



Original article

Effectiveness of a progressive stepping program on lower limb function in community dwelling older adults

Lena Fung ^{a,*}, Michael Lam ^b

^a Department of Physical Education, Hong Kong Baptist University, Renfrew Road, Kowloon, Hong Kong, China

^b Department of Nursing, Hong Kong University, Hong Kong, China

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Abstract

A progressive stepping program (PSP) comprising of 28 sessions each of 75 minutes were offered to two groups of community dwelling older adults with different levels of mobility at a frequency of 3 times a week so as to assess the program's effect on lower limb function as reflected in the Timed Up-and-Go test (TUG) and the Timed Open-eyed Single Leg Stand test (TOLS). Significant differences were found among the different groups in the TUG score ($F = 11.05, p < 0.05$). Moreover, the TUG score gain was greater in the lower mobility group (21.5%) than in the higher mobility group (7.8%). It was concluded that while the PSP was effective in improving dynamic balance, alternative modes would be needed in order to achieve improvements in the TOLS scores.

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Keywords: Lower limb function; Older adults; Stepping

Introduction

On the list of “Top 20 worldwide Fitness Trends for 2010”, that of “Special fitness programs for older adults” has remained in the top 10 for 4 consecutive years.¹ This interest in developing programs targeted at the older population has resulted in an increase in the number of studies geared towards assessing the training effects of different exercise modes on participating elderly persons. Whereas some studies were more interested in the frequency of training (e.g., Bates et al²), others were more focused on the actual types of exercise and their related effects (e.g., Liu-Ambrose et al,³ Toraman et al⁴). A review of exercise interventions provided to community dwelling older adults,⁵ has reported that the more popular and effective interventions included distance walking, and resistance and flexibility exercises.

More recently, dancing was examined as a possible exercise alternative for older adults. For example, a study working with a group of institutionalized seniors,⁶ found that their 3-month dance exercise program was effective in improving the participants' lower-limb function as indicated by tests such as the Chair Stand Test and the Timed Up-and-Go Test. Similarly, jazz dancing (e.g., Alpert et al⁷) and Chinese dancing (e.g., Wu et al⁸) were also found to be effective in inducing increased lower-extremity function in older adults. Much like dancing but without the use of music, structured stepping programs, were introduced by Japanese researchers as a means to enhance lower limb function in elderly populations. One rationale for the use of structured stepping rather than dance routines is based on the fact that the participants can perform their required tasks without too much cognitive demand because very simple and repetitive patterns were used.⁹ Our study has followed a previous philosophy⁹ and provided a program that enabled the participants to focus more on the stepping task in hand and less on remembering patterns and routines. It was hypothesized that the Progressive Stepping Program (PSP)

* Corresponding author. Department of Physical Education, Hong Kong Baptist University, Renfrew Road, Kowloon, Hong Kong, China.

E-mail address: lenaf@hkbu.edu.hk (L. Fung).

designed for this study would be effective in improving the participants' lower limb function. Another purpose of the study was to assess whether the PSP protocol was effective in inducing changes in lower limb function between those who were more mobile (those who scored higher in the Timed Up-and-Go Test) than those who were less mobile (those who scored lower in the Times Up-and-Go Test).

Methods

Research design and participants

The study was of a three-group non-randomized design involving community dwelling older adults from two different districts but with similar socio-economic backgrounds and living in similar housing estates. Of the three groups, one served as the control group (C group) and the other two groups receiving the PSP were classified as the higher mobility group (HM group) and lower mobility group (LM group) based on their performance in a mobility test.

Recruitment of participants for the PSP group

From a group of older adults ($n = 78$) who took part in the Timed Up-and-Go Test (TUG), two extreme mobility groups, namely those who scored in the upper 25th percentile rank and those who scored in the lower 25th percentile rank, were invited to take part in the study. In response to this invitation, 23 older adults (12 from the HM group and 11 from the LM group) consented to take part.

Recruitment of participants for the control group

Older adults ($n = 55$) from another housing district also underwent the TUG assessment in a "Fun and Fitness Day" event. From this group of older adults, invitations to take part in an exercise program were also made, but the invitees were told that the program would not begin until 3 months later. They were also told that they should refrain from doing anything different and to make as little change as possible to their lifestyle because their eligibility for the exercise program would depend on their second set of test scores, taken just prior to the start of the program. From this group, 20 older adults indicated their willingness to join the program.

Participants of the study

From the original group of older adults recruited, 7 dropped out from the exercise program for various reasons. Therefore, the exercise group ended up with 16 persons (9 from the HM group and 7 from the LM group) whereas the control group ended up with 15 persons. Only 15 of the original 20 who agreed to join the exercise program in the first place returned for their second TUG assessment and subsequent exercise program.

In sum, the total number of data sets used for analysis in this study comprised of 5 sets of male data and 26 sets of

female data collected from 31 community dwelling older adults. The age range of the 31 participants was from 61 years to 86 years [mean = 77.58 years, standard deviation (SD) = 6.52 years]. All participants were living in similar subsidized housing complexes and thus were very similar in terms of socio-economic status. There were also no notable differences between the groups in terms of lifestyle pattern and health conditions. The exercise group ($n = 16$) were all from one housing estate whereas the control group ($n = 15$) were from another housing estate.

Exercise regimen

The PSP was carried out regularly three times week, except where a public holiday resulted in skipping one session for that particular week. A total of 28 sessions, each of 75 minutes in duration, were provided over the course of 10 weeks. The LM group and the HM group received their PSP separately so that space constraints could be optimized. However, the same instructors were used in all sessions and for both groups to ensure consistency in delivery.

The PSP comprised several key elements. A 10-minute callisthenic movement to music was used as warm-up. This was followed by 10 minutes of sit-down chair stretching exercises. The actual progressive stepping exercise section had three major components: (a) a 3-person team relay stepping exercise; (b) a step on the line exercise; and (c) a grand stepping tour exercise.

The 3-person team relay stepping exercise required the person carrying a baton to walk the length of the room (approximately 6 m), step over a low obstacle placed in the middle of the course (3 m point) and then to pass the baton to the other person on the team. There was no competitive element in this exercise, but participants were asked to keep moving for about 3 minutes. These 3 minutes were increased to 4 and then 6 minutes at sessions 10 and 16, respectively.

The step on the line exercise requires the person to walk the distance of 6 m while stepping on two colored lines which were taped on the ground and veering apart at a tangent so that eventually the person had to spread out their legs to beyond shoulder width in order to place their feet on the line. As the persons arrived to the end of the course, they were asked to return to the start point to repeat the course again. The duration of this exercise again progressed from 3 minutes, onto 4 minutes then to 6 minutes at sessions 10 and 16, respectively.

The grand stepping tour exercise was a stepping course marked out by colored squares, soft rubber cushions, and low obstacles. The purpose was to create a course whereby the person was required to step on and off the colored squares, over low obstacles, and on and off soft rubber cushions. The course was set in such a way that the participants needed to move in a non-stop circuit-like manner. The entire grand stepping exercise progressed from initially 6 minutes, onto 8 minutes and then to 10 minutes at sessions 10 and 16, respectively. The course design was also changed after each week and increased in complexity.

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