The Effectiveness of Hollowing and Bracing Strategies With Lumbar Stabilization Exercise in Older Adult Women With Nonspecific Low Back Pain: A Quasi-Experimental Study on a Community-based Rehabilitation

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Abstract

Objective: The purpose of this study was to explore the therapeutic effectiveness of hollowing lumbar stabilization exercise (HLSE) and bracing lumbar stabilization exercise (BLSE) for older adult women with nonspecific low back pain (NSLBP) in community welfare centers.

Method: A total of 38 older adult women with NSLBP were allocated to either the HLSE group (n = 17, 70.4 ± 1.7 years) or the BLSE group (n = 21, 66.8 ± 4.4 years). Both groups performed intervention for 12 consecutive weeks, 3 times per week. Each group performed 5 lumbar stabilization exercises, including side plank exercise, bridge exercise, 4-kneeling exercise, prone plank exercise, and prone back extension exercise with hollowing and bracing strategy, respectively. The baseline and post-test values of trunk strength, low back disability (Korean Oswestry Disability Index [K-ODI] and Korean Roland Morris Disability Questionnaire [K-RMDQ]), and static balance (1-leg standing test) were compared by using per-protocol analysis.

Results: In trunk strength, the trunk flexor had significant difference ($F = 11.10$, $P = .001$) between groups and within groups of BLSE ($t = –5.56$, $P = .001$) and HLSE ($t = –2.50$, $P = .024$). Trunk back extensor of HLSE ($t = –6.00$, $P = .001$) and BLSE ($t = –9.19$, $P = .001$) only had significant within-group difference. However, in trunk side flexor, HLSE and BLSE had only significant difference between groups. In low back disability, K-ODI for HLSE ($t = 4.50$, $P = .001$) and BLSE ($t = 4.60$, $P = .001$) had significant within-group difference but no significant difference between groups ($F = 0.28$, $P = .202$). In K-RMDQ, HLSE only had significant within-group difference ($t = 3.97$, $P = .001$). In trunk muscle strength, the effect size of HLSE and BLSE groups for trunk flexor was HLSE –0.53 (medium) and BLSE –1.21 (large); trunk side flexor: HLSE 0.27 (small) and BLSE –0.24 (small); and trunk back extensor: HLSE 1.1 (large) and BLSE 2.00 (large), respectively. In low back disability, the effect size of both groups for K-ODI was HLSE 0.88 (large) and BLSE 1.05 (large), and K-RMDQ, HLSE 0.19 (small) and BLSE 0.40 (small), respectively.

Conclusion: Our findings suggest that HLSE and BLSE could be recommended for community settings to improve trunk strength and low back disability in older adult women with NSLBP. Especially, HLSE and BLSE could be recommended for elderly women with NSLBP who have lower back disability and weak trunk muscle strength, respectively. (J Manipulative Physiol Ther 2017;xx:1-9)

Key Indexing Terms: *Low Back Pain; Exercise Therapy; Adult, Aged; Rehabilitation*

Introduction

The incidence of low back pain, a condition that can potentially affect 70% to 80% of the population,[1] has increased in persons aged 60 years and older.[2] Chronic nonspecific low back pain (NSLBP) is a pain not associated with any specific disease; it accounts for approximately 80% to 90% of all cases of low back pain.[2] Nonspecific low back pain patients tend to have muscle weakness, excessive muscle activation to compensate for the unstable posture in abdominal muscles,[3-5] and decreased static balance.[6,7]

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Lumbar stabilization exercises have become increasingly popular as a treatment for low back pain.[8] The exercise protocols to improve lumbar stabilization vary from training of multifidus and transversus abdominis (TrA) with isometric contraction to using weight machines designed to strengthen the prime movers of the spine.[9,10] Some notable lumbar stabilization exercises include the side plank, bridge, 4-kneeling, prone plank, and prone back extension exercises. Lumbar stabilization exercises are commonly used to improve lumbar stability and increase trunk muscle strength.[11,12] Although previous studies have revealed the therapeutic effectiveness of lumbar stabilization exercises, these exercises focus on contraction of rectus abdominis (RA), external oblique (EO), and erector spinae (ES) muscles[13] but considered less preferential contraction of the TrA or co-contraction of anterolateral muscles, which are effective to relieve pain and low back disability.[14]

Hollowing strategy preferentially contracts the TrA while minimizing global muscles, including the RA muscle.[15,16] Bracing strategy simultaneously contracts anterolateral abdominal muscles, including TrA, internal oblique (IO), EO, and RA.[13,15] The hollowing strategy has been reported to relieve pain and improve low back disability in persons with NSLBP.[17,18] Hollowing strategy is effective for muscle activation mainly focused on RA, EO, IO, and TrA, which contribute to the partial stability of the spine.[11,12] The bracing strategy is also beneficial in inducing higher activation in deep abdominal muscles.[13] However, because the therapeutic effects of hollowing and bracing strategies in previous reports were based on experimental studies, it is difficult to apply the therapeutic effects to the community setting.

Hollowing and bracing strategies with lumbar stabilization exercises could be expected to provide the preferred neutral lumbar spine position with contraction of the IO, EO, and TrA muscles, which all contribute to spinal stability.[17,19] Therefore, the purpose of the present study was to explore the therapeutic effectiveness of HLSE and BLSE for older adult women with NSLBP to be applied in a community setting. We hypothesized that HLSE and BLSE are effective in enhancing trunk strength and static balance and improving low back disability in older adult women with NSLBP in community welfare centers. To test our hypothesis, we measured trunk strength (trunk flexor, trunk side flexor, and trunk back extensor), static balance (1-leg standing), and low back disability (Korean Oswestry disability index [K-ODI] and Korean Roland Morris disability questionnaire [K-RMDQ]) of older adult women with NSLBP, at baseline and then after 12 weeks of the intervention, in community welfare centers.

Methods

Design

We used a quasi-experimental design on community-based rehabilitation to identify the therapeutic effectiveness of HLSE and BLSE for older adult women with NSLBP in community welfare centers. All participants signed an informed consent form. This study was approved by the Medical Research Ethics Committee of Korea University (IRB NO. 1040548-KU-IRB-14-19-A-1).

Participants

From February 2014 to April 2014, 67 participants were recruited from 2 local community welfare centers, located in Seongbuk-gu, Seoul, South Korea, through announcements on notice boards 1 month before the intervention. To assign groups, we set up the 1 community welfare center as the HLSE group and another community welfare center as the BLSE group. The HLSE and BLSE groups performed the intervention at different community welfare centers 20 minutes' walking distance apart, which minimized the economic differences of participants between the 2 community welfare centers. The participation eligibility criteria were as follows: elderly women aged 60 or older, those diagnosed with chronic NSLBP by a doctor, those who could participate in intervention 3 times a week or more, and those living in Seongbuk-gu. Participants younger than 60 years with previous spinal surgery or spinal pathologic conditions such as lumbar herniated intervertebral disk, spondylolysis, spondylolisthesis, or nerve root pain signs were excluded. Thirty-eight participants completed the 12-week intervention. As shown in Figure 1, 19 of 67 were excluded. Before the commencement of intervention, 12 participants were dropped from the hollowing group and 7 from the bracing group. Each group performed 5 lumbar stabilization exercises, including side plank, bridge, 4-kneeling, prone plank, and prone back extension exercises, with hollowing or bracing strategy, respectively.

Preintervention Stage for Instruction

Ultrasonography (Sonoplus 992; Enraf Nonius, Delft, Netherlands) was used by 1 physical therapist with more than 3 years' clinical experience to instruct the participants on performing the hollowing and bracing strategies. The movements of the EO, IO, and TrA on the right side of the abdominal wall were monitored by using ultrasonography, and visual feedback from the connected monitor was used to identify the correct abdominal contraction by 1 physical therapist. The physical therapist could identify TrA and IO+EO contractions during hollowing and bracing strategies, respectively. Ultrasonography was performed about 3 to 5 times until the participants proficiently performed the hollowing and bracing strategies. Another physical therapist who was the assistant guided the participants and checked for the correctness of the performance of the strategies by palpating and observing the abdominal muscles nearby. After instruction of ultrasonography, 1