Home-Based Physical Activity Programs for Middle-Aged and Older Adults: Summary of Empirical Research

Audie A. Atienza

Despite the well-documented health benefits of regular physical activity, a substantial number of middle-aged and older adults remain sedentary. As many older adults prefer to engage in physical activity on their own, rather than in a group or facility, home-based physical activity represents a promising modality for improving the health of the public at large. This paper reviews the empirical research on home-based physical activity programs designed for middle-aged and older adults. Results of aerobic and strength training home-based physical activity studies are summarized for both middle-aged and older community-residing adult and patient populations. Research gaps in the home-based physical activity literature are delineated, along with some of the barriers to filling those gaps. Finally, recommendations are offered for future research on and development of home-based physical activity programs.

Older adults represent one of most sedentary segments of the U.S. population, with middle-aged adults following close behind (U.S. Dept. of Health and Human Services, 1996). Several comprehensive reviews have documented the health benefits afforded by increased physical activity among middle-aged and older adults (Buchner, Beresford, Larson, LaCroix, & Wagner, 1992; Hagberg, 1994; King, Rejeski, & Buchner, 1998; McAuley & Katula, 1998). Some researchers have further sought to examine whether home-based physical activity programs can influence health among middle-aged and older adults in the community, or in older patient populations. One exercise intervention study designed specifically for older adults indicated that more than one-third of participants preferred to exercise individually rather than in a group (Mills, Stewart, Sepsis, & King, 1997), and another community survey reported that more than two-thirds of older adults preferred to exercise on their own (Wilcox, King, Brassington, & Ahn, 1999). Indeed, home-based physical activity programs merit further consideration as a viable physical activity modality to improve the health of older adults.

The aim of this review is to summarize and synthesize the research literature on home-based physical activity programs for middle-aged and older adults (ages 40+ years). The first section discusses the available evidence on the effectiveness...
of home-based physical activity programs. The second section outlines empirical gaps in the current research and potential barriers to filling these gaps. Finally, recommendations for future studies and for home-based exercise program development are offered.

Home-based physical activity studies included in this review were physical activity interventions or programs that could be performed in or around the home environment, and/or programs in which the channel of intervention implementation was in the home environment (e.g., telephone-based physical activity counseling, home visits by exercise trainers). Although the studies reviewed were selected because of their home-based emphasis, the program activities varied in type (e.g., aerobic, strength, flexibility) and intensity (light, moderate, hard, very hard). Also included in this review are physical activity programs for middle-aged and/or older adults that incorporate a combination of clinic-supervised and home-specific activities.

Several physical activity programs that have shown promise in improving physical activity patterns among adults in general in or around the home environment (e.g., “Project Active,” Dunn, Garcia, Marcus, et al., 1998; Dunn, Marcus, Kampert, et al., 1997, 1999; and “motivationally-tailored [via mail] physical activity program,” Marcus, Bock, Pinto, et al., 1998; Marcus, Emmons, Simkin-Silverman, et al., 1998) were not included in this review, as this review focused on programs specifically targeting middle-aged and older adults. However, the generalizability of these other promising programs to other adult populations warrants further research attention. Studies that included home-based exercise as part of a multicomponent risk reduction program (e.g., Stanford Coronary Risk Intervention Project; Haskell, Alderman, Fair, et al., 1994) were also not included in this review because of the difficulty in isolating the health effects of home-based exercise from other aspects of the risk reduction program such as nutrition counseling and smoking cessation.

**Overview of Existing Research**

Table 1 displays the home-based physical activity studies focused on middle-aged and/or older adults. Studies emphasizing aerobic-only exercise programs are described first, followed by combined aerobic plus strength/flexibility exercise programs, and finally, strength/flexibility-only exercise programs.

A series of randomized clinical trials conducted in Northern California by Stanford University researchers has found that middle-aged and older adults assigned to home-based moderate- or high-intensity physical activity programs had greater improvements in physiological and/or psychological functioning compared to those assigned to control groups. These improvements were first documented in middle-aged volunteers who were employed (Juneau, Rogers, DeSantos, et al., 1987). The findings were subsequently replicated in studies with community-residing middle-aged and older adults (King, Haskell, Taylor, Kraemer, & DeBusk, 1991; King, Haskell, Young, Oka, & Stefanick, 1995; King, Kiernan, Oman, et al., 1997; King, Oman, Brassington, Blwise, & Haskell, 1997; King, Taylor, & Haskell, 1993). More recent research has indicated that home-based physical
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| Juneau et al. (1987) 24-week program          | 120 healthy but sedentary Lockheed employees, ages 40–60 yrs            | - Home-based aerobic moderate intensity exerc. (portable HR monitors used to self-regulate intensity)  
- Control group                                                                 | - Functional capacity: VO\textsubscript{max} (treadmill test)  
- % body fat  
- Plasma lipids  
- Participation: daily logs | - VO\textsubscript{max}: exercise > control  
- % body fat: exercise > control  
- Plasma lipids: no group diff.  
- 100% completed logs |
- High-intensity home-based aerobic exercise  
- Low-intensity home-based aerobic exerc. (home-based had telephone counseling)  
- Control group | - Functional capacity: VO\textsubscript{max}, duration (treadmill test)  
- Resting blood pressure  
- Plasma lipids  
- Body mass index  
- Exercise adherence  
- Psychological functioning: depression, stress, anxiety | - VO\textsubscript{max} & duration: exercise > control  
- VO\textsubscript{max} & treadmill: no diff. between exercise groups  
- BP, lipids, BMI (1 yr): no diff.  
- Plasma HDL (2 yrs): home-based groups increased significantly over baseline groups  
- Adherence (1 yr): 75–79% vs. 53%, home-based > group-based  
- Anxiety/depression: exercise < control |
| King & Brassington (1997) 4-month program     | 24 healthy but sedentary women caregivers of dementia patients, ages 50–75 yrs | - Home-based aerobic exerc., mod. intensity (phone counseling conducted)  
- Waiting list control | - Anger expression  
- Caregiving burden  
- Exercise adherence | - Anger control: exercise < control  
- Higher exercise self-efficacy related to lower burden  
- Home-based adherence = 79% of prescribed activity |
| King, Oman, et al. (1997) 4-month program     | 43 healthy but sedentary adults, volunteer sample, ages 50–76 yrs        | - Mod-intensity aerobic exerc: class & home-based (home based had phone counseling)  
- Waiting list control | - Sleep quality self-rated  
- Functional capacity: VO\textsubscript{max} (treadmill test)  
- Exercise adherence | - Sleep quality: exercise > control  
- VO\textsubscript{max}: exerc. > control (women)  
- Adherence: mean = 93.6% of exerc, class-based = home-based |
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<td>King, Baumann, et al. (1999)</td>
<td>100 healthy but sedentary women caregivers of dementia patients; caregiver ages: 50–75 yrs</td>
<td>• Home-based aerobic exerc, moderate-intensity (telephone counseling)  • Home-based dietary program (telephone counseling conducted)</td>
<td>• Energy expenditure  • Dietary habits  • Functional capacity: VO&lt;sub&gt;max&lt;/sub&gt; (treadmill test)  • Exercise adherence</td>
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<td>King et al. (2000)</td>
<td>103 healthy but sedentary older adults in the community, ages 65+ yrs</td>
<td>• Fit &amp; Firm (class &amp; home-based): mod-intensity aerobic, strength, &amp; muscle-tone training  • Stretch &amp; Flex (class &amp; home-based): flexibility tmng (home-based: phone counseling conducted)</td>
<td>• Functional capacity: VO&lt;sub&gt;max&lt;/sub&gt;, submax HR, duration (treadmill test)  • Strength &amp; flexibility  • Physical performance (walking speed, walking distance, impairment)  • Quality of life (QOL)  • Exercise adherence</td>
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<td>Morey et al. (1999)</td>
<td>210 impaired (cardiorespiratory fitness and/or spinal flexibility) older adults, sedentary, ages 64+ yrs</td>
<td>• Aerobic-only: 3 mos hospital supervised &amp; 6 mos home-based moderate exercise  • Spinal flexibility + aerobic (S+F): 3 mos hospital supervised &amp; 6 mos home-based program (home-based: telephone contact conducted)</td>
<td>• Axial rotation  • Functional capacity: VO&lt;sub&gt;max&lt;/sub&gt; (treadmill test)  • Functional reach  • Timed-bed mobility  • Physical function (SF-36)  • Home-based exercise adherence</td>
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| DeBusk et al. (1979) | 70 men, post-myocardial infarction patients, mean age: control = 54 yrs, gym-based = 52 yrs, home-based = 55 yrs | - Home-based hard-intensity aerobic training (EKG monitored)  
- Gym-based hard-intensity aerobic training  
- No-training control | - Functional capacity: max HR, submax HR, peak workload (treadmill test) | - Max HR: all groups increased, gym > control  
- Submax HR: all groups increased, no group diff  
- Peak workload: all groups increased, home-based > control |
| Miller et al. (1984)  
DeBusk et al. (1985)  
Taylor et al. (1986) | 198 men, post-myocardial infarction patients, mean age 52 yrs | - Home-based aerobic exercise (transtelephonically monitored)  
- Group-based aerobic exercise  
- No training (3 wks)  
- Control (26 wks) | - Functional capacity: VO₂max (treadmill test)  
- Exercise adherence | - VO₂max: both home-based & group-based increased, home = group > no training  
- Adherence [3-11 wks] (11-26 wks): home-based = [89%] (72%)  
- group-based = [84%] (71%)  
- No training-related complications |
| Stevens & Hanson (1984) | 204 men, CABG surgery patients, mean age: home-based = 55 yrs, supervised = 56 yrs | - Home-based hard-intensity aerobic exercise (supervised)  
- Supervised on-site hard-intensity aerobic training | - Functional capacity: max HR, max SBP, rate-pressure product (RPP), peak workload in METs (treadmill test) | - All functional capacity measures: home-based = supervised on-site (all age groups 40-49, 50-59, & 60-69 yrs); mean METs incr. = 1.4 ± 1.5 |
| Heath et al. (1987) | 65 men & women, CABG surgery patients, mean age 59 yrs | - Home-based, hard to very hard intensity aerobic training (self-monitored)  
- Group-based, hard to very hard intensity aerobic training  
- Control, no training | - Functional capacity: peak workload in METs (treadmill test)  
- Self-reported physical activity | - METs: home-based < group-based, both increased  
- Self-reported physical activity: home = group > control |
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| Hands et al. (1987)           | 28 men, CABG surgery patients, mean age: home-based = 56.3 yrs gym-based = 57.4 yrs | - Home-based, hard-intensity aerobic tranq, unsupervised  
- Gym-based hard-intensity aerobic tranq, supervised  
- Functional capacity: max HR, max SBP, max RPP, max workload, max time (treadmill test)  
- Left ventr ejection fractions  
- All functional capacity measures: home-based = gym-based, both groups improved  
- LVEF: no change in both groups |
| Ades et al. (2000)            | 113 cardiac rehab patients, mean age: home-based = 56 yrs clinic-based = 58 yrs | - Home-based; hard-intensity aerobic exercise rehab (transtelphon. monitored)  
- Clinic-based; moderate aerobic exercise rehab.  
- Functional capacity: (treadmill test) VO_{2,max}, max workrate  
- Quality of life (QOL)  
- Program participation  |
| Lan et al. (1999)             | 20 men CABG surgery, low-risk, phase II rehab. patients, ages 53–64 yrs | - Group-based Tai Chi Chuan (TCC) program  
- Home-based self-adjusted (walking) moderate-intensity exercise program (control group, unsupervised)  
- Functional capacity: VO_{2,max}, max HR, maxO_{2}, max V\textsubscript{E}  
- Ventilatory threshold (VO\textsubscript{2}, O_{2}, WR): TCC > Walk  
- Ventilatory threshold (HR, V\textsubscript{E}): no diff/changes  
- Participation: TCC > Walk |
| Hernandez et al. (2000)       | 60 COPD patients, mean age: exercise = 64.3 yrs control = 63.1 yrs | - Home-based walking rehab program (self-monitored w/ walking speed audiotape)  
- Usual-care control  
- Pulmonary functioning  
- Dyspnea  
- Submax intensity resistance exercise test  
- Quality of life (QOL)  
- Program participation  |

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<td>Ettinger et al. (1997)</td>
<td>439 older adults w/knee osteoarthritis, pain, &amp; disability, ages 60+ yrs</td>
<td>• Aerobic exercise: 3-month facility-based walking + 15-mo home-based walking + 15-mo home-based program (home-based: telephone contact) &lt;br&gt;• Health educ. (control): discussed physical activity</td>
<td>• Self-reported physical disability &lt;br&gt;• Physical performance &lt;br&gt;• Activities of daily living (ADL) &lt;br&gt;• Functional capacity: VO\textsubscript{2max} (treadmill test) &lt;br&gt;• Strength &lt;br&gt;• Knee pain &lt;br&gt;• Postural sway &lt;br&gt;• Balance &lt;br&gt;• Exercise adherence</td>
<td>• Disability: exercise &gt; control &lt;br&gt;• Ambulation &amp; transfers: exercise &gt; control &lt;br&gt;• ADL: aerobic &gt; control &lt;br&gt;• VO\textsubscript{2max}: aerobic &gt; control &lt;br&gt;• Strength: exercise &gt; control &lt;br&gt;• Pain: exercise &lt; control &lt;br&gt;• Postural sway: exercise &gt; control &lt;br&gt;• Balance: aerobic &gt; control &lt;br&gt;• Adherence (% of prescribed): 85% (3 mos), 70% (9 mos), 50% (18 mos); overall 68% (aerobic), 70% (resistance)</td>
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<td>Rejeski et al. (1997)</td>
<td>233 older women in the community, ages 80+ yrs</td>
<td>• Home-based, moderate intensity strengthening exercises + walk 3x/wk (home visits &amp; telephone contact conducted) &lt;br&gt;• Usual-care control</td>
<td>• Falls &lt;br&gt;• Falls with injury &lt;br&gt;• Balance &lt;br&gt;• Exercise adherence</td>
<td>[6 &amp; 12 months] &lt;br&gt;• Falls: exercise &lt; control &lt;br&gt;• Falls w/injuries: exercise &lt; control &lt;br&gt;• Balance: exercise &lt; control &lt;br&gt;• Adherence: 42% of prescribed @ 12 months [24 months] &lt;br&gt;• Falls: exercise &lt; control &lt;br&gt;• Falls w/ injuries: no group diff.</td>
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<td>Messier et al. (2000) 18-month program</td>
<td>93 older men &amp; women, taking psychotropic medication, ages 65+ yrs</td>
<td>• Home-based, moderate intensity strengthening exercises + walk 2x/wk (home visits &amp; phone contact) &lt;br&gt;• Usual-care control</td>
<td>• Falls &lt;br&gt;• Exercise adherence</td>
<td>• Falls: no group diff. &lt;br&gt;• Adherence: 63% strength exercises, 72% walked 2x/week</td>
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<td>Study</td>
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<td>Duncan et al. (1998)</td>
<td>20 older stroke patients, mean age 68 yrs</td>
<td>Home-based strength (w/ elastic bands), balance, &amp; endurance (w/ walk or stationary bike) (8 wks w/ therapist, 4 wks independent)</td>
<td>Lower extremity motor recovery: exercise &gt; control</td>
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<td>Usual-care control (physical therapy)</td>
<td>Upper extremity motor recovery: no group diff, no improvement</td>
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<td>Jette et al. (1996)</td>
<td>102 nondisabled older adults in the community (with Medicare), ages 65+ yrs</td>
<td>Home-based resistance training, (w/videos &amp; elastic bands) (phone counseling conducted)</td>
<td>Gait speed: exercise &gt; control</td>
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<td>Waiting list control</td>
<td>Balance: no diff, both improved</td>
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<td>6-min walk: no diff, both improved</td>
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<td>ADL: no group diff, both improved</td>
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<td>MOS: no diff., both improved</td>
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<td>Jette et al. (1998)</td>
<td>215 functionally limited older adults in the community, ages 60–94 yrs</td>
<td>Home-based resistance training, (w/videos &amp; elastic bands) (home visits &amp; telephone counseling, incentives used)</td>
<td>Knee extension torque: exercise &gt; controls (&lt;72 yrs)</td>
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<td>Waiting list control</td>
<td>Shoulder strength: no group diff.</td>
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<td>Anger &amp; tension: exercise &lt; control (older men)</td>
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<td>Vigor: exercise &lt; control (men)</td>
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<td>Social: exercise &gt; control (older)</td>
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<td>Adherence: mean 58%, median 71%</td>
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<td>Jette et al. (1999)</td>
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<td>Muscle strength (hip &amp; knee extension &amp; flexion)</td>
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<td>Balance</td>
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<td>Functional mobility</td>
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<td>Disability status</td>
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<td>Program participation</td>
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<td>Exercise adherence</td>
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<td>Mikesky et al. (1994)</td>
<td>62 older adult volunteers, mean age: exercise = 69.2 yrs control = 72.8 yrs</td>
<td>Resistance training (with elastic Thera-tubing), 1 day/wk class supervised, 2 days/wk home-based trg unsupervised</td>
<td>Muscle strength: exercise &gt; control</td>
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<td>No-training control</td>
<td>Balance (gait): exercise &gt; control</td>
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<td>Mood: no group diff.</td>
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<td>Decrease disability: exercise &gt; control</td>
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<td>Participation: 58% had complete program participation</td>
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<td>Adherence: 89%: psychol. factors most predictive of adherence</td>
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<td>Knee flexion &amp; extension: exercise &gt; control</td>
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<td>Flexibility &amp; anthropometric: no group differences</td>
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<td>Adherence (% of prescribed): class = 90%, class + home = 52%</td>
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| Brown et al. (2000) 3-month program | 48 older adult volunteers, ages 78+ yrs | - Class-based low-intensity general conditioning (with elastic bands) 3x/wk  
   - Home-based flexibility program (unsupervised) + clinic supervised flexibility (1x/month) | - Strength: knee extension & flexion  
   - Range of motion/flexibility  
   - Balance  
   - Gait  
   - Coordination | - Strength: class > home  
   - Flexibility: both class & home groups improved.  
   - Balance: class > home  
   - Gait (walk cadence): class > home  
   - Coordination: class > home |
| Sherrington & Lord (1997) 1-month program | 44 older adults in the community, ages 64–94 yrs | - Home-based weight-bearing exercise (w/ telephone books) (one home visit conducted)  
   - Control | - Quadriceps strength  
   - Postural control  
   - Weight-bearing ability  
   - Walk velocity  
   - Self-rated fall risk  
   - Adherence | - Quad strength: exercise > control  
   - Postural control: no diff.  
   - Weight-bearing: exercise > control  
   - Walk velocity: exercise > control  
   - Fall risk: exercise > control  
   - Adherence: 81% of prescribed |
| McMurdoo & Johnstone (1995) 6-month program | 86 elderly volunteers w/ limited mobility, ages 75–96 yrs | - Home-based strength program (w/ elastic bands)  
   - Home-based mobility  
   - Health education (control) (home-based: home visits) | - Functional mobility  
   - Lower limb strength  
   - Activities of daily living  
   - Spinal mobility  
   - Program participation | - No signif. group diff. on any outcome measures  
   - Participation: 80.2% |
| O'Reilly et al. (1999) 6-month program | 191 men & women w/knee pain, residing in the community, ages 40–80 yrs | - Home-based strength program (isometric contraction + steps) (home visits conducted)  
   - No-treatment control | - Global pain  
   - Pain – walking, stairs  
   - Strength  
   - Health status (SF-36)  
   - Exercise adherence | - Global pain reduction: exer > control  
   - Pain reduction walk & stairs: exercise > control  
   - Quad strength: exercise > control  
   - Health status: no diff  
   - Adherence: more adherence = decr. pain & increased strength |
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<td>Skelton et al. (1995)</td>
<td>52 healthy older women volunteers, mean age 79.5 yrs</td>
<td>- Resistance strength training (w/ rice bags &amp; elastic bands), 1 group supervised sess. + 2x/wk home-based program (w/ exercise audiotape &amp; HR monitor)</td>
<td>- Strength: exercise &gt; control</td>
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<td></td>
<td>- Control</td>
<td>- Leg extension: exercise &gt; control</td>
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<td>- Strength: knee exten. &amp; flexion, hand-grip strength</td>
<td>- Functional ability: no group diff.</td>
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<td>- Functional ability</td>
<td>- Adherence: median session completed = 35.5 (36 prescribed)</td>
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<tr>
<td>Tinetti et al. (1999)</td>
<td>304 older patients who underwent surgical hip repair, ages 65+ yrs</td>
<td>- Home-based rehab (physical therapy &amp; functional therapy) including resistance training (w/ elastic bands) (home visits conducted)</td>
<td>- Lower limb strength: Sit-to-stand &amp; stair climb time</td>
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<td>- Usual-care control (physical therapy)</td>
<td>- Balance</td>
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<td>- Lower limb strength: Sit-to-stand &amp; stair climb time</td>
<td>- Gait</td>
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<td>- Lower limb strength: Sit-to-stand &amp; stair climb time</td>
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<td>- Lower limb strength: Sit-to-stand &amp; stair climb time</td>
<td>- Falls</td>
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<td>- Exercise adherence</td>
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<td>- Lower limb strength: no group diff, both improved (6 to 12 mos)</td>
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<td>- Balance: no group diff, little improvement (6 to 12 mos)</td>
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<td>- Gait: no group diff, little improvement (6 to 12 mos)</td>
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<td>- Upper extremity strength: (6 mos) exercise &gt; control</td>
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<td></td>
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<td>- Lower extremity strength: no group diff, both improved (6 to 12 mos)</td>
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<td></td>
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<td>- Falls: no group diff</td>
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<td></td>
<td></td>
<td>- Adherence: 56% did 70% of exerc, 77% completed exerc &gt;1/2 the time</td>
<td>(Baseline data not reported)</td>
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<td>McCool et al. (1999)</td>
<td>22 frail elderly patients with chronic medical conditions, ages 65+ yrs</td>
<td>- Home-based, high-intensity leg-strengthening (w/ ankle wts) unsupervised; family or friend encouraged to support patient w/ home exercises</td>
<td>- 1-Repetition max wt.</td>
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<td>- 1-Repetition max wt.</td>
<td>- Habitual &amp; tandem walking</td>
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<td>- Lower limb strength: Sit-to-stand time</td>
<td>- Habitual &amp; tandem walking: signif. improved</td>
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<td>- Lower limb strength: Sit-to-stand time</td>
<td>- Sit-to-stand: signif. improved</td>
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activity can also improve the health of middle-aged and older adults experiencing chronic stress, namely family caregivers of dementia patients (King, Baumann, O'Sullivan, Wilcox, & Castro, 1999; King & Brassington, 1997; King, Castro, O'Sullivan, Baumann, & Wilcox, 1999).

There is some evidence that lower-intensity home-based activity (e.g., brisk walking) can improve fitness at levels comparable to higher-intensity home-based activity among middle-aged adults (King et al., 1991). Moreover, findings indicated that adherence to home-based aerobic programs was significantly higher, at 75–79%, compared to adherence to a group-based aerobic program, at 53% (King et al., 1991).

Greater adherence to home-based exercise in these Northern California studies may be partly attributable to the incorporation of a telephone-counseling component into the program. Possible mechanisms of the telephone counseling include increased self-regulation of exercise behaviors, provision of encouragement and support, and reduction of barriers to exercise via problem solving. The aerobic exercise programs developed by researchers at Stanford University have been consistently found to increase physical activity levels during the course of the interventions. In light of this, similar home-based aerobic activity programs targeting healthy but sedentary middle-aged and older adults in the community could be developed by other researchers that follow the design and methodology employed in these Northern California studies.

The beneficial effects of home-based aerobic exercise programs have also been documented with various middle-aged and older patient groups. Earlier studies indicated that both high-intensity home-based and supervised gym-based aerobic programs improved cardiorespiratory function among low- to moderate-risk cardiac (postmyocardial infarction or coronary artery bypass graft) rehabilitation patients, but that the gym-based programs displayed greater improvements (DeBusk, Houston, Haskell, Fry, & Parker, 1979; Heath, Maloney, & Fure, 1987). But subsequent studies have suggested that high-intensity home-based aerobic rehabilitation improves cardiorespiratory function at levels comparable to supervised group-based or gym-based aerobic rehabilitation among low- to moderate-risk cardiac patients (Ades, Pashkow, Fletcher, et al., 2000; DeBusk, Haskell, Miller, et al., 1985; Hands, Biffa, Henderson, et al., 1987; Miller, Haskell, Berra, & DeBusk, 1984; Stevens & Hanson, 1984; Taylor, Houston-Miller, Ahn, Haskell, & DeBusk, 1986).

Among middle-aged and older adults with chronic obstructive pulmonary disease (COPD; Hernandez, Rubio, Ruiz, et al., 2000) or osteoarthritis (Ettinger, Burns, Messier, et al., 1997; Messier, Royer, Craven, et al., 2000; Rejeski, Brawley, Ettinger, Morgan, & Thompson, 1997), home-based rehabilitation exercise (i.e., walking) has been shown to increase functional capacity, improve balance, and increase quality of life. In contrast, no-training/usual care failed to show such improvements. Some research has suggested that home-based aerobic programs are less effective than clinic-supervised programs among frail older adults (Morey, Schenkman, Studenski, et al., 1999), and not effective in low-risk cardiac rehabilitation patients (Lan, Chen, Lai, & Wang, 1999). However, less than optimal adherence to prescribed home-based exercises in these studies may have diminished the effects of home-based exercise.
A few studies have evaluated combined home-based aerobic + strengthening (or flexibility) exercise programs with older adults, but outcome measures in these studies have differed. In one study, older adults in the community assigned to class- and home-based aerobic + flexibility exercise (“Fit and Firm”) had greater endurance (i.e., submax heart rate) and strength improvements than those only performing flexibility exercise (“Stretch & Flex”) (King, Pruitt, Phillips, et al., 2000). Interestingly, King and colleagues further noted that adherence to home-based exercise was significantly higher than adherence to class-based exercise for both exercise conditions, “Fit and Firm” and “Stretch & Flex.”

In another study, older community-residing women participating in home-based aerobic + strength training had fewer falls than older women in a usual-care control condition (Campbell, Robertson, Gardner, Norton, & Buchner, 1999a; Campbell, Robertson, Gardner, et al., 1997). Among older stroke patients, aerobic + strength home-based training improved gait speed and lower extremity motor recovery to a greater extent than did usual-care (that included some physical therapy). Both home-based training and usual-care displayed comparable improvements in balance, ADL, and quality of life (Duncan, Richards, Wallace, et al., 1998). However, among older adults taking psychotropic medication, rates of falls in those participating in home-based aerobic + strength training were no different than for those in a control condition (Campbell, Robertson, Gardner, Norton, & Buchner, 1999b). In general, available research suggests that home-based aerobic + strength or aerobic + flexibility exercise programs can improve the health of both populations: older adults in the community and older mildly- to moderately-impaired stroke patients.

Other researchers have focused on home-based strength training programs (e.g., resistance training) with middle-aged and/or older adults. Researchers at Boston University have developed the Strong-for-Life program, a resistance training program using elastic bands. It has been shown to be effective in improving strength, balance, and functioning among both nondisabled and functionally limited older adults in the community (Jette, Harris, Sleeper, et al., 1996; Jette, Lachman, Giorgetti, et al., 1999; Jette, Rooks, Lachman, et al., 1998). Similar to the aerobic exercise model developed by Stanford University researchers (King et al., 1991; King & Brassword, 1997; King, Castro, et al., 1999), the Strong-for-Life program incorporated telephone contact to facilitate program adherence. In addition, exercise videotapes, home visits, and behavioral incentives were incorporated into the home-based resistance training program. The Strong-for-Life program produced strength gains that were significantly greater when compared with no-training control conditions.

While these improvements were relatively modest compared to gains typically achieved in facility-based strength training programs, home-based resistance training programs such as Strong-for-Life can be implemented on a wider scale than a facility-based program (Jette et al., 1996). Thus, the potential benefits of home-based programs at the community (or population) level may be greater than the possible benefits of facility-based programs. Other researchers have also documented strength improvements with exercise programs incorporating home-based resistance (elastic band) training among healthy older adults (Mikesky, Topp, Wigglesworth, Harsha, & Edwards, 1994; Skelton, Young, Greig, & Malbut, 1995) and older hip surgery patients (Tinetti, Baker, Gottschalk, et al., 1999).
Yet, some researchers have failed to detect differences in strength levels between a home-based resistance-training program and a no-training control condition among older volunteers with limited mobility (McMurdo & Johnstone, 1995). Similar to literature on home-based aerobic programs, poor rates of exercise adherence may explain the null findings (McMurdo & Johnstone, 1995). Home-based strength training programs that used weights (e.g., dumbbells, ankle weights) have also been shown in some studies to improve strength and functioning among frail older adults (Ettinger et al., 1997; McCool & Schneider, 1999; Messier et al., 2000). Other home-based strength training programs have shown that strength training exercises with elastic tubing (Mikesky et al., 1994), rice bags (Skelton et al., 1995), telephone books (Sherrington & Lord, 1997), isometric contractions, and step climbing (O’Reilly, Muir, & Doherty, 1999) can increase muscle strength in middle-aged and older adults, though replication of these programs is needed.

SUMMARY OF PRIOR RESEARCH

The following summarizes findings from prior research:

- Moderate-intensity home-based aerobic exercise (i.e., brisk walk/jog) has been shown to improve the health of community-residing middle-aged and older adults in a series of studies conducted in Northern California.
- Lower-intensity home-based aerobic exercise programs have been shown to improve functional capacity at levels comparable to higher-intensity home-based exercise programs among middle-aged adults.
- Exercise adherence in community samples was higher for home-based aerobic exercise compared to group-based exercise. Telephone-based physical activity counseling may facilitate exercise adherence.
- Cardiorespiratory improvements have been documented with home-based high-intensity aerobic activity programs tailored to middle-aged and older adults undergoing cardiac rehabilitation. Home-based programs involving aerobic exercise have also been shown to increase functioning among older COPD and osteoarthritis patients.
- Research suggests that the physical functioning of middle-aged and older adults in the community can improve with home-based aerobic + strength training or aerobic + flexibility exercise, and that older minimally to moderately impaired stroke patients can benefit from home-based aerobic + strength training exercise.
- Most published research to date has indicated that home-based strength (e.g., resistance) training programs can improve muscle strength among middle-aged and older adults. Strength gains with home-based training may not be as potent as with more extensively supervised (facility-based) training, but home-based programs may be more convenient and can be implemented on a wider scale.
- The impact of home-based exercise programs on health may depend largely on the level of adherence to the prescribed exercise regimen. Higher adherence to home-based exercise prescriptions is likely to produce greater health improvements.
Research Gaps

This section outlines research gaps in the literature concerning home-based exercise programs that target middle-aged and older adults. The first gap concerns the need to replicate studies in different environments and geographic regions. Most studies on home-based aerobic exercise with community-residing middle-aged or older adults have been conducted in the western region of the U.S., specifically Northern California. However, there are regional differences in levels of physical activity and inactivity. The West is the region with lower rates of inactivity; i.e., higher rates of physical activity (U.S. Dept. Health and Human Services, 1996). Therefore, it is unclear whether the findings of prior research on home-based aerobic training would generalize to middle-aged or older adults in different regions of the United States.

Less is known about the prevalence of strength training in various geographical regions, but a similar argument can be made concerning the need to empirically establish whether home-based strength training programs generalize to middle-aged and older adults in various regions of the U.S. The South has the highest rate of sedentary lifestyles (U.S. Dept. Health and Human Services, 1996); thus, research on home-based exercise programs with midlife and older adults in this region remains a high priority. It is also important to note that not all home and neighborhood environments are alike. Therefore, additional research is needed to examine which environments facilitate the initiation and maintenance of home-based physical activity among aging adults. A barrier to such studies is that relatively few researchers are currently investigating home-based physical activity programs.

The oldest-old (ages 85+) subgroup represents the most sedentary segment of older adults and may benefit substantially from participation in home-based physical activity programs (King et al., 1998). However, few home-based aerobic exercise studies have focused on this subgroup of older adults. Development of appropriate home-based aerobic exercise tailored to the oldest-old requires inclusion of and specific focus on the oldest-old population in future research. A handful of home-based strength training studies have included adults ages 85 years or older (Brown, Sinacore, Ehsani, et al., 2000; Jette et al., 1999; McMurdo & Johnstone, 1995; Skelton et al., 1995). However, these studies have not conducted subgroup analyses focusing specifically on the oldest-old.

There is also an absence of information on whether older adults from different ethnic or socioeconomic status (SES) backgrounds can benefit similarly from home-based exercise programs. Prior home-based studies have often failed to report the ethnic/racial and SES characteristics of their samples, or have not included a variety of ethnic/racial or SES groups. That is, they have worked mostly with white middle- to upper-class populations (King et al., 1998).

Among studies that have reported ethnic and SES characteristics, limited sample sizes have often precluded analyses of subgroup differences. Ethnic/racial minorities, particularly African American and Native American women, are less active than white populations (Brownson, Eyler, King, et al., 2000; Crespo, Smit, Andersen, Carter-Pokras, & Ainsworth, 2000; U.S. Dept. Health and Human
Services, 1996) and have disproportionate rates of chronic illness and preventable mortality (American Heart Association, 1991). Similarly, low SES populations are less likely to be active than more affluent populations (Taylor, Baranowski, & Young, 1998). Thus, research exploring the effectiveness of home-based exercise programs with middle-aged and older adults from low-income, African American, and Native American populations as a way to curb morbidity and mortality rates in these communities remains a high research and public health priority. The data on physical activity among middle-aged and older Asian Americans is scarce, which limits the ability to make recommendations for these racial groups. Thus more research on overall physical activity patterns in these ethnic groups is indicated.

Barriers to filling the gaps in research concerning racial and low-income groups include a paucity of researchers exploring home-based exercise among older adults from minority or low-income groups, the distrust that some ethnic or low-income communities may feel toward research institutions, and language translation issues, which in turn can influence recruitment, program implementation, and measurement validity. Building cooperative coalitions with these communities, with various community and social organizations, and with health care professionals may help reduce these barriers and produce sustainable programs.

A third research gap concerns long-term exercise maintenance in the home and neighborhood environment. As noted above, prior research has found that higher exercise adherence is related to better outcomes in middle-aged and older adult populations. Some researchers have also found that incorporating cognitive-behavioral strategies (e.g., cognitive training, behavioral incentives, telephone counseling) into the intervention can enhance adherence to prescribed exercise regimens during the course of a research study (Jette et al., 1998; King et al., 2000; Lachman, Jette, Tennstedt, et al., 1997). However, programs that produce long-lasting exercise behavior change after an intervention ends have not been empirically established (Marcus, Dubbert, Forsyth, et al., 2000; Rothman, 2000).

A number of theoretically based physical activity models and mechanisms have been proposed in the general physical activity literature (see reviews by Baronowski, Anderson, & Carmack, 1998; Epstein, 1998; King, Blair, Bild, et al., 1992; Marcus, Owen, Forsyth, Cavill, & Fridinger, 1998; Rothman, 2000; U.S. Dept. Health and Human Services, 1996) (also see Stewart, this issue, for a discussion of Social Ecology Models and physical activity). Yet studies that test theoretically based mechanisms responsible for long-term maintenance of exercise behaviors among middle-aged and older adults are lacking. Evaluation of these mechanisms requires long-term (i.e., longitudinal) investigations that extend beyond the intervention phase of a study. The identification of key mechanisms may help researchers design future home-based programs for middle-aged and older adults that produce lasting effects.

An issue more difficult to evaluate is the identification of home-based programs that are less effective for middle-aged and older adults. Studies producing null results are less likely to be published, given the publication bias toward positive findings, and thus are absent from the research literature. The limited data that does exist indicates that home-based programs with poor exercise adherence are less effective for middle-aged and older adults.
SUMMARY OF RESEARCH GAPS

The following summarizes gaps in the current research:

- Studies are needed that explore the generalization of established home-based exercise programs to middle-aged and older adults who reside in different geographic regions, particularly the South, and in different home or neighborhood environments.
- Little empirical data exists on the physical activity patterns of the oldest-old (age 85+ years). Future studies exploring home-based exercise in this subgroup are warranted, given the high sedentary rates in this population.
- Research is needed on the effectiveness of home-based exercise programs among middle-aged and older adults of different ethnic/racial backgrounds and socioeconomic levels, given the high rates of morbidity and mortality and the low rates of physical activity in these groups.
- Longitudinal research is needed that examines the maintenance of exercise behavior among middle-aged and older populations, and the mechanisms responsible for continued physical activity after the intervention ends.

Overall Summary and Recommendations

The health benefits of regular physical activity are well documented. Despite the importance of regular physical activity, large proportions of older adults in the U.S. remain sedentary (U.S. Dept. Health and Human Services, 1996). As studies have indicated that many older adults prefer to exercise individually or on their own, rather than in a class-based or group-based format (Mills et al., 1997; Wilcox et al., 1999), home-based physical activity represent a notable modality to improving the health of older adults. Based on the present review of home-based physical activity programs for middle-aged and older adults, a number of conclusions and recommendations are made:

1. Home-based moderate-intensity aerobic training (aerobic-only, aerobic + strength training, or aerobic + flexibility) has been found to improve cardiopulmonary health and overall functioning in community-residing adults who are middle-aged or older. Home-based high-intensity physical activity programs have been shown to be safe and effective for improving functioning among older cardiac rehabilitation patients. Other patient groups (e.g., COPD, osteoarthritis patients) may also benefit from home-based aerobic programs. Future research is needed to determine whether the health benefits of established programs can generalize to underserved and understudied populations such as the oldest-old, older ethnic/racial minorities, and older adults in low-income groups.

2. Ongoing cooperative relationships between researchers, community groups, and health care professionals must be established to develop effective and sustainable home-based (or combined class- and home-based) exercise programs for middle-aged and older adults, particularly among sedentary, high-risk, and understudied groups.

3. In some studies, home-based aerobic training programs have produced higher rates of adherence to prescribed exercise compared to group-based training.
Home-based programs may be more convenient and preferred over group-based programs. They may also be implemented on a wider scale. Thus, demonstration studies for community-wide implementation of home-based aerobic interventions targeting middle-aged and older adults are indicated.

4. Home-based programs with telephone-based counseling have been particularly effective in facilitating high program participation, exercise adoption, and program adherence among middle-aged and older adults. However, future research is needed to delineate programs, and factors, that produce long-term exercise maintenance.

5. Home-based strength training has been shown to improve muscle strength and physical functioning among middle-aged and older adults. Health improvements from home-based resistance training (using elastic bands) have been documented in several studies. Other home-based strength training programs need empirical replication.

6. Physical activity programs applicable to home-based activity that have been found to be effective for adults in general (e.g., "Project Active," Dunn et al., 1997; 1998; 1999; and "motivationally-tailored [via mail] physical activity programs," Marcus, Bock, et al., 1998; Marcus, Emmons, et al., 1998), should be tested with older adults to examine whether the health benefits documented extend to older adults.

7. Longitudinal physical activity research extending beyond the end of the exercise intervention with middle-aged and older adults is needed. Theoretically based longitudinal research is especially needed to evaluate behavioral, psychological, environmental, and biological mechanisms responsible for increases in and maintenance of physical activity during and following home-based physical activity interventions.

References


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