

Original Article

Effect of Stationary Cycle Exercise on Gait and Balance of Elderly Women

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Abstract. [Purpose] A stationary bicycle exercise and a treadmill exercise were conducted in order to determine the effect of these exercises on the balance and walking ability of elderly women. [Subjects and Methods] Twenty-four elderly women aged 65 or older were equally assigned to a stationary bicycle exercise group and a treadmill exercise group, and they performed exercise three times per week for 8 weeks for 20 minutes each time. In order to examine gait, step length and time were measured as parameters of walking ability, and in order to examine dynamic balance, subjects were evaluated with the Berg balance scale (BBS). [Results] After the intervention, step time and step length and BBS significantly increased significantly decreased, in both groups. A comparison of BBS after the intervention between the two groups revealed that the stationary bicycle group showed larger increases than the treadmill group. [Conclusion] The stationary bicycle exercise group and treadmill exercise group showed significant improvements in gait and balance. Stationary bicycle exercise can help to prevent falls by improving the balance of elderly persons.

Key words: Stationary bicycle exercise, Treadmill exercise, Elderly females

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INTRODUCTION

A fall is one of the most frequently occurring incidents experienced by elderly individuals, and such incidents can cause serious injury¹⁾. Approximately 30% of elderly persons over 65 years old experience at least one fall a year, and 15% of individuals annually experience a fall twice or more²⁾. Falls occur as a result of several factors, including decreased vision, impairment of somatosensory functions, lower extremity weakening, and decreased movement. Most falls experienced by the elderly occur during walking, particularly when walking while performing another exercise or cognitive task³⁾.

Due to aging, a decrease in muscle strength around the knees and ankles occurs more often in the elderly than in younger individuals, resulting in gait and balance impairments. Balance plays an important role in stability as well as mobility, and loss of balance is considered to have the highest risk factor for a fall⁴⁾. Balance or postural control is dependent on interactions among various systems⁵⁾, but postural control mechanisms tend to become inefficient as aging progresses⁶⁾.

How to prevent falls by elderly individuals is a major

area of study, but there are limitations to the application of successful methods to the elderly population in general⁷⁾. Nonetheless, exercise can reduce the risk of a fall due to decrease in balance ability, thereby decreasing the risk of fall for an individual elderly person as well who lives in a local community^{7, 8)}. Dynamic resistance exercises⁹⁾, fall risk assessment and management programs consisting of multi-lateral elements¹⁰⁾, proprioception training programs¹¹⁾, and programs utilizing music¹²⁾ and yoga¹³⁾ have all been found to improve the balance and walking ability of the elderly.

In the present study, a stationary bicycle exercise and a treadmill exercise, which have not been compared in previous studies, were conducted in order to determine the effect of these exercises on the balance and walking ability of elderly women.

SUBJECTS AND METHODS

The subjects of the present study were 24 elderly women from Gyunggi-do, Korea, who met the following selection criteria: over 65 years old, no experience of a fall for one year prior to the study, no specific disease that might have influenced task performance, no visual or hearing impairment, and no vestibular organ problem. Subjects also needed to sufficiently understand the experimental tasks. All subjects agreed to actively participate in the exercises once they had been given sufficient explanation of the tasks (Table 1).

The subjects were divided into two groups, a stationary bicycle group and a treadmill group, each with 12 subjects, and all subjects performed their respective exercises for 20

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Table 1. General characteristics of subjects

	Stationary Bicycle	Treadmill
Age (year)	69.1±3.3	68.1±2.5
Height (cm)	159.5±4.3	159.8±3.6
Weight (kg)	57.3±5.1	56.4±4.5
Mean±SD		

minutes a day, three times a week for eight weeks. All the subjects understood the purpose of this study and provided their written informed consent prior to their participation in the study, in accordance with the ethical principles of the Declaration of Helsinki.

The stationary bicycle was set to no resistance, while the treadmill was set to start increasing from 0.1 km/hour to the maximum walking speed that could be achieved by the subject in 20 minutes. Balance assessed using the Berg balance scale (BBS) before and after the exercise, while step length and step time were measured with an AP1105 (GaitRite CIR, USA) to measure the walking ability. The average ± standard deviation of group measurements were calculated.

SPSS for Windows (version 18.0) was used to analyze the data. The paired t-test was used to examine pre- and post-intervention differences, and the independent t-test was used to examine differences between the groups, both with a statistical significance level of $\alpha = 0.05$

RESULTS

After the intervention, BBS and step length increased significantly ($p < 0.05$), and step time significantly decreased ($p < 0.05$) in both groups. A comparison of BBS after the intervention between the two groups revealed that the stationary bicycle group showed larger increases than the treadmill group ($p < 0.05$) (Table 2).

DISCUSSION

In order to compensate for reduced balance and stability during walking, elderly individuals show decreased cadence and stride length, an increase in the base of support, and a decrease in walking speed¹⁴. As a result, elderly individuals are vulnerable to falls, an event more common in elderly women than any other group¹⁵.

In this study, the two groups had similar physical characteristics before the start of the intervention. Following eight weeks of exercise, the stationary bicycle group showed notably improved balance compared to the treadmill group, and step length had also notably increased. In particular, the BBS score was higher in the stationary bicycle group than in the treadmill group, indicating that stationary bicycle exercise is more effective at improving the balance of elderly women than treadmill exercise.

BBS is a measure of dynamic balance, and Thorbahn et al.¹⁶ reported that a BBS score of <45 indicates an increased risk of a fall. In this study, the lower limb weight movement and stability exercise of the stationary bicycle exercise had a

Table 2. Comparison of measurement values at pre-test and post-test

Variable	Group	Pre	Post
Step length (cm)	Stationary Bicycle	41.4±7.8	47.3±7.0 ^a
	Treadmill	42.5±9.3	48.5±6.8 ^a
Step time (sec)	Stationary Bicycle	0.7±0.1	0.6±0.1 ^a
	Treadmill	0.7±0.1	0.6±0.1 ^a
BBS (score)	Stationary Bicycle	42.4±1.9	48.0±2.8 ^{ab}
	Treadmill	42.6±2.0	45.6±2.4 ^{ab}

^a significant difference between pre-test and post-test, ^b significant difference between Stationary Bicycle and Treadmill at post-test

positive effect on the BBS score of the elderly women. This result is consistent with that of Englund et al.¹⁷ who showed that complex exercise through weight movement resulted in an increase in the BBS score.

The stationary bicycle group showed a greater improvement in the BBS score than the treadmill group because the bicycle exercise was a balance exercise on a narrow saddle, compared to the treadmill, which requires stable weight movement using two feet. In addition, in the bicycle exercise the right and left weight movement of the lower extremities, in which the center of mass is dependent on a saddle, has more effect on the lateral bending movement of the pelvis than walking on a treadmill. The subsequent increase in pelvic movement in the elderly women positively influenced their balance.

Balance impairment can result in unstable walking¹⁸. The present study demonstrated that improved balance had a positive effect on step length. One limitation of this study was the small number of subjects, limiting the extent to which the results can be applied to elderly women in general. Future research will need to include a larger number of elderly women to determine the improvements of characteristics other than balance and walking resulting from stationary bicycle exercise.

As society ages, the need to study the causes of falls and preventative measures that can be applied to the elderly has been recognized, and effective exercise methods have been introduced. The stationary bicycle exercise can help to prevent falls by improving the balance of elderly women.

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