelchairs, all could weight-bear and ambulate short distances with a walker or personal assistance. By providing minimal assistance for standing, and by using chair backs for support, these individuals were able to perform the FFLTC exercises. Neither dementia nor incontinence constituted criteria for exclusion. Some of our participants were incontinent (23%) and/or had varying degrees of cognitive impairment (25%). As others have found (4,5,7,10), exercises for this population need to be highly structured and repetitive. Even residents with a diagnosis of dementia could follow such exercises through constant cueing and mimicking the movements of the instructor and fellow participants.
Group programs are thought to be more efficient than individual physical therapy, but the relative benefits of the two approaches must be documented (18). The present study adds to the growing body of literature on the feasibility of group-based exercise programming for this population (4, 5, 10, 14, 18). For residents who were not cognitively impaired and higher in mobility, we found up to 10 people per class was feasible. For lower mobility residents, smaller classes of three to five people, and/or more volunteers to assist the instructor were necessary for optimal delivery.

For residents who are severely deconditioned and bed-bound, individualized regimens of bed exercises (1) may be necessary. Schnelle and colleagues have demonstrated that simple exercises (such as sit to stands and bathroom walking/wheeling) can be incorporated into prompted voiding programs for very frail, incontinent residents (17). For the majority of residents, who can stand independently or with minimal assistance, however, we recommend group-based exercise programming following the FFLTC model. This study demonstrates that such programming is suitable for many residents, feasible for staff and volunteers to deliver with minimal training, and does not require costly exercise equipment. Most importantly, the resulting benefits in functional outcomes after 4 months are clearly superior to those obtained from a seated ROM program.

Similar to our study, researchers working with this population can expect to face challenges in delivering exercise interventions, assessing residents, and achieving adequate sample sizes. The location of the exercise class may be in the same space as dressing appointments, choir practice, or bingo. Transporting residents to laboratory settings for assessment is not a viable option. Exercises (such as sit to stands and bathroom walking/wheeling) can be incorporated into prompted voiding programs for very frail, incontinent residents (17). For the majority of residents, who can stand independently or with minimal assistance, however, we recommend group-based exercise programming following the FFLTC model. This study demonstrates that such programming is suitable for many residents, feasible for staff and volunteers to deliver with minimal training, and does not require costly exercise equipment. Most importantly, the resulting benefits in functional outcomes after 4 months are clearly superior to those obtained from a seated ROM program.

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