Effects of 6-Month Walking Program and 12-Month Detraining on Locomotive Syndrome Risk Stages and Brisk Walking Speed in Middle-Aged and Elderly Japanese People: a Case Report

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Objective: To examine the effects of 6-month walking and 12-month detraining (DT) on locomotive syndrome (LS) risk stages and walking ability in middle-aged and elderly Japanese people.

Methods: Six middle-aged and elderly volunteers (3 female, 3 male, age, 65 ± 5 years, mean ± SD) participated in our walking program for 6 months. They were instructed to walk three or more times per week. Additionally, two participants performed walking with blood flow restriction once or twice per week. Before (Pre) and after (Post) the program and at the 12th month after the end of the program (DT), body composition and brisk walking speed were measured. At the same times, the LS risk stages (0-2) were evaluated by the three tests: stand-up test, two-step test, and 25-question Geriatric Locomotive Function Scale.

Results: At the Pre test, five of six participants were assessed as LS risk stage 0, and another participant was assessed as LS risk stage 1. The participant remained classed at stage 1 in both Post and DT tests. In addition, one more participant was added as stage 1 in the DT test. The time of 10-m brisk walking test was significantly reduced from the Pre test (4.60 ± 0.61 s) to the Post test (3.95 ± 0.70, p<0.05) but increased at the DT test (4.87 ± 0.40 s, p<0.05).

Conclusions: In middle-aged and elderly Japanese volunteers, walking ability was improved by the 6-month walking program, but the improvement was diminished following a 12-month DT period. Moreover, although the program was not sufficient to improve the LS risk stages, the program may be partly effective for maintaining locomotive function.

Key words: locomotive syndrome, walking, detraining, risk stage

Introduction

In recent years, according to increase of life expectancy, the importance of healthy life expectancy is also claimed1). Some previous studies have reported the effects of exercise intervention, especially walking exercise, on physical components and functions and other health-related
parameters in middle-aged and elderly people. However, few reports have shown the change of these parameters after the intervention (i.e., the effects of detraining). In 2007, the concept of locomotive syndrome (LS) was proposed by the Japanese Orthopaedic Association (JOA). LS is a disease related to locomotion such as in the muscle, bone, and joint and an indicator of the decrease of abilities of standing and walking. For early detection and prevention of LS, the JOA proposed the screening LS risk tests, two-step test, stand-up test, and 25-question Geriatric Locomotive Function Scale (GLFS-25), which are classified into 3 stages (0–2). Although the effects of exercise training on the prevention of locomotive dysfunction were reported in recent years, the changes after the detraining were rarely reported.

The aim of this study was to examine the effects of a 6-month walking program and 12-month detraining on walking ability and locomotive function in middle-aged and elderly Japanese people.

Participants

Six community-dwelling Japanese volunteers (women = 3, men = 3) participated in the present study. Their profiles are shown in Table-1. This study was carried out from December 2014 to June 2016 and composed of a 6-month walking program, 12-month detraining, and three physical measurement tests: Pre, before the walking program; Post, after the walking program; and DT, at the 12th month after the walking program.

All procedures and any potential risks were explained to the participants before starting the study, and all participants provided written informed consent. This study was approved by the local ethics committee, and all experiments were performed in accordance with the Declaration of Helsinki.

Training program

The participants performed a 6-month walking program. The training program of each participant was determined according to their physical ability and daily life schedule (Table-1). The program of participants A and E consisted of the blood flow restriction (BFR) walking and home-based walking, and the program of the other participants was home-based walking. The procedure of BFR walking was described in the previous reports. Briefly, the participants walked with BFR of both legs using nylon cuffs (105 mm wide, MT-870 Digital Tourniquet; Mizuho, Tokyo, Japan) on the treadmill for 20 min at an exercise intensity of 70–85% of their age-predicted maximum heart rate. In the home-based walking, the participants were instructed to walk at a self-selected, faster pace than usual for ≥30 min per day.

Measurements

1. Body composition

Height and body weight were measured to the nearest 0.1 cm and 0.1 kg, respectively. BMI was calculated as the body weight divided by the square of the height. Fat mass, muscle mass, and percentage body fat were assessed by the bioelectrical impedance analysis method (InBody720, Biospace Co, Korea).

| Participant | Sex | Age (years) | Training program |
|-------------|-----|-------------|------------------|
| A           | Male| 70          | BFR walking (2 times/wk) + Home-based walking (≥1 times/wk) |
| B           | Female| 69      | Home-based walking (≥3 times/wk) |
| C           | Male| 66          | Home-based walking (≥3 times/wk) |
| D           | Female| 63      | Home-based walking (≥3 times/wk) |
| E           | Male| 63          | BFR walking (1 times/wk) + Home-based walking (≥2 times/wk) |
| F           | Female| 54      | Home-based walking (≥3 times/wk) |

BFR—blood flow restriction.
2. Walking performance test
Walking ability was evaluated by timing each participant as they walked across a 10-m corridor on a hard-surface floor. The width of the corridor was set at 1 m. They performed two-timed trails and were encouraged to maintain a straight course. They were asked to walk down the corridor as fast as possible without running. Times were measured using a digital stopwatch (LC058; CITIZEN, Tokyo, Japan), and the fastest time was used for the 10-m walking time.

3. LS risk screening test

1) Two-step test
The participant started from the standing posture and moved two steps forward with maximum strides. If the participant held the final standing position for 3 s not losing balance, the trial was judged as completed. To standardize the value, the distance of two steps was divided by the participant’s height (two-step test score). The test was performed four times (twice starting from either leg), and the best result was recorded.

2) Stand-up test
The stand-up test was performed with stools of 10, 20, 30, and 40 cm in height. Participants were required to stand from each stool with one leg or two legs. If the participant held the standing position for 3 s not losing balance, the trial was judged as completed.

3) GLFS-25 questionnaire
A participant was asked to fill out the GLFS-25 questionnaire, which consisted of 25 items with a score of 0-4 for each item (the higher score indicated worse conditions). The total score (ranging from 0 to 100) was used for analyses.

4) Evaluation of the LS risk stage
A participant was recorded as LS-1, if he or she was not evaluated as LS-2 (see below) and met any of the following conditions: 1) a two-step test score <1.3, 2) difficulty with one-leg standing from a stool of 40 cm in height (either leg), and 3) GLFS-25 total score ≥7.
A participant was determined as LS-2, if he or she met any of the following conditions: 1) a two-step test score <1.1, 2) difficulty with two-leg standing from a stool of 20 cm in height, and 3) GLFS-25 total score ≥16.

5) Statistical analysis
Statistical analyses were performed using the SPSS for Windows (version 24; SPSS, Chicago, IL). The data were analyzed using one-way analysis of variance, followed by the Bonferroni post hoc test. p-values < 0.05 were considered significant.

Results
The averaged body weight, BMI, and composition at the Pre, Post, and DT tests are shown in Table-2. These parameters were not significantly changed among the three tests.

The time of a 10-m brisk walking test at the Post test was significantly decreased compared to that in the Pre test. However, the time at the DT test was significantly increased compared to that in the Post test and similar to that in the Pre test (Figure-1).

The scores of three LS risk screening tests were unchanged throughout the three tests (Table-3).
At the Pre test, only participant B was classified as LS stage 1, but the others were classified as LS stage 0. Although the LS risk stages of participants B to F were not changed throughout the three tests, the stage of participant A was aggravated at the DT test compared to those in the Pre and Post tests (Table-4).

**Discussion**

We examined the effects of a 6-month walking program and 12-month detraining on walk ability and LS risk stages in middle-aged and elderly people. The main findings are that brisk walking speed was improved by the 6-month walking program but returned after a 12-month detraining period and that our program did not change the LS risk stage and the score of three tests. This study has some weak points, especially the number of subjects, inconsistent training programs, and unclear physical activities during the detraining periods, but this is an important case report to indicate the change in physical ability after stopping the exercise training program.

The 6-month walking program reduced the time of brisk walking but did not change the body composition in this study, different to previous studies. These different results might be partly brought about by the small sample size of participants (n=6) and low training intensity in our study. Yoshimura et al. have reported that ~50% of community-dwelling Japanese people aged 60–69 years were classified as LS risk stages 1 and 2. In this study, only one participant was classified as stage 1, whereas the others were classified as stage 0 at the Pre test, compared to the participants of previous cross-sectional studies, physical ability and daily life activity in our participants, who voluntarily participated our longitudinal study, might be high. However, participant A was classified as LS risk stage 1 at the DT test. This result implies that our program was not enough to prevent the increase of LS risk stage with aging.

In summary, brisk walking speed was improved by the 6-month walking program in middle-aged and elderly community-dwelling Japanese volunteers, but the improvement was diminished following a 12-month detraining period. Moreover, although our program was insufficient to improve the LS risk stage, our program may be partly effective for maintaining locomotive function.

**References**

1) Salomon JA, Wang H, Freeman MK, et al: Healthy life expectancy for 187 countries, 1990–2010: a systematic analysis for the Global Burden Disease Study 2010. Lancet, 2012; 380: 2144–2162.
2) Sato KK, Hayashi T, Kambe H, et al: Walking to work is an independent predictor of incidence of type 2 diabetes in Japanese men: the Kansai Healthcare Study. Diabetes Care, 2007; 30: 2296–2298.
3) Ozaki H, Loenneke JP, Thiebaud RS, Stager JM, Abe T: Possibility of leg muscle hypertrophy by ambulation in older adults: a brief review. Clin Interv Aging, 2013; 8: 369–375.
4) Aoki K, Sakuma M, Ogisho N, Nakamura K, Chosa E, Endo N: The effects of self-directed home exercise with serial telephone contacts on physical functions and quality of life in elderly people at high risk of locomotor dysfunction. Acta Med Okayama, 2015; 69: 245–253.
5) Hardman AE, Hudson A: Brisk walking and serum lipid and lipoprotein variables in previously sedentary women—effect of 12 weeks of regular brisk walking followed by 12 weeks of detraining. Br J Sports Med, 1994; 28: 261–266.
6) Nakamura K: A "super-aged" society and the "locomotive syndrome". J Orthop Sci, 2008; 13: 1–2.
7) Yoshimura N, Muraki S, Oka H, et al: Association between new indices in the locomotive syndrome risk test and decline in mobility: third survey of the ROAD study. J Orthop Sci, 2015; 20: 896–905.
8) Ito S, Hashimoto M, Aduma S, Yasumura S: Effectiveness of locomotion training in a home visit preventive care project: one-group pre-intervention versus post-intervention design study. J Orthop Sci, 2015; 20: 1078-1084.

9) Ozaki H, Nakagata T, Natsume T, Machida S, Naito H: Effect of combined increased physical activity and walking with blood flow restriction on leg muscle thickness in older adults. Juntendo Medical Journal, 2016; 62 (Suppl 1): 206-210.