Published in final edited form as:

PM R. 2016 June ; 8(6): 520–528. doi:10.1016/j.pmrj.2015.10.004.

Translation of a Motor Learning Walking Rehabilitation Program into a Group-based Exercise Program for Community-Dwelling Older Adults

Jennifer S. Brach, PhD, PT¹, Sara J. Francois, PT, DPT, MS², Jessie M. VanSwearingen, PhD, PT¹, Sandra Gilmore, RN, MS³, Subashan Perera, PhD^{4,5}, and Stephanie A. Studenski, MD, MPH⁶

¹Department of Physical Therapy, University of Pittsburgh, Pittsburgh, PA

²Program in Physical Therapy, Washington University, St. Louis, MO

³University of Pittsburgh Medical Center, Community Provider Services, Pittsburgh, PA

⁴Division of Geriatric Medicine, Department of Medicine, University of Pittsburgh, Pittsburgh, PA

⁵Department of Biostatistics, University of Pittsburgh, Pittsburgh, PA

⁶National Institute on Aging, Baltimore, MD

Abstract

Background—Traditional exercise programs for older adults, which focus on aerobic and strength training, have had only modest effects on walking. Recently, a motor learning exercise program was shown to have greater effects on walking when compared to a traditional exercise program. Translating this novel motor learning exercise program into a group exercise program would allow it to be offered as an evidence-based community-based program for older adults.

Objective—To translate a walking rehabilitation program based on motor learning theory from one-on-one to group delivery (On the Move©) and evaluate multiple aspects of implementation in older adults with impaired mobility.

Design—The translation process involved multiple iterations including meetings of experts in the field (Phase I), focus groups (Phase II) and implementation of the newly developed program (Phase III). Phase III was based on a one-group model of intervention development for feasibility, safety, potential effects and acceptability.

Setting—Community sites including two independent living facilities, an apartment building and a community center.

Corresponding Author: Jennifer S. Brach, PhD, PT, University of Pittsburgh, School of Health and Rehabilitation Sciences, Department of Physical Therapy, Bridgeside Point 1, 100 Technology Drive, Pittsburgh, PA 15219, Phone: 412-383-6533, Fax: 412-648-5970, jbrach@pitt.edu.

No medical devices were used during this study.

Parts of this work was presented at APTA Combined Sections meeting 2014 in Las Vegas, NV and ISPGR 2014 in Vancouver, CA

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Participants—Adults 65 years of age or older who could ambulate independently and who were medically stable. Thirty-one adults, mean age 82.3 ± 5.6 years, were eligible to participate.

Methods—The group exercise program was held twice a week for twelve weeks.

Main Outcome Measurements—Acceptability of the program was determined by retention and adherence rates and a satisfaction survey. Risk was measured by adverse events and questions on perceived challenge and safety. Mobility was assessed pre and post intervention by gait speed, figure of eight walk test (F8WT), and six minute walk test (6MWT).

Results—Modifications to the program included adjustments to format/length, music, education, and group interaction. The 12 week program was completed by 24/31 entrants (77%). Adherence was high with participants attending on average 83% of the classes. Safety was excellent with only one subject experiencing a controlled non-injurious fall. There was preliminary evidence for improved mobility after the intervention: gait speed improved from $0.76 \pm .21$ to $0.81 \pm .22$ m/s, $p = .06$; Figure 8 Walk Test from 13.0 ± 3.9 to 12.0 ± 3.9 s, $p = .07$; and Six Minute Walk Test from 246 ± 75 to 281 ± 67 meters, $p = .02$.

Conclusions—The group-based program was safe and acceptable to older adults with impaired mobility and resulted in potentially clinically meaningful improvements in mobility.

INTRODUCTION

Impaired mobility is a common and costly problem for older adults. Exercise is believed to improve mobility and prevent disability. Current exercise recommendations for older adults focus primarily on aerobic and strength training;¹ however, studies incorporating these standard exercise programs have shown only modest improvements in walking.²⁻⁴

Walking is a complex task that places demands on multiple systems including the cardiopulmonary, musculoskeletal, and nervous systems. Current exercise programs address the cardiopulmonary and musculoskeletal systems with aerobic and strength training, but overlook the nervous system. Given that many older adults have subclinical neurological deficits that contribute to mobility limitations,⁵⁻⁸ incorporating neurological training into exercise for older adults may result in improved mobility.

An individual exercise program that incorporates elements of motor skill training, often used in neurologic rehabilitation, was developed to reduce the energy cost of walking in older adults with mobility limitations. This novel motor learning exercise program was based on task-oriented, motor skill-based exercise principles. Motor skill-based exercise includes: 1) a defined movement goal, 2) movement to gain knowledge of muscles and postures, 3) practice to correct errors in movement, develop and adjust motor plans, and 4) challenge to select the optimal motor plan. This program challenges the brain to adapt and learn the appropriate timing and sequence of movements in synchronization with the postures and phases of gait to improve walking. The program includes stepping and walking patterns to promote the appropriate timing and coordination of stepping throughout the gait cycle by enhancing proper weight transfer during stepping and interlimb timing during walking. Compared to a standard exercise program (ie aerobic and strength training), the motor learning exercise program resulted in significantly greater improvements in energy cost,

walking confidence, self-reported function and disability, gait speed, and challenging gait tasks.^{9–11}

The evidence for the benefits of this motor learning exercise was based on a one-to-one approach provided by experienced physical therapists. Translating this novel motor learning exercise program into a group exercise program would allow it to be offered as a community-based program, providing evidence-based therapeutic exercise to older adults who would benefit whether or not they would qualify for, have access to, or have been referred for physical therapy services. Therefore, the purposes of this article are 1) to describe the operational translation of an individual motor learning exercise program into a group-based exercise program (On the Move[®]) and 2) to describe the acceptability, risk, mobility outcomes and feasibility of the On the Move[®] program in community-dwelling older adults.

METHODS

Overview

An iterative process was used to translate the individual motor learning walking rehabilitation program into a group-based exercise program called On the Move[®]. The individual program was modified into a group program via expert opinion (Phase I). The group program was then administered to older adults who provided feedback about their experience with the group exercise through focus groups (Phase II). The program was modified accordingly and then implemented at 4 separate facilities (Phase III). The acceptability, risks, effectiveness and feasibility of the program were evaluated. The (Blinded) Institutional Review Board approved this research, and all subjects provided informed consent.

Phase I – Expert Opinion

The individual program was developed into a group program over multiple meetings with nine physical therapists. These therapists were familiar with the individual program and/or had experience working with older adults and conducting group exercise classes. Multiple aspects of the program were discussed, including, but not limited to: content and format of the program, length of the class, progression of the exercises, and use of music and equipment. The goal of Phase I was to adapt the individual program into a feasible and safe group program.

The initial modification of the individual program into a group program focused primarily on the issue of safety while still maintaining the content of the program. The individual program had been performed one-on-one or in small groups with no adverse events; however, due to the standing and walking aspects of the program, safety of the participants in a group setting was a concern. After a review of the literature and discussion with the expert therapists, a group size of no more than 10 participants was determined as what one physical therapist and one assistant could safely accommodate in the program. The experts also determined that the program should initially be conducted with older adults who ambulated independently and did not require physical assistance to stand or walk.

Phase I of development resulted in a 30-minute continuous class consisting of a warm-up, walking patterns, stepping patterns, strengthening, and stretching/cool-down being performed to a variety of musical artists and genres. The older adults would be instructed to hold onto a solid surface (ie table or chair) for support during the warm-up and stepping patterns due to the balance and safety concerns. Playground balls would be used during the stepping patterns to facilitate group interaction. To educate and motivate the older adults, the instructor would discuss the rationale behind the exercises and activities while performing them.

Phase II – Feedback from Older Adults

The goal of Phase II was to determine if the older adults liked the program and if they would attend such a program on a regular basis. To obtain input from the older adult participants on the group program developed in Phase I, feedback sessions were implemented in Phase II. The feedback was completed in two ways: (1) following performance of a single class of the On the Move[®] program and (2) following performance of multiple classes of the On the Move[®] program. The single class feedback sessions included 13 community-dwelling older adults (mean age 79.8 ± 5.7 years, 38.5% female) who had participated in a previous study incorporating the individual motor learning exercise program.¹¹ The sessions consisted of a single class of the On the Move[®] group program followed by a group discussion in which the older adults provided feedback about the program. The group discussions were based on the Nominal Group Process,¹² and included having each older adult record their likes and dislikes about the program on an index card. The participants shared one of the likes or dislikes they had recorded, and a list of the shared comments was displayed for all to view. Lastly, the facilitators guided a semi-structured discussion on topics the older adults had mentioned as well as other topics previously defined by the facilitators (eg music, level of difficulty, size of group, etc.)

The multiple class feedback sessions consisted of 8 residents (mean age 83.4 ± 3.1 years, 62.5% female) at an independent living facility where On the Move[®] program was being delivered. The subjects' mean gait speed was 0.93 ± 0.14 m/s, indicating our sample had impaired mobility below the desired gait speed of 1.2 m/s. After participating in On the Move[®] program twice a week for six weeks, older adults attended a feedback session which included a semi-structured guided discussion about the program content, as well as discussion about the benefits and drawbacks of the group program at this facility. Based on comments from the 21 older adults who participated in the feedback sessions, the experts identified four major concepts (format/length, music, education, and group interaction) which were adjudicated by the older adults. The concepts and associated modifications are listed in Table 1 and described in further detail below.

The first major concept that arose was the format/length of the program. The majority of the older adults stated 30 minutes was not sufficiently long for the exercise class; they wanted a longer class with a small rest break. Some subjects recommended 60 minutes, but others thought 60 minutes was too long. A compromise was reached, and the class was lengthened to approximately 45–50 minutes including a rest break after the walking patterns to allow the participants to rest and hydrate.

The second major concept discussed was the music. The participants reported the music was necessary; however, they did not like the type of music that was played. The original playlist included a variety of musical artists and genres, including contemporary artists. During the first feedback session, a song by a contemporary/pop artist (such as Adele, Sara Bareilles, etc.) was played and one of the participants stated “I can tell you right now, I don’t like the music.” The older adults indicated they preferred music from their generation (eg Frank Sinatra, Dean Martin, etc.). Also, some of the original songs chosen for the walking patterns were removed as it was difficult to find the beat of the song to be able to walk to it. The playlists were modified accordingly, deleting songs from the more contemporary artists and maintaining the music of artists from the older adults’ generation.

Providing information about why the exercises were being performed was another concept that occurred throughout the feedback sessions. The older adults enjoyed the education provided by the instructor but wanted to learn even more. They wanted to know why they were doing the exercises and what exactly each exercise was doing to help them. A few of the participants even requested the education be taken a step further with suggestions for applications of the activities and exercises performed in the class to other real-life situations (eg doing ankle pumps when seated for an extended period of time, etc.). More education on the exercises was incorporated into the program, and the information was extrapolated to other activities and situations as appropriate.

The enjoyment of the group interaction was the final concept that emerged from the feedback sessions. In order to facilitate social interaction (an often cited reason for older adults participating in group programs^{13–16}), during the stepping patterns, participants worked with a random partner and passed a ball back and forth or worked as a group and passed balls diagonally down a line. This enabled conversation, encouragement, and peer coaching to occur between the participants. Also, during the walking patterns, the participants walked in two ovals next to each other. When the groups passed each other in opposite directions, the participants would give members of the other group high fives. Participants enjoyed the group dynamic, and such activities were incorporated into almost all of the classes.

Phase III – Implementation

The 12 week On the Move[®] program was implemented at two independent living facilities, one senior community center and one senior apartment building. The locations/sites were selected to expand the diversity of the sample and begin to examine the feasibility of conducting the program in different community settings. Participants were recruited using a recruitment talk/information session at the facility.

Participants—All participants underwent a brief screening examination to determine eligibility based on the inclusion and exclusion criteria. Inclusion criteria were: 1) 60 years of age or older and 2) ambulate independently (may use a straight cane or a rollator). Exclusion criteria included: 1) non English speaking, 2) impaired cognition defined as Mini Mental State Exam score < 24, 3) plans to leave the area for an extended period of time over the following 4 months, 4) progressive neuromuscular disorder such as Parkinson’s or

Multiple Sclerosis, 5) any acute illness or unstable medical condition, and 7) inappropriate response to the 6 minute walk test (ie exercise heart rate ≥ 120 bpm, exercise systolic blood pressure (SBP) ≥ 220 or a drop in SBP > 10 mmHg, or diastolic blood pressure ≥ 110 mm Hg).¹⁷

Intervention—At each of the four sites, the group exercise program (On the Move[®]) was offered twice weekly for 12 weeks for a total of 24 sessions. Each exercise session lasted approximately 50 minutes and was led by a trained physical therapist. On the Move[®] program is described in Table 2. The program began with a 5–7 minute warm-up, incorporating weight shifting and light stepping activities. The walking patterns were performed next, with the older adults walking in oval or serpentine patterns around cones. This portion of the class lasted 10–15 minutes and was performed to music with a strong beat, typically around 90–95 beats per minute. After the walking, a 5–10 minute seated rest/water break was allowed. Following the rest break, the stepping patterns were completed, which include forward and backward steps on a diagonal to promote appropriate weight shifting and coordination of the limbs. Lastly, a few lower extremity strengthening exercises occurred followed by 3–5 minutes of stretching.

The class leader implemented the timing and coordination stepping patterns and walking patterns with tasks that required low timing and coordination (eg stationary environment, no or little trial variability, body stable and no manipulation of objects) and progressed the subjects to more skilled movement exercise as indicated by the success in the performance. Based on the principles of motor learning, an individual should be successful at a task about 80% of the time to indicate they have learned the task.^{18,19} Progression also encourages the subject to continue participating in the exercise program. If the participant struggles too much with a task, they will get frustrated and may become discouraged with the activity.^{20–22} As learning occurred, the exercises were progressed by using the options provided in Table 2, changing only one component at a time. Once the participants were successful with progression in one component, another component was altered.

When implementing and progressing, the functional level of the members of the group was taken into consideration. Throughout the group sessions, modifications were presented for many of the exercises so that subjects could adjust the difficulty of the exercise to meet their needs. For example, for a simple stepping exercise, some subjects held onto a chair to complete the exercise (easiest) where others only rested a finger on the chair for support, and some even did not hold on at all (most difficult).

Outcomes

Acceptability: Acceptability of On the Move[®] program was evaluated with respect to retention, adherence rates and responses on a general satisfaction survey completed at the end of the 12-week program. Participants were asked to rate their satisfaction with the program using a 5-point Likert scale where 1 indicated very dissatisfied, 3 indicated neutral opinion, and 5 indicated very satisfied.

Risk: The overall safety and risk of the program was evaluated through adverse events that occurred during the exercise program and through questions on perceived challenge and

safety administered at the completion of the 12-week program. Participants were asked to rate how much the program challenged them on a 5-point Likert scale where 1 indicated not at all challenged, 3 indicated somewhat challenged and 5 indicated very challenged. Safety was also evaluated on a 5-point Likert scale with 1 indicating that they felt very unsafe, 3 was a neutral response and 5 indicating they felt very safe.

Mobility outcomes: Mobility outcomes were assessed before and after the 12-week exercise program.

Gait speed: Participants walked at their usual, self-selected speed on a 6-m course. The time to complete the central 4 meters was recorded. Participants completed two trials and the mean of the two trials was used as the indicator of gait speed. The test-retest reliability of gait speed is $ICC = 0.79$.²³ A small meaningful change in gait speed is 0.05 m/s and a substantial change is 0.10 m/s.^{24,25}

Motor skill in walking: The Figure of 8 Walk test time was used as a measure of motor skill in walking.²⁶ The test involved walking a figure of eight pattern about two markers placed 5 feet apart. Performance was scored based on the time to complete the figure 8 walk. The Figure of 8 Walk has established inter-rater reliability ($ICC=0.90$) and validity by comparison to measures of gait, motor control and function.²⁶ Lesser time is an indicator of greater skill in walking.

Walking endurance: The Six-Minute Walk Test (6MWT) of distance walked (meters) in six minutes, including time for rest as needed was used to assess walking endurance.²⁷ The 6MWT has established psychometric properties including test-retest reliability (Pearson $r=.95$) in older adults^{28,29} and construct validity for graded exercise test and functional classification.³⁰ A small meaningful change in 6MWT distance is 20m and a substantial change is 50m.²⁴

Analysis—Descriptive statistics (ie means and percentages) were used to describe the participants, acceptability and risks of the program. Paired-sample t-tests were used to assess significant change in mobility outcomes from pre- to post-intervention.

Results

Acceptability: Thirty-one older adults, mean age 82.3 ± 5.6 years, with a mean gait speed of 0.73 ± 0.21 m/s were eligible to participate. Twenty-four of the thirty-one participants or 77% completed the 12-week exercise program. The 24 participants who completed the program had a mean age of 82.2 ± 4.7 years and a gait speed of 0.76 ± 0.21 m/s. The majority of the participants, $n=21$ (88%), were female. Of the 7 participants who did not complete the program, 6 withdrew secondary to medical problems unrelated to the intervention and one withdrew because of dissatisfaction with the program.

Adherence was high with participants attending 83% or 479 of the potential 576 classes (24 classes X 24 subjects = 576 classes). Twenty-one of the twenty-four participants (87.5%) attended at least 75% of the classes. In addition, 96% of the participants stated they were either satisfied or very satisfied with the program. Also, many of the older adults reported

they would continue to attend this program, even after their role as research subjects had ended.

Risk: The exercise program had an excellent safety profile with only one controlled, non-injurious fall reported. Participants, in general, felt safe but challenged with 96% reporting the program to be somewhat or more than somewhat challenging and 96% reporting that they felt safe or very safe.

Mobility: At the conclusion of the 12-week program, as a group the participants walked faster, with greater motor skill in walking and better walking endurance (Table 3). The improvements in both gait speed and 6MWT met criteria for clinically meaningful changes.²⁴

Feasibility: By implementing the program at four different locations, we were able to assess the feasibility of performing the program at various sites in the community. The experience of running On the Move[®] program twice a week for 12 weeks highlighted some challenges and barriers that need to be considered such as: space required to hold the class, dealing with visual and hearing deficits, and exercising to music.

On the Move[®] program was held in various size rooms in the 4 facilities. Smaller rooms (23×26 feet) limited the ability to properly complete the walking patterns. Participants were often limited by the speed of the person in front of them, and with limited space, there was no ability to pass other participants. Performing the program in a larger space (approximately 50×70 feet) resolved this issue, but lessened the intimacy of the group setting. The older adults reported they preferred the smaller room even though they were limited during the walking patterns. Therefore, for a group of 8–10 subjects, we recommend performing the program in an open space approximately 1200 square feet where the length and width are approximately identical (ie a square) or the length is no more than 2 times the width (ie a rectangle). This will allow for ample space to perform the walking and stepping patterns.

Another major concept that emerged during the implementation of the program included the adjustments and adaptations necessary for hearing and visual deficits. When working with older adults, concerns regarding hearing and vision constantly affect the provision of services. Working individually with an older adult allows for specific modifications of the interaction in which the older adult can hear or grasp the exercise instructions and see the movements demonstrated. In addition, the individual exercise program in physical therapy is usually not performed with music. Within the group setting, providing effective verbal and visual cues requires substantial thought and effort. Some of the modifications made due to hearing and vision concerns included turning down the volume or stopping the music completely when providing instructions, staggering the chairs to allow for each person to see the instructor, and providing individual instruction to reinforce the directions provided. Specific adaptations had to be made for one participant who was legally blind – making sure she was in the front of the room, providing her with bright-colored balls that were easy to see, and using colors of cones that were easy to differentiate. It only took very simple

adjustments for the same individual to participate in the program whereas, in most group exercise class conditions, she likely would have been excluded because of her visual deficits.

To provide the music for the exercise classes, we used an iPod TouchR (Apple Inc., Cupertino, CA) and a JamboxR portable speaker (Jawbone, San Francisco, CA) to which the iPod connected via Bluetooth. We downloaded the TempoMagicR application, which allowed for adjustment of the beats per minute of the original music without significantly altering the song. The portability of the iPod and the tempo altering application enabled the instructor to start and stop the musically easily and to slow down or speed up the beat of a song based on the functional level of the participants.

DISCUSSION

We were able to take a novel individual motor learning exercise program designed to improve walking in older adults and operationalize it into a group exercise program. We used feedback from physical therapists as well as from older adults in the community to modify the program. The input we received from the older adults was invaluable, and resulted in changes to the program we never expected. For example, we had thought we needed to provide a shorter program but keep the older adult active the entire time. Instead, the older adults preferred a longer program that included a short break. As a group of physical therapists who had years of combined experience working with older adults, we had thought we had designed an optimal program. Having the feedback sessions and hearing the comments from the older adults made us realize how important it is to get input from the clients when implementing community exercise programs. Making sure the program addresses the client's needs will improve adherence,^{31,32} and subsequently improve outcomes.³³

Another important lesson we learned from this experience was the disconnect between healthcare professionals and older adults with respect to concerns regarding falls. The older adults considered the challenging nature of On the Move[®] program an advantage, whereas it would often be considered a safety concern by many healthcare professionals. Fall risk reduction and prevention of falls are at the forefront of healthcare and are issues on nearly every geriatric healthcare professional's mind. When On the Move[®] exercise program was presented to the independent living facility managers, the first questions raised were "What do we do when they fall? Is it safe to offer this type of class?" However, when the older adults were asked what risks they see in participating in this type of program, the response was "I don't feel like I'm putting myself at risk." When the management's concern about falling was explained to the residents, one participant responded "There's a certain perception of older people and what they can do, and it's not good." Performing activities that are safe but do not challenge the older adult may not be beneficial. This exercise program focused on improving walking, which cannot be done by completing seated exercises. The older adults noticed the difference in content, stating "This is different than what I get in exercise programs offered by my health plan."

Nevertheless, this concern should not prohibit healthcare professionals from providing programs and activities that challenge the older adult – it just merits discussion about who

should lead this type of exercise program. This program was developed with the intention of being used as a community-based exercise program. In many situations, these programs are led by personal trainers at healthcare facilities or by activity directors at independent or assisted living facilities. However, the current program has only been studied when delivered by a physical therapist. Physical therapists are trained to recognize individuals at risk for falls and have the knowledge and skills to alter the program for those individuals accordingly. Future research should look at whether the delivery of this program, due to the perceived increased risk for falls, necessitates a physical therapist or if other healthcare personnel are able to safely and feasibly lead this program. If this program is led by healthcare personnel without the knowledge and training of physical therapists, some community-dwelling older adults may not be appropriate for this type of group program. Research should also attempt to identify older adults who are appropriate for this type of program versus older adults who would benefit from a more supervised, individualized physical therapy program.

The study has limitations that should be addressed. Our participants were a small, homogenous sample of older adults. The participants in the single and multiple class feedback sessions were mostly white, highly educated, and able to ambulate independently. The feedback gained from this select group of individuals may not generalize to other groups of older adults; however, it is planned to expand the implementation of this group exercise program to more diverse samples of older adults.

Also, the program has only been delivered by individuals who helped develop it. It is a long-term goal for On the Move[®] program to be used as a community-based exercise program in which a variety of healthcare professionals may be delivering On the Move[®] exercise program to groups of older adults. As a part of this development process, training materials for the program instructors will be created, and quality of the training materials needs to be assessed.

Finally, the preliminary evidence of the effectiveness of the program was examined using a simple single group pre-test, post-test design. In addition, this pilot feasibility study was not statistically powered to detect significant changes. Despite the limited sample size, we were still able to detect a small meaningful change in gait speed with the intervention. As expected, the improvements in gait speed for the group-based program were smaller than the improvements in gait speed obtained for a one-on-one program (group program gait speed change 0.05 m/s vs one-on-one program gait speed change 0.13 m/s).¹¹ The true efficacy and effectiveness of the program needs to be established using a rigorous randomized controlled trial design.

CONCLUSION

Multiple sources of evidence, including clinicians and the older adult participants, identified modifications necessary to translate an individual exercise program into a group-based motor learning program designed to improve walking in older adults. On the Move[®] program challenges the older adult by incorporating standing and walking activities, and is safe and acceptable to the older adult with impaired mobility. The program resulted in

clinically meaningful improvements in gait speed and walking endurance. Future research should assess the outcomes of On the Move[®] motor learning group exercise program compared to a standard aerobic and strength training group exercise program as well as assess the transition of leadership from physical therapists to other healthcare professionals.

Acknowledgments

Funding: Pittsburgh Older Americans Independence Center (NIA P30 AG024827), Pittsburgh Training in Geriatrics and Gerontology (T32 AG021885), University of Pittsburgh Aging Institute, CTSI, Community-Based Participatory Research (NIH UL1 RR024153 and UL1TR000005).

References

1. Nelson ME, Rejeski WJ, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation*. 2007; 116(9):1094–1105. [PubMed: 17671236]
2. Pahor M, Blair SN, et al. LIFE Study Investigators. Effects of a physical activity intervention on measures of physical performance: Results of the lifestyle interventions and independence for Elders Pilot (LIFE-P) study. *J Gerontol A Biol Sci Med Sci*. 2006; 61(11):1157–1165. [PubMed: 17167156]
3. Keysor JJ, Brems A. Exercise: necessary but not sufficient for improving function and preventing disability? *Curr Opin Rheumatol*. 2011; 23(2):211–218. [PubMed: 21252681]
4. Lord SR, Lloyd DG, Nirui M, Raymond J, Williams P, Stewart RA. The effect of exercise on gait patterns in older women: a randomized controlled trial. *J Gerontol A Biol Sci Med Sci*. 1996; 51(2):M64–70. [PubMed: 8612105]
5. Inzitari M, Pozzi C, Ferrucci L, et al. Subtle neurological abnormalities as risk factors for cognitive and functional decline, cerebrovascular events, and mortality in older community-dwelling adults. *Arch Intern Med*. 2008; 168(12):1270–1276. [PubMed: 18574083]
6. Rosano C, Aizenstein H, Brach J, Longenberger A, Studenski S, Newman AB. Gait measures indicate underlying focal gray matter atrophy in the brain of older adults. *J Gerontol A Biol Sci Med Sci*. 2008; 63(12):1380–1388. [PubMed: 19126852]
7. Rosano C, Brach J, Longstreth WT Jr, Newman AB. Quantitative measures of gait characteristics indicate prevalence of underlying subclinical structural brain abnormalities in high-functioning older adults. *Neuroepidemiology*. 2006; 26(1):52–60. [PubMed: 16254454]
8. Rosano C, Kuller LH, Chung H, Arnold AM, Longstreth WT Jr, Newman AB. Subclinical brain magnetic resonance imaging abnormalities predict physical functional decline in high-functioning older adults. *J Am Geriatr Soc*. 2005; 53(4):649–654. [PubMed: 15817012]
9. VanSwearingen JM, Perera S, Brach JS, Cham R, Rosano C, Studenski SA. A randomized trial of two forms of therapeutic activity to improve walking: effect on the energy cost of walking. *J Gerontol A Biol Sci Med Sci*. 2009; 64(11):1190–1198. [PubMed: 19643842]
10. VanSwearingen JM, Perera S, Brach JS, Wert D, Studenski SA. Impact of exercise to improve gait efficiency on activity and participation in older adults with mobility limitations: a randomized controlled trial. *Phys Ther*. 2011; 91(12):1740–1751. [PubMed: 22003158]
11. Brach JS, VanSwearingen JM, Perera S, Wert D, Hornyak V, Studenski S. Motor skill versus standard exercise in older adults with subclinical gait dysfunction. *J Am Geriatr Soc*. 2012; 60(Suppl S4):P24.
12. Van de Ven AH, Delbecq AL. The nominal group as a research instrument for exploratory health studies. *Am J Public Health*. 1972; 62(3):337–342. [PubMed: 5011164]
13. de Groot GC, Fagerstrom L. Older adults' motivating factors and barriers to exercise to prevent falls. *Scand J Occup Ther*. 2011; 18(2):153–160. [PubMed: 20545467]
14. Withall J, Jago R, Fox KR. Why some do but most don't. Barriers and enablers to engaging low-income groups in physical activity programmes: a mixed methods study. *BMC Public Health*. 2011; 11:507. [PubMed: 21711514]

15. Costello E, Kafchinski M, Vrazel J, Sullivan P. Motivators, barriers, and beliefs regarding physical activity in an older adult population. *J Geriatr Phys Ther.* 2011; 34(3):138–147. [PubMed: 21937904]
16. Rasinaho M, Hirvensalo M, Leinonen R, Lintunen T, Rantanen T. Motives for and barriers to physical activity among older adults with mobility limitations. *J Aging Phys Act.* 2006; 15:90–102. [PubMed: 17387231]
17. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. 5. Baltimore, MD: Williams & Wilkins; 1995.
18. Schmidt, RA. Organizing and scheduling practice. In: Schmidt, RA., editor. *Motor Learning and Practice: From Principles to Practice.* Champaign, IL: Human Kinetics Books; 1991. p. 199-225.
19. Gentile, A. Skill acquisition: action, movement, and neuromotor processes. In: Carr, JH.; Shepherd, RB.; Gordon, J.; Gentile, AM.; Held, JM., editors. *Movement Science: Foundations for Physical Therapy in Rehabilitation.* Rockville, MD: Aspen Publishers, Inc; 1987. p. 93-154.
20. Schmidt, RA.; Wrisberg, CA. *Motor Learning and Performance.* 3. Champaign, IL: Human Kinetics; 2004.
21. Van Norman, KA. *Exercise and Wellness for Older Adults: Practical Programming Strategies.* 2. Champaign, IL: Human Kinetics; 2010.
22. Bryant, CX.; Green, DJ., editors. *Exercise for Older Adults: ACE's Guide for Fitness Professionals.* 2. San Diego, CA: American Council on Exercise; 2005.
23. Jette AM, Jette DU, Ng J, Plotkin DJ, Bach MA. Are performance-based measures sufficiently reliable for use in multicenter trials? Musculoskeletal Impairment (MSI) Study Group. *J Gerontol A Biol Sci Med Sci.* 1999; 54(1):M3–6. [PubMed: 10026655]
24. Perera S, Mody SH, Woodman RC, Studenski SA. Meaningful change and responsiveness in common physical performance measures in older adults. *J Am Geriatr Soc.* 2006; 54(5):743–749. [PubMed: 16696738]
25. Perera S, Studenski S, Newman A, et al. Are estimates of meaningful decline in mobility performance consistent among clinically important subgroups? (Health ABC study). *J Gerontol A Biol Sci Med Sci.* 2014; 69(10):1260–1268. [PubMed: 24615070]
26. Hess RJ, Brach JS, Piva SR, VanSwearingen JM. Walking skill can be assessed in older adults: validity of the Figure-of-8 Walk Test. *Phys Ther.* 2010; 90(1):89–99. [PubMed: 19959654]
27. Butland RJ, Pang J, Gross ER, Woodcock AA, Geddes DM. Two-, six-, and 12-minute walking tests in respiratory disease. *Br Med J (Clin Res Ed).* 1982; 284(6329):1607–1608.
28. Harada N, Chiu V, Damron-Rodriguez J, Fowler E, Siu A, Reuben DB. Screening for balance and mobility impairment in elderly individuals living in residential care facilities. *Phys Ther.* 1995; 75(6):462–469. [PubMed: 7770493]
29. Harada ND, Chiu V, Stewart AL. Mobility-related function in older adults: assessment with a 6-minute walk test. *Arch Phys Med Rehabil.* 1999; 80(7):837–841. [PubMed: 10414771]
30. Guyatt GH, Sullivan MJ, Thompson PJ, et al. The 6-minute walk: a new measure of exercise capacity in patients with chronic heart failure. *Can Med Assoc J.* 1985; 132(8):919–923. [PubMed: 3978515]
31. Nied RJ, Franklin B. Promoting and prescribing exercise for the elderly. *Am Fam Physician.* 2002; 65(3):419–426. [PubMed: 11858624]
32. American College of Sports Medicine. Physical activity programs and behavior counseling in older adult populations. *Med Sci Sports Exerc.* 2004; 36(11):1997–2003. [PubMed: 15514518]
33. Belza B, Topolski T, Kinne S, Patrick DL, Ramsey SD. Does adherence make a difference? Results from a community-based aquatic exercise program. *Nurs Res.* 2002; 51(5):285–291. [PubMed: 12352776]

Table 1

Concepts and modifications from Phase II – feedback from older adults

Concept	Original Group Program	Modification/Adjustment
Format	30-minute continuous class	Class lengthened to 45–50 minutes; included a short, seated rest break after the walking patterns
Music	Variety of artists and genres from multiple decades	Limited music to artists from the older adults' generation
Education	Provided rationale for some of the exercises	Expanded the information provided during the exercises and extrapolated the education to other activities and situations
Group interaction	Incorporated playground balls to facilitate group interaction	Included activities that enhanced the social aspect in almost every session

Table 2

Abbreviated description of On the Move[®] group exercise program

Exercise (examples)	Goal/Rationale	Progression	Duration (minutes)	Music
<u>Warm-up</u>		Perform without holding on to something for support Add arm movements	5–7	Relaxing, encourages preparation for activity
• weight shifting				
• stepping				
<u>Walking patterns</u>	Shift center of pressure (during medial stance) Timing and interlimb coordination of muscle activations (ie abductors of going-to-be swing limb with adductors of stance limb)	Change amplitude (ie narrower ovals) Alter speed Increase complexity Walk past other walkers Object manipulation (ie pass ball back and forth in hands, bounce ball, etc.)	10–15	90–100 BPM Strong beat to enhance steady, consistent pace
• ovals				
• serpentine				
<u>Rest break</u>			5–10	
<u>Stepping patterns</u>	Shift center of pressure posterolateral then forward, encouraging hip extension	Perform without holding on to something for support Alternate right and left Combine forward and backward Add opposing arm movement Increase speed	10–15	120–135 BPM Moderate beat that instills rhythmicity
• forward across				
• backward across				
<u>Strength exercises</u>	Target strengthening of lower extremity muscles important for gait	Perform repetitions more slowly Increase number of repetitions Add/increase weight	5–10	110–120 BPM Moderate beat for performing repetitions
• standing heel raise				
• repeated chair rise				
• seated hip abduction				
<u>Cool-down/stretch</u>			3–5	Relaxing, encourages return to baseline state

Table 3

Mean (standard deviation) mobility outcomes pre- and post-intervention

Outcome	Pre-exercise	Post-exercise	P-value*
Gait speed, m/s	0.76 (0.21)	0.81 (0.22)	.06
F8WT, s	13.0 (3.9)	12.0 (3.9)	.07
6MWT, m	246 (75)	281 (67)	.02

* P-value for paired sample t-test
F8WT = Figure 8 Walk Test
6MWT = Six Minute Walk Test