J. Phys. Ther. Sci.
26: 1445–1447, 2014

Original Article

# Effects of the Indoor Horseback Riding Exercise on Electromyographic Activity and Balance in One-leg Standing

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**Abstract.** [Purpose] This study investigated the influence of the indoor horseback riding exercise on the electromyographic activity of the lower extremity and balance during one-leg standing. [Subjects] Twenty normal adults were divided into an indoor horseback riding exercise group (IHREG, n=10), which performed the indoor horseback riding exercise using equipment 3 times a week for 3 weeks, and a control group (CG, n=10), which performed no exercise. [Methods] For comparitive analysis, an electromyographic test was performed to measure the electromyographic activities of the rectus femoris (RF), adductor longus (AL), and gluteus medius and the Biodex Balance System was used to measure the anteroposterior stability index (APSI), mediolateral stability index, and overall stability index (OSI). [Results] The electromyographic activities of RF and AL significantly increased and the balance abilities of APSI and OSI decreased significantly in the IHREG compared to the CG. [Conclusion] We consider indoor horseback riding exercise is an effective intervention for increasing electromyographic activities of the RF and AL, and the balance abilities of APSI and OSI of normal adults.
**Key words:** Indoor horseback riding, Electromyographic activity, Balance

*(This article was submitted Jan. 13, 2014, and was accepted Mar. 31, 2014)*

## INTRODUCTION

Maintaining balance during one-leg standing, which often occurs in daily activities and sports, requires activation of the hip abductors[1, 2)]. The hip adductors also provide stability to the pelvis, which is supported by the lower extremities. The pelvis becomes fixed in a symmetrical position as balance is achieved through the co-contraction of the ipsilateral and contralateral adductor and abductor[3)]. This plays a vital role in producing the torque required for pelvic stability in the frontal plane[4)]. Exercises that enhance balance in one-leg standing include aquatic exercise, which utilizes water resistance and buoyancy, combination exercise using leg press equipment in a seated position, balance exercise on an unstable surface, and the recently introduced indoor horseback riding exercise.

Sitting on a horse provides security as well as comfort even over a long time, and the movement of a horse is similar to that of human walking. Recently, horseback riding has been receiving increasing attention as a leisure sport activity, but due to its high cost and spatial issues, it has yet to become popular. Consequently, horseback riding equipment that replicates the movement of a horse is being developed for the public to enjoy exercising on a horse indoors. Indoor horseback riding equipment reproduces horseback riding in a confined space, and is designed to provide both the mental and physical effects of horseback riding so that office workers, housewives, young adults, and others can easily enjoy it.

To scientifically prove the effects of indoor horseback riding exercise equipment, most studies have attempted to measure its effect on double stance standing, and research into the electromyographic activity of the lower extremity and balance ability during one-leg standing is lacking. Therefore, this study investigated the differences in electromyographic activity and balance between a group that used indoor horseback riding exercise equipment and another group that did no exercise.

## SUBJECTS AND METHODS

The subjects of this study were 20 healthy adults (10 males, 10 females) who were attending Chungbuk Y University. Subjects were divided into 2 groups: an indoor horseback riding exercise group (IHREG; age 20.4±0.7 years, height 170±9.1 cm, weight 60.5±8.0 kg) and a control group (CG; age 20.6±0.7 years, height 170.2±7.9 cm, weight 61.2±11.0 kg). The study conformed to the ethical principles of the Declaration of Helsinki, and all subjects provided their informed consent after being given information about the purpose of the experiment and exercise method. The selected subjects had no horseback riding experience or abnormal medical findings and were not receiving medical

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**Table 1.** Comparison of the electromyographic activity of the lower extremity and balance ability within each group

| | Group | Muscle | Before | After |
|---|---|---|---|---|
| EA (%) | IHREG | RF** | 11.0±12.0 | 23.5±13.4 |
| | | AL** | 7.6±5.2 | 14.7±8.4 |
| | | GM | 9.9±5.2 | 10.0±5.9 |
| | CG | RF | 21.5±12.8 | 16.6±8.9 |
| | | AL | 11.9±5.6 | 10.2±5.3 |
| | | GM | 10.1±6.4 | 9.4±3.9 |
| BA (score) | IHREG | APSI* | 4.7±1.7 | 3.5±0.8 |
| | | MLSI | 2.2±0.6 | 2.0±0.8 |
| | | OSI** | 5.5±1.7 | 4.3±1.0 |
| | CG | APSI | 3.8±1.2 | 4.0±1.2 |
| | | MLSI | 1.9±0.8 | 2.0±0.6 |
| | | OSI | 4.5±1.4 | 4.8±1.2 |

EA, electromyographic activity; BA, balance ability; IHREG, indoor horseback riding exercise group; CG, control group; RF, rectus femoris; AL, adductor longus; GM, gluteus medius; APSI, anteroposterior stability index; MLSI, mediolateral stability index; OSI, overall stability index **, $p<0.01$; *, $p<0.05$

treatment. Those who had been weight training in the past 6 months or who had had orthopedic or neurologic damage were excluded.

We used the motorized indoor horseback riding equipment (SRIDER; Neipplus, Co., Korea) to provide the horseback riding exercise experience. SRIDER is widely distributed in Korea, and its shape resembles the back of a horse. In contrast to existing horseback riding simulators, it is a compact version with a length of less than 1 m; its speed and range of saddle movement can be adjusted to control exercise intensity. The IHREG used the exercise program for the whole body and the combination exercise program from among the programs installed in the exercise equipment. The subjects were told to place their knees on the side of the equipment while straightening their spine and place both hands on the front handle. Exercise was performed for 30 minutes a session, 3 times per week for 3 weeks. During the exercise, subjects were asked to maintain a consistent posture for 30 minutes to reduce error between subjects due to posture. The CG performed no exercise on the equipment.

In order to measure the change in electromyographic activity of the muscles, surface electromyography (EMG) using an MP150 (BIOPAC System Inc., Santa Barbara, CA, USA) was used. Surface electrodes were attached to the rectus femoris (RF), adductor longus (AL), and gluteus medius (GM). EMG signals were sent to the MP150 system to be converted to digital signals, which were processed by Acqknowledge software (version 4.01) on a PC. The average value of the EMG signals was expressed as a percentage of the maximum isometric contraction (%MVIC) of each subject.

To collect clinical data related to balance ability, the Biodex Balance System (Biodex Medical Systems Inc, USA) was used. On this system, the stability of the footing ranges from levels 1 to 8 in ascending order of instability. We used levels 1–6, repeated the measurements twice, and calculated the average values. Low values of overall stability index (OSI), anteroposterior stability index (APSI), and mediolateral stability index (MLSI) signify a higher balance level. In order to measure electromyographic activity and balance ability, subjects were asked to raise their arms to 90° and hold still while keeping their eyes closed in a one-leg standing position.

In this study, the paired sample t-test was used to test differences in electromyographic activity and balance ability of muscles within each group. SPSS 12.0 for Windows was used for statistical analyses, with a significance level of 0.05.

## RESULTS

The results show there was a significant increase ($p<0.05$) in the electromyographic activity of RF and AL and a significant decrease in APSI and OSI ($p<0.05$) in IHREG. For CG, there was no significant difference ($p>0.05$) (Table 1).

## DISCUSSION

The muscular strength of the lower extremity is a major factor affecting the stability of balance or falling. In general, the ankle joint is used more often when adjusting balance than the knee joint or hip joint, but when there is a sudden change in position, the knee and hip joints are used more often[5, 6].

Lee[7] reported that female college students showed improvement in their total body endurance, muscular strength, muscular endurance, balance, and flexibility after using indoor horseback riding equipment to exercise. The horseback riding simulator exercise also improved the thigh and lumbar muscular strengths of 20 normal female adults[8], and was effective at improving the balance ability and proprioceptive senses based on the results of 30 normal adults[9]. Kang et al.[10] demonstrated significantly increased basal fitness, flexibility, and muscular function of 20 normal adults who used indoor horseback riding exercise equipment for 4 weeks. Horseback riding exercise was also found to improve the muscular strength of the hamstring and quadriceps of 20 normal female adults[11]. Back et al.[12] reported that 40 normal adults who exercised using a horse riding simulator showed significantly higher electromyographic activity in the biceps brachii muscle, transverse abdominis muscle, abdominal oblique muscle, and adductor longus muscle compared to a group which did jogging.

Balance ability was enhanced significantly for elderly subjects with Alzheimer's dementia, vascular dementia, and those without disease who used indoor horseback riding exercise equipment for 6 weeks[13], and sway area, sway distance, and maximum sway velocity significantly decreased in elderly subjects with dementia who performed horseback riding exercise[14]. Quint and Toomey[15] studied 13 cerebral palsy children and reported a significant increase in their anteroposterior obliquity range of passive pelvis motion due to horseback riding exercise. The static and dynamic balance of children with cerebral palsy who performed horseback riding exercise for 3 months was also improved[16], and a significant improvement in balance ability, especially that concerning left-right change, was reported for 25 children with cerebral palsy who exercised on a horse riding simulator for 12 weeks[17].

The IHREG in this study showed significant increases in the electromyographic activities of RF and AL, similar to previous findings[18], and a significant decrease in the balance ability of APSI and the hip adductor of a healthy adult takes up 25% of the thigh by volume and is related to muscular strength output[19]. This hip adductor is the major muscle involved in adduction of the thigh and maintains pelvic balance when the weight is on one leg. Hence, increased electromyographic activity represents improved stability of the pelvis, which we assume significantly improves the balance ability of APSI and OSI. No significant differences were seen in RF, AL, or GM in the CG after the intervention. The CG performed no experimental manipulation and the CG subjects' daily lives did not affect muscle activity or balance ability. Therefore, we consider indoor horseback riding exercise had no effect on daily life, but indoor horseback riding exercise influences the activities of the RF and AL and is effective at improving the balance abilities of APSI and OSI.

One limitation of this study is that it did not include a large number of subjects. Also, since the 20 subjects were selected from only the Chungbuk area of South Korea, generalization of the results is questionable. Finally, this study failed to verify that indoor horse-riding exercise was more effective than other exercises. Future research is needed to examine how indoor horseback riding exercise and other exercises affect muscle activity of the lower extremities and balance ability.

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