EFFECT OF STANDING EXERCISE USING PELVIS AND THORAX SYMMETRICAL DEVICE FOR CARE WORKERS WITH LOW BACK PAIN

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ABSTRACT

Objectives: Healthcare workers have a high prevalence of low back pain (LBP). Purpose of this study was to verify the effect of exercise during work for the low back pain of care workers.

Methodology: Study design was a randomized control trial with 8-month follow-up.

Participants: Thirty-six care workers have complaining LBP were randomized two groups. Exercises were supplied to subjects in the intervention group, performed exercises ten to thirty minutes a day while 8-month. In another group was no intervention. At the beginning of the study, two weeks, four weeks, and eight weeks were recorded two outcomes—Roland-Morris Disability Questionnaire (RMDQ) and Visual Analog Scale (VAS) on four postures (trunk extension/flexion/rotation and standing posture). In both groups, only Subjects of VAS ≥40mm on the beginning of this study were extracted to compare between groups at four terms. Statistical analyses were used the Mann-Whitney U test after Bonferroni correction. Significance level before correction = .05.

Results: There was no difference between groups regarding all outcomes recorded at the beginning of the study. In sub-group analysis, Intervention group showed significant improvement of the pain outcomes; Trunk extension at two weeks (p = .004) and eight weeks (p = .012), Trunk rotation at eight weeks (p = .008). RMDQ was no difference between groups.

Conclusion: Exercise aimed at symmetrization of pelvis and thorax reduces the pain of trunk extension and rotation for healthcare workers of low back pain VAS ≥40mm.

KEY WORDS: Healthcare Workers, Low back pain, Exercise Therapy, Alignment, Devices.
organization of the facility, and indicated that physical disorders become one of the factors leading individuals to quit a job. However, a strategy for preventing LBP in nurses and healthcare workers has not yet been established [13]. Therefore, it is necessary to establish a method of LBP prophylaxis in the workplace.

Recently, several preservation strategies have been proposed for LBP. Despite systematic reviews related to conservative therapy for LBP, the effectiveness of therapeutic exercise, physiotherapy and additional harness therapy has not been established for either acute or chronic LBP or for any of the functional disorders caused by LBP [2,11,14-16]. Both positive and negative results have been reported for continuous application of additional devices such as a lumbar or pelvic belt [13, 17-19]. One limitation is that prolonged usage of such a belt may cause decreased muscle thickness [20]. Considering that care workers must perform the intervention during working hours, the time required for the intervention should be minimized and exercises that can be performed while standing would be preferred to those performed in a lying position. Although pelvic asymmetry and decrease in thoracic mobility have been noted as causes of LBP [21], treatments aimed at correcting pelvic or thoracic asymmetry have not been proposed [22-24].

A lumbar corset and pelvic belt are often prescribed for patients with clinically diagnosed LBP, but none of these devices are designed to restore pelvic or thoracic alignment. The pelvic belt applies compressive force on the sacroiliac (SI) joint and may work to reduce the conformity of the SI joints, but has no effect on correcting asymmetric sagittal tilts of the innominate. Moreover, none of these devices treats thoracic asymmetry. Therefore, the research question would be whether a device designed to correct asymmetric alignment of the pelvis and thorax can effectively reduce pain and improve the ability of care workers to function.

Correcting pelvic or thoracic alignment may require the application of external force to restore and hold these regions in the optimal positions, which may enhance motor learning to stabilize the pelvis or thorax in the corrected alignment. Mulligan [25] considered that bony positional faults contribute substantially to painful joint restrictions. Therefore, he advocated “mobilizations with movement”, which is achieved by an active exercise while the joint position is corrected. Positive effects of treatment based on Mulligan’s concept have been reported in numerous studies, and his theory is now widely accepted [26,27].

Accordingly, we developed a set of PTRD currently called ReaLine CORE (GLAB Corp, Japan) to achieve more symmetrical alignment of the pelvis and symmetrical lateral expansion mobility of the lower thorax by performing standing activities while wearing the device [Figure 1]. It is a set of two identical devices, which have rigid front and back frames, two belts and 2 sets of ratchets. When it is applied to the pelvis, the pelvis becomes more symmetrical and stable with the application of focal forces on the bilateral anterior superior iliac spines and compressive forces on the SI joints while standing exercises are performed. When applied to the thoracic, the middle and lower thorax become more symmetrical and mobile with the application of force to the anterior thorax. It is speculated that pain and range of motion during forward or backward bending are improved because surfaces of the facet joints in the lumbar vertebrae have become more parallel and are under less constraint when symmetrical positions of the pelvis and thorax are maintained. Therefore, we assume that PTRD reduces the concentration of stress on the lower back, which leads to pain reduction and functional improvement in care workers with LBP.

The hypotheses of this study are that 1) significant improvement of pain and activities of daily living (ADL) can be achieved using the PTRD; and 2) individuals with a higher visual analog scale (VAS) score at baseline would exhibit significant improvement in pain and ADL. Our study could suggest a simple and effective exercise therapy for the nursing field if the exercises wearing PTRD can be implemented.
within about 10 minutes a day. A single-blinded randomized controlled trial was performed to test the hypotheses.

MATERIALS AND METHODS

Participants: This study was a single-blinded randomized control trial with a 4-week intervention and 4-week follow-up. Subjects were recruited from nurses and care workers at three nursing homes. Inclusion criteria were: 1) care workers complaining of LBP on a questionnaire; and 2) aged between 18 and 60 years. Exclusion criteria were: 1) history of surgery around the pelvis; 2) neurologic symptoms; 3) osteoporosis; 4) pregnant or within one year postpartum; 5) inability to understand the study protocol. Thirty-six care workers and nurses (male; 15, female; 21) complaining of LBP were randomized into intervention and control groups by a computer-generated table of random numbers. This study was conducted according to the principles expressed in the Declaration of Helsinki. All study protocols and forms were developed and utilized as instructed by the ethics committees of the nursing facilities.

Intervention and compliance: A 10-minute program involving eight standing exercises while wearing PTRD was performed by the intervention group 1-3 times/day, five days a week for 4-weeks with a four-week follow-up period thereafter. The exercise program consisted of: 1) deep breaths to enhance lateral expansion of the middle and lower thorax; 2) shoulder elevation; 3) upper thoracic rotation; 4) stepping; 5) lateral shift of the pelvis; 6) pelvic rotation with knees extended; 7) pelvic rotation with knees flexed; and 8) forward and backward bending of the trunk while standing [Figure 2]. There was no intervention performed by the control group. At work, ordinary duties were carried out by both groups. An occupational therapist instructed the intervention group on the intervention program and supervised the exercises performed by the participants.

Outcome Measures: At baseline, 2 weeks, 4 weeks, and 8 weeks, two outcome measures were recorded. As the primary measure, the progression of pain and functional decline due to LBP was evaluated by the Roland-Morris Disability Questionnaire (RMDQ). The RMDQ is frequently used as a “core” outcome measure in LBP trials [28,29], has proven reliability and validity [30,31] and known test-retest reliability in various settings [28,29,30]. The second outcome measure was pain Visual Analog Scale (VAS) during four postures (trunk extension, flexion, rotation, and standing posture). The pain VAS was measured using a horizontal scale from 0 (no pain) to 100 (maximal pain). VAS is a standardized instrument to measure pain intensity and shows a high test-retest reliability (r > .95) [10]. The assessor was blinded to the group assignments of the subjects during questionnaire assessments and measurements.

Statistical Analysis: The sample size was calculated using G*Power. The sample size was estimated based on the primary outcome measure (RMDQ) at 8-weeks follow-up, and assuming 80% power and 5% significance. To detect a clinically meaningful difference of 5 points between group mean changes from baseline to 8-weeks follow-up on the RMDQ, a total sample size of 36 was required. This total was based on a standard deviation of 2.3 points. Reports after the start of the trial suggested that a change score of 3 points on the RMDQ should have been used for the sample size calculations. Post-hoc power analysis was performed. On sub-group analysis, low statistical power was demonstrated by a power (1-β) of approximately 0.08.

PASW statistics18 was used for calculations. Data at baseline, 2 weeks, 4 weeks, and 8 weeks were extracted for comparison between groups Statistical analyses were performed using the Mann-Whitney U test after Bonferroni correction. The significance level before correction was α = .05.

RESULTS

A total of thirty-six care workers participated (Mean age; 38.7 ± 9.7 year, BMI; 23.4) in this study [Table 1]. Eighteen subjects were randomized to each group, and there were no dropouts. There were no statistically significant differences between the groups at baseline. The intervention frequency in the intervention group was approximately one time/day. For hypothesis 1, there were no significant differences between groups for any of the terms on RMDQ and VAS.
However, aggravation of low back pain was not reported either.

For hypothesis 2, a VAS score ≥ 40 mm during each movement at baseline was used to identify high VAS score groups. There were 10 participants who reported a VAS score of 40 or greater during trunk rotation and 12 such participants during maximal backward bending. The intervention group showed significant improvement of pain outcomes for trunk extension at 2 weeks (p = .004) and 8 weeks (p = .012), trunk rotation at 8 weeks (p = .008). However, there were no differences on RMDQ between the intervention and non-intervention groups.

**Table 1:** Characteristics of surveyed subject (mean ± SD).

<table>
<thead>
<tr>
<th>Number of the subject</th>
<th>Intervention group</th>
<th>Control group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18 (M 8, F 10)</td>
<td>18 (M 7, F 11)</td>
<td>0.735</td>
</tr>
<tr>
<td>Age (year)</td>
<td>42.6 ± 8.8</td>
<td>38.7 ± 9.7</td>
<td>0.216</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160.5 ± 8.6</td>
<td>162.4 ± 8.5</td>
<td>0.518</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>59.6 ± 14</td>
<td>61.7 ± 16.9</td>
<td>0.714</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>22.8 ± 4.8</td>
<td>22.7 ± 3.4</td>
<td>0.958</td>
</tr>
</tbody>
</table>

**DISCUSSION**

The aim of this study was to determine whether a 4-week intervention involving a 10-minute daily exercise program while wearing a PTRD would effectively reduce LBP symptoms and improve the ability of care workers to function. The results did not show significant differences between the groups on either RMDQ or VAS at any time point, which did not support hypothesis 1. In the high VAS score subgroup, pain during maximum trunk extension was significantly decreased at 2 weeks and 8 weeks, and pain during rotation at 8 weeks.

At baseline, VAS and RMDQ scores of all subjects combined averaged 25.2 and 1.8, respectively, showing an obvious floor effect. Therefore, these results were considered inconsistent with previous studies demonstrating improvements in VAS and RMDQ using a lumbopelvic belt [17,19,33]. Compliance with the intervention program was one time a day and did not satisfy the original protocol. However, considering multiple risk factors for LBP associated with care work [34-37], it is a positive finding that the LBP symptoms did not worsen.

On the other hand, subjects who scored LBP higher than 40 mm on VAS at baseline reported less pain during rotation and extension after the intervention. These findings were similar to those
of a previous study that compared corset and non-intervention groups [17,33]. Our intervention program requires only 10 minutes of standing exercises per session and can fit into the working environment of care facilities. Since corset therapy requires prolonged usage [17,19], the intervention program offers a great advantage in limiting the risk of decreased trunk strength or increased stiffness.

To date, there have been few devices that effectively restore pelvic symmetry and lower thoracic mobility. Pelvic asymmetry may reduce conformity of the sacroiliac joints, and reduce form closure [38,39]. The thorax is related to mobility of the spinal column, in particular lower thorax expansion is considered important in gaining thoracic mobility [9,40]. Although associations between reduced thoracic mobility and LBP have not yet been shown, it is speculated that increased mobility of the thorax may contribute to a reduction of mechanical stress on the lumbar spine. Accordingly, 10-minute standing exercises while wearing PTRD might have contributed to improved symmetry of the pelvis and thorax, improved thoracic mobility and reduced mechanical stress on the lumbar spine. Therefore, we think that pelvic and thoracic symmetry may be a contributing factor for realigning the spine and improving function.

There were no dropouts, and there were no censored data. The study was designed as a randomized control trial to remove measurement bias. However, the intervention was not fully monitored and the quality of exercises was not uniform across the subjects. Nearly 60% of the subjects were females and the mean age was approximately 40 years old, which matches the demographics of the care workers and nurses in Japan. Therefore, the results of this study can be generalized to Japanese care workers and nurses.

There are four limitations in this study. 1) We did not obtain objective outcome scores such as pain-free range of motion measurement. 2) Because we carried out unsupervised interventions, the quality of the intervention may have been uneven. 3) There is a possibility of a β error due to the limited sample size. 4) We were not able to maintain a sufficient frequency of the intervention sessions per day with the average being less than one time/day. If we could have maintained a greater intervention frequency, subjects might have shown greater improvement. Insufficient frequency of intervention sessions might have limited the degree of functional recovery and pain reduction.

Exercises while wearing the pelvic and thoracic realigning device for care workers and nurses with LBP contributed to restoring function and reducing pain in subjects with higher VAS scores. None of the subjects with higher VAS scores experienced sharp pain exacerbation during the intervention period while continuing to work. Future studies may require a supervised intervention program with a higher frequency of sessions.

Conflicts of interest: None

REFERENCES


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