

The Effect of Power Nordic Walking on Spine Deformation and Visual Analog Pain Scale in Elderly Women with Low Back Pain

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Abstract. [Purpose] The purpose of this study was to examine whether Nordic walking exercise can relieve low back pain and change the spine shape in elderly women. [Subjects] Sixteen elderly women with chronic low back pain from N University in Chungcheong-do, South Korea, were enrolled. [Methods] The participants were asked to walk in an upright posture, with the head upright and looking forward. The Nordic poles were held close to the body. When a foot was moved forward, the arm on the other side lifted the Nordic pole and moved it forward. The participants were using the Nordic pole when walked on the track with their arms lifted above their shoulders. The type of shoes worn during walking was not considered. [Results] One-way analysis of variance was used to determine the presence of significant differences between the measures of spine deformation and VAS. [Conclusion] Chronic low back pain, a complaint often received from elderly women, was reduced by pole-induced power walking reduction on the balance of the spine and back of this important exercise program is presented as a guideline.

Key words: Nordic walking, Back pain, Spine deformation

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INTRODUCTION

Walking is the most primitive movement of humans. It does not need a lot of time or space. People can enjoy walking regardless of their age, because it is the most common movement. The World Health Organization (WHO) recommends consistent walking exercise to prevent and treat low back pain. Walking exercise strengthens the back and abdominal muscles, thereby reducing back pain¹⁾. Specifically, it is beneficial for patients with musculoskeletal disorders and can help improve breathing capacity and relieve pain by activating the lumbar deep muscles²⁾. The causes of low back pain are diverse and complex, but its fundamental cause is posture abnormalities³⁾; the most common causes of musculoskeletal diseases are posture abnormalities, intervertebral disc degeneration, degenerative spinal diseases, sprain, and muscle contraction. The transverse abdominis (TVA) muscle stabilizes the lower back. It is one of the main core stabilizing muscles of the lumbar spine. Kim⁴⁾ reported that walking with a straight posture could increase

the muscle tone of the TVA, improve breathing capacity, and relieve low back pain. In patients with musculoskeletal disorders, it also relieves back pain, strengthens the deep muscles, and improves breathing. Specifically, the study showed that walking exercise includes movements that improve muscle tone of the TVA. A previous study showed that the deep muscles such as the TVA and multifidus may contribute to stability of the spine through a range of tasks⁶⁾. Thereafter, several studies have attempted to determine how specific exercises can be used to improve the ability to contract the multifidus and TVA muscles⁵⁾. Since 1980, muscular strength exercises have been developed to help rapid recovery of muscle force and pain relief for rehabilitation⁷⁾. Further, the relationship between exercise and relief of back pain has been well established. A recent study also established the relationship between the back pain relief and spinal stabilization⁸⁾. In general, changes in walking speed require control from the nerve muscles, and muscle activity is essentially inherent. If walking speed decreases, the time to support the feet will increase, and changes in walking can be expected from the synergy effects of the postural muscles⁹⁾. Nordic walking is a method of training both the upper body and lower body. The muscles and endurance of the arms, shoulders, upper body, chest, and abdomen will be improved if walkers perform Nordic walking using their arms. Nordic walking also effectively helps patients with pain in lower extremity joints or muscle weakening¹⁰⁾. In

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a previous study conducted in a hospital that specializes in the diagnosis and treatment of low back pain, lumbar stabilization exercise was conducted to strengthen the abdominal muscles in order to stabilize the spine. Such exercise not only yielded lumbar stabilization, but also led to harmonious muscle activities with the TVA and diaphragm¹¹. Jeong¹² showed that spinal stabilization exercise increases spine stability and decreases low back pain. In addition, Park¹³ found that lumbar stabilization exercise may help in effectively relieving back pain and that a good posture could help prevent low back pain. Previous studies have indicated that aerobic exercise could be especially beneficial in relieving low back pain in elderly people with obesity and arthritis. Aerobic exercise has been shown to be beneficial for the elderly with low back pain. However, very few studies have investigated whether Nordic walking can alleviate low back pain. Thus, the aim of this study was to examine whether Nordic walking exercise can relieve low back pain and change the spine shape in elderly women.

SUBJECTS AND METHODS

Sixteen elderly women with chronic low back pain from the N University in Chungcheong-do, South Korea, were enrolled in this study. The age (mean \pm SD), height, weight, and body mass index of the subjects in the lumbar stabilization group 71.80 ± 3.64 years, 163.00 ± 6.59 cm, 62.3 ± 8.90 kg, and $23.4 \pm 2.85\%$ respectively. Participation in this study was voluntary.

The Inbody 720 (Biospace, Seoul, South Korea) was used to measure the body composition of the subjects, and the Formetric 4D (DIERS, International GmbH, Schlangenbad, Germany) was used for pelvic analysis. Weight, body fat, and lean body mass were measured with InBody 3.0 (Biospace) by using the direct segmental multifrequency bioelectrical impedance analysis method for body composition measurement. To measure three-dimensional trunk vertebrae images, pelvis obliquity, and static balance ability, a pressure footstool (Pedoscan; DIERS) and trunk measurement system (Formetric 4D, DIERS), which is a 3D image-processing apparatus with a high resolution for the vertebrae that was used in the studies of Lippold et al.¹⁴ and Schroder¹⁵, were used in this study. These devices perform analyses automatically. First, the curves on the surface of the back are analyzed to find a symmetric line. This line is quite similar to the line that connects the spinous processes with each other. Thereafter, the surface of the back is analyzed, and four anatomical peaks, that is, VP (C7), SP (sacrum point), and two dimples (DL and DR) are automatically found accordingly. The conditions of the pelvis were analyzed based on the symmetric line and anatomical points found as such to measure and analyze the lateral slope of the pelvis, the anterior/posterior slope of the pelvis, trunk rotation, trunk length, the lateral slope of the sagittal plane, and the lateral slope of the coronal plane. The participants were asked to walk in an upright posture, with their head upright and looking forward. The Nordic poles were held close to the body. When a foot was moved forward, the arm on the other side lifted the Nordic pole and

moved it forward. The participants were using the Nordic pole when walked on the track with their arms lifted above their shoulders. They wore shoes when walking; the type of shoe was irrelevant. During weeks 1 to 6, the walking speed was set to the average (5–6 km/h) of the speeds at which the subjects could comfortably walk 20 laps around a 200-m track in a 40-m period. The exercise intensity prescribed by Karvonen's equation was set at a target heart rate of 50 to 60% with a 6-week exercise-monitoring arrangement. During weeks 7 to 12, the speed of the walking was set to the average (6–7 km/h) of the speeds at which the subjects could walk 24 laps around a 200-m track in a 40-m track in a 40-min period. The exercise intensity prescribed by Karvonen's equation was set at a target heart rate of 60–70% with a 6-week exercise-monitoring arrangement.

The Statistical Package for the Social Sciences (SPSS 18.0) was used for data analysis. We conducted a series of 3 measurements for each participant including the following 5 spine parameters and pain parameter: trunk length vertebra prominens (VP)-midpoint between lumbar dimples (DM), trunk imbalance VP-DM, pelvic tilt dimple left-dimple right (DL-DR), pelvic torsion DL-DR, lateral deviation VP-DM, and a visual analog pain scale (VAS). These parameters were assessed before the study in all participants (pre-test). Subsequently, the 6-week phases began, and these parameters were measured again in all participants at the same time of day (mid-term test). At the end of study, these parameters were measured once more in all participants (post-test). The data were calculated by one-way analysis of variance (ANOVA) followed by Tukey's test to compare the different measurements. The level of statistical significance was set as a *p*-value of 0.05.

All the subjects understood the purpose of this study and provided written informed consent prior to participation, in accordance with the ethical standards of the Declaration of Helsinki.

RESULTS

One-way ANOVA was used to determine any significant differences between the means of trunk length VP-DM. The trunk length VP-DM and trunk imbalance VP-DM were significantly higher at the mid-term test than at the post-test ($p < 0.01$; Table 1). Further, the pelvic tilt DL-DR was significantly highest at the pre-test, and the value decreased in the order of the pre-test, mid-term test, and then post-test ($p < 0.01$; Table 1). Pelvic torsion DL-DR was also significantly higher at the pre-test than at the post-test ($p < 0.01$; Table 1), and lateral deviation VP-DM was significantly higher at the middle test than at the post-test ($p < 0.01$; Table 1). Additionally, VAS was significantly highest at the pre-test, and value decreased in the order of the pre-test, mid-test, and then post-test ($p < 0.01$; Table 2).

DISCUSSION

Kukkonen-Harjula¹⁶ compared training responses for brisk walking and Nordic walking in nonobese sedentary women and found that sciatica decreased after training with Nordic walking. Reuter et al.¹⁷ studied the effects of a flex-

Table 1. Measurements of spinal deformity according to time

Factor	Period	N	M	SD	Post hoc
Trunk length VP-DM (mm)	Pre-test	30	422.16	24.365	b > c
	Mid-term test	30	425.71	34.735	
	Post-test	30	415.11	24.477	
Trunk imbalance VP-DM (mm)	Pre-test	30	9.08	7.931	b > c
	Mid-term test	30	7.72	6.693	
	Post-test	30	10.24	8.124	
Pelvic tilt DL-DR (mm)	Pre-test	30	8.48	9.691	a > b > c
	Mid-term test	30	7.56	7.450	
	Post-test	30	6.88	8.522	
Pelvic torsion DL-DR (°)	Pre-test	30	0.0800	4.74664	a > c
	Mid-term test	30	-0.0833	4.57791	
	Post-test	30	-0.0633	3.53704	
Lateral deviation VPDM (rms)	Pre-test	30	7.6167	4.58078	b > c
	Mid-term test	30	9.9000	10.33451	
	Post-test	30	6.7967	3.07285	

a, Pre-test; b, Mid-term-test; c, Post-test

Table 2. VAS according to time

Factor	Period	N	M	SD	Post hoc
VAS (cm)	Pre-test	30	5.6667	0.80230	a > b > c
	Mid-term test	30	2.9333	0.58329	
	Post-test	30	0.7667	0.67891	

a, Pre-test; b, Mid-term-test; c, Post-test

ibility and relaxation program, normal walking, and Nordic walking on walking speed, stride length, and stride length variability in Parkinson disease patients and found that low back, hand, and leg pain were alleviated in all groups. Strength and muscular power were found to be important factors for maintaining functional abilities that allow people to perform activities of independent living. However, muscle strength gradually declined and the decline accelerated further with age; in particular, lower body muscle strength decreased dramatically. Weakness of lower body muscles was associated with walking speed in the elderly and weakened the lumbar region, which could lead to development of a bad posture. Weakness of the lumbar muscle strength was maintained spine stability during static and dynamic movement and, at the same time, the decrease of lumbar muscle strength declined spine stability due to the imbalance of lumbar extensor and flexor strength. Timothy et al.¹⁸⁾ concluded that the use of Nordic walking poles increased oxygen consumption, heart rate, and calorie expenditure as compared with regular walking. Moreover, the use of walking poles might benefit the elderly, individuals with orthopedic limitations, and individuals with balance problems by increasing stability and reducing loading. Farnsworth and Burtscher¹⁹⁾ showed that use of Nordic walking poles resulted in use of the upper extremities together with the lower extremities and, therefore, improved muscle strength and body balance. In a study involving 14 elderly women aged >65 years with chronic degenerative knee

arthritis, Hong²⁰⁾ reported that pain reduced significantly when abdominal exercise, lower body muscle exercise, and balance training were performed for 45 to 60 min per week (3 times a week) for 8 weeks. Roddy et al.²¹⁾ reported that aerobic walking and home-based quadriceps strengthening exercises reduced pain and disability in patients with knee osteoarthritis. In a 3-month program, Fisher et al.²²⁾ studied the effects of a quantitative progressive exercise muscle rehabilitation program on knee osteoarthritis in 40 elderly persons (20 men and 20 women) chosen from a group of volunteers (N = 437). Applied strength, endurance, and angular velocity were measured, and the results showed that the program participants improved difficulties from the step up and decreased their pain by more than 30%. Nordic walking causes muscle activation that has a lower extremity effect²³⁾. As a result of this study shown, the muscles around the spine which was is aligned and left-right balance in equilibrium.

The current study employed power walking exercise using Nordic poles for elderly women with chronic back pain. Our results showed that low back pain decreased because the upper extremities were used together with the lower extremities during the exercises performed using the Nordic poles (neutral position). Nordic walking using the poles was a full-body exercise, and it developed the upper and lower body muscles simultaneously. This exercise strengthened the paraspinal muscles and enabled the participants to maintain a steady position for a long period, because the ab-

dominal muscles, pelvic muscles, and sensory nervous system were used together. This exercise can improve muscle strength and muscle endurance and consequently could be useful for recovering the normal angle balance of the trunk and relieve pain. In this study, the effect of pain reduction in the muscle from the enhancements and the reduction of the weight load reduces the pain as a result of the normalization of the spine in misalignment displacement. We believe that intermittent use, but not in lame kink patients (intermittent claudication patients), of Nordic pole walking on applying for research²⁴ the distance from the pain (claudication distance) and the maximum walking distance showed an increase in satisfaction and this is not corporal as a result of a decrease in the burden and pain caused by stress.

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