THE EFFECT OF BALL EXERCISE ON PHYSICAL FUNCTIONS IN THE ELDERLY WOMEN

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Abstract

This study aimed to investigate the effects of Ball Exercise on physical functions related to fall prevention among community-dwelling elderly. Nineteen healthy elderly women voluntarily participated in a Ball Exercise course that consisted of 60-min classes once a week for three months. We assessed their physical functions at baseline and then again after the Ball Exercise course. Significant improvements ($p < 0.05$) were observed in one leg standing without vision (+7.2 s), functional reach (+14.4%), trunk flexibility test (+7.1%), maximum walking speed (+17%) and the isometric muscle strength of the knee and ankle joints (+9.8~35.7%) but no changes were observed in grasping power. This study suggested that Ball Exercise might be a suitable fall prevention and health promoting exercise for elderly people. We therefore concluded that ensuring a high level of physical functions is important to prevent falls and maintain a high quality of life for elderly people.

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key word : Ball Exercise, physical function, elderly people, health promoting exercise,
fall prevention

Introduction

In Japan, the proportion of those aged 65 years or older is projected to be over 25% in 2015. In rural areas, the proportion of the aged has already reached nearly 40%. Falls among the elderly are a serious health problem, with the potential to cause a femoral neck fracture, and thus, lead to restrictions of activities of daily living (ADL)¹⁾. Fear of falling also decreases the quality of life (QOL) among elderly persons²⁾. Therefore, strategies to prevent falls are important.

Many studies have reported the intervention effects of some exercises on physical functions related to fall prevention in the elderly^{3~6)}. These exercises include muscle training, walking, balance training, and Tai Chi. However, to our knowledge, there has been no research on the effects of Ball Exercise. The purpose of this study is to investigate the effects of Ball Exercise on physical functions related to fall prevention among community-dwelling

elderly.

Methods

Subjects

Nineteen functionally independent women (age, 66.3 ± 6.5 years; height, 152.4 ± 5.2 cm; weight, 57.9 ± 8.9 kg; mean $\pm$ SD, respectively) living in Fukuoka City, southwest Japan, voluntarily participated in a Ball Exercise course. All were community-dwelling and led a normal lifestyle, capable of daily activities without limitations. They were all beginners at Ball Exercise. Subjects were informed about the purpose of this study and consented to participate.

Ball Exercise course

The course consisted of 60-min classes held once a week for three months. The first and last classes involved evaluations of participants' physical functions. The second and third classes were lectures on 'Fall and fall prevention for the elderly' and 'Exercise and nourishment for the elderly', respectively.

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Figure 1. Ball Exercise course.

From the fourth to the fourteenth classes, Ball Exercises including stretching and cooldown were performed under the guidance of expert instructors.

Evaluation of physical functions

Physical functions related to fall prevention were evaluated as follows: one leg standing without vision, functional reach⁷⁾, the trunk flexibility test, maximum walking speed for 10 m, grasping power (GP), and the isometric muscle strength of knee and ankle joints (knee flex, knee extension, plant flex and dorsiflex). Grasping was performed using the dominant hand, and the muscle strength of the lower extremities was performed on the other side. Knee flexor/extensor strengths were obtained using Combit (MINATO, Co. Ltd., Osaka, Japan), and ankle planter flexor/dorsiflexor strengths were obtained

using Myoret (Kawasaki Heavy Industry, Kobe, Japan).

Statistical analysis

The design of this study was a before-after trial. Using the better score from two performances, the student's t-test or Mann-Whitney U test was performed to compare baseline (pre-Ex) and endpoint scores (post-Ex). A value under 0.05 was considered significant.

Results

Table 1 shows the changes in physical functions with Ball Exercise. After 3 months, BMI decreased from 24.9 to 24.4 ($p < 0.05$). Significant improvements were observed in one leg standing (+7.2s), functional reach (+14.4%), the trunk flexibility test (+7.1%), maximum walking speed (+17%), and the isometric muscle strength of the knee and ankle joints (+9.8 ~ +35.7%), but no changes were observed in GP. No participant dropped out of the course (dropout rate=0%).

Discussion

One leg standing and functional reach are indexes of body balance function. The results of this study showed improvement in balance, muscle strength in the lower extremities, trunk flexibility and walking

Table 1. Change of physical functions after Ball Exercise course Data are listed as mean $\pm$ SD.

Physical functions	Pre-Ex	Post-Ex	Change (%)	P
BMI (kg/m^2)	24.9 $\pm$ 3.3	24.4 $\pm$ 3.1	$\triangle 1.7$	< .05
One leg standing without vision (sec)	5.7 $\pm$ 3.8	12.9 $\pm$ 12.1	+ 128.5	< .05
Functional reach (cm)	33.5 $\pm$ 5.5	38.4 $\pm$ 6.0	+ 14.4	< .01
Trunk flexibility test (cm)	35.4 $\pm$ 10.1	39.1 $\pm$ 9.9	+ 10.2	< .05
maximum walking speed (m/s)	2.3 $\pm$ 0.7	2.7 $\pm$ 0.4	+ 17.0	< .01
grasp power (kg)	24.6 $\pm$ 3.5	23.9 $\pm$ 4.5	$\triangle 2.7$	N.S.
Isometric muscle strength ($\text{kg} \cdot \text{m}$)				
Knee flexor	3.6 $\pm$ 0.7	4.6 $\pm$ 1.0	+ 26.0	< .01
Knee extensor	10.0 $\pm$ 2.9	10.9 $\pm$ 2.5	+ 9.8	< .01
Ankle planter flexor	5.4 $\pm$ 2.1	7.4 $\pm$ 2.4	+ 35.7	< .01
Ankle dorsiflexor	1.4 $\pm$ 0.5	1.6 $\pm$ 0.6	+ 13.5	< .05

function. Ball Exercise is usually used for balance training ; however, in this study, not only the balance capacity but also muscle strength showed significant improvement. Ball Exercise involves repetitive bouncing, rolling, and holding. In order not to fall from the ball, balance and muscle strength are therefore required, and in addition to trunk flexibility improvements as a result of stretching using the ball, had a synthetic effect on walking speed . In ADL, the upper extremities are frequently used, but in Ball Exercise, there is a low incidence of use. For this reason, GP did not change.

Many reports^{3,5,8)} have suggested that falls in elderly are reduced by the effects of exercise on physical functions. In this study, most physical functions improved with Ball Exercise, indicating that it might be a suitable exercise for recommendation in a fall prevention program for the elderly.

In this study, the dropout rate was 0%. Ryan⁹⁾ claimed that intrinsic regulation, for example interest, enjoyment, and inherent satisfaction, is the highest motivation. By enjoying the Ball Exercise, subjects were able to find the motivation to continue participating in the course. Continuation of any exercise helps improve or maintain physical functions, and therefore, intrinsic motivation is very important.

Despite its findings, this study has a limitation. The lack of controls weakens the internal validity of our major findings, and therefore, further controlled study is needed.

Conclusion

Ball Exercise significantly improved muscle

strength, flexibility, and balance in elderly women, suggesting that this exercise can be recommended as a fall prevention and health promoting exercise for elderly people. However, further studies are required to examine its effectiveness using appropriate controls.

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