ORIGINAL ARTICLE

# The impact of combination of core stabilization exercise and walking on pain perception and low-back pain disability

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

**Abstract**

*Background and Study Aim* Low-back pain (LBP) has increasingly been the leading cause affecting work performance, daily activities, and rising the cost of healthcare services. Currently, sitting time increases and walking activity lessens among people. The purpose of this study - identify the effect of Core Stabilization Exercise (CSE) with walking on pain perception and LBP disability among people who suffered from non-specific low-back pain (NSLBP).

*Material and Methods* In this study, a total of 36 active people (18-42 years old) with BMI⩾24.9 kg.m$^{-2}$ voluntarily participated and were divided randomly into three groups. Intervention groups included CSE group (CSEG; n=12), CSE with walking (CSEWG; n=12), and control group (CG; n=12). The intervention groups carried out the exercise programs (CSE with and without 30 minutes of walking), three times a week for six weeks. In this study, the pain perception was assessed via the Numerical Pain Rating Scale (NPRS) and LBP disability was measured by using a modified Oswestry Disability (ODI) questionnaire.

*Results* A one-way analysis of variance (ANOVA) displayed significant effectiveness of CSEG and CSEWG on pain perception as the interaction between time and group [f (2, 33) = 4.95, p=0.032]. The pain perception significantly decreased in CSEG (p=0.021) and CSEWG (p=0.003) after six weeks of the intervention programs compare to CG. The results also showed a significant effect on LBP disability for the interaction between time and group after six weeks of both intervention programs (f (2, 33) =6.52, p=0.015). Disability function (ODI score) significantly improved in CSEG (p=0.031) and CSEWG (p=0.007). Even though the results revealed no significant difference between CSEG and CSEWG, and both groups proved to reduce pain perception and LBP disability, the disability index improvement was greatest in CSEWG.

*Conclusions* In conclusion, CSE with 30 minutes of walking, as an intervention program, has shown greater improvement with a larger effect size in pain perception and LBP disability among people who suffered from NSLBP.

**Keywords**: core stabilization exercise, walking, low-back pain disability, pain perception.

## Introduction

It is well-documented that more than 80% of working adults tolerate an episode of low-back pain (LBP) during a period of their lifetime. LBP will increase not only the cost of health care but decreases the working hours and the productivity of the societies [1, 2]. In addition, for many years, LBP has been the leading indication for medical rehabilitation [3] and affected the quality of life as well (4). Furthermore, while previous studies showed that healthcare services for chronic non-specific low-back pain (NSLBP) have considerably augmented over the past two decades [5, 6], the COVID-19 pandemic now threatens to further intensify the effect of musculoskeletal disease and chronic LBP in many populations [7, 8].

Meanwhile, several curative strategies recently endorse exercise therapy as a first-line treatment for the reduction of musculoskeletal pain and disability improvement. The exercise can improve back extension strength, mobility, endurance, and functional disability [9, 10]. Thus, people who suffer from NSLBP need to do exercises that help to recover their pain and disability in daily life. Besides, there are various types of land-based and water-based exercises for NSLBP such as lumbar stabilization exercise (LSE), lumbar flexion exercise, motor control


doi:10.15561/26649837.2022.0501

exercise, core exercise, lumbar flexion exercise, bracing exercise, walking exercise (WE), and also aquatic exercise as a non-weight bearing workout that helps in the treatment and rehabilitation of NSLBP [11, 12]. Next, core stabilization exercise or home-based exercise is the type of exercise that is considered a standard and effective physiotherapy intervention which people with NSLBP may follow. Furthermore, flexibility and core strength (e.g., stretching and strengthening exercises) not only can improve the quality of life but also can help to avoid worsening LBP, particularly NSLBP [13, 14, 15]. Besides, core strength home-based exercise has shown a long-term effect for up to one year [16]. In addition, walking is not only a favorable, convenient, easy, and inexpensive exercise for all populations [17], but recently it is also highly recommended to rehabilitate patients with NSLBP [12].

On the other hand, recent studies revealed that walking activities decline among people who suffer from NSLBP [11, 18], while low–moderate evidence revealed the benefit of walking as an effective intervention strategy for LBP treatment [19, 20]. Hence, this study has been carried out to determine the effect of a six-week CSE with walking exercise (CSEW) on pain perception and LBP disability for individuals who suffer from NSLBP.

## Materials and Methods

*Participants*

This study was a randomized control trial (RCT) with the intervention programs among equivalent groups. The participants were active people who suffered from NSLBP. All participants were informed of the study procedure and signed a consent form before participation. This study was approved by Sultan Idris Education University Ethical Committee.

A total of 41 participants (male and female) who reported LBP in Sultan Idris Education University (UPSI) Sports Rehabilitation Clinic were recruited. Finally, 36 of them completed the study procedure. The inclusion criteria for acceptance were aged 18-45 years, physically active lifestyle, suffering from NSLBP for more than six months with at least two symptoms of LBP. The considered symptoms were overall pain report, difficulty and feeling more pain intensity when lifting, prolonged sitting (>30 minutes), changing postural position, and poor sleep quality. The exclusion criteria included surgery, cardiorespiratory health problems, feeling any uncomforting or dizziness during walking, feeling pain in any part of the body during exercises, and not attending two consecutive sessions in a week.

The subjects were randomly divided into three groups; the core stabilization exercise group (CSEG), CSE with walking exercise (CSEWG) as intervention groups, and the control group (CG). Each group consisted of 12 active people with NSLBP. The CSE group conducted only the CSE program and, CSEW also performed CSE after 30 minutes of walking exercise for six weeks, three sessions weekly. Meanwhile, the control group did not do any exercise or intervention program during these weeks.

*Sample Size.*

A total sample size of 36 (n=12 per group) was recommended by G*Power 3.0.10 when assuming a size of 36, a power of 0.95 %, and a type I error of 5% for three groups with 10 numbers of predictors (sub-sections of ODI).

*Research Design*

*Instrumentation.*

In this study, the Numeric Rating Pain Scale (NRPS) was used as a research instrument to measure pain perception [21]. The modified Oswestry disability (ODI) questionnaire (Bilingual; English-Malaysian Malay) was also accomplished to measure NSLBP disability. The measurement procedure was completed by all participants one day before (Baseline data) and a day after the intervention program as the post-test.

ODI questionnaire is subtended by 10 sections including pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, traveling, and employment/homemaking [11, 22]. Each section was separately scored (0 to 5 points) and then amounted up (total=50). As a participant completed all 10 sections, it would indeed double the patient's score (maximum total=100). Additionally, the data of weight, height, and BMI were self-reported measurements. It should be mentioned that to ensure their health background, all of the participants completed the General Health Questionnaire (GHQ), Physical Activity Readiness Questionnaire (PAR-Q), and an informed consent form as well.

*Core Stabilization Exercise with Walking.*

A six-week core stabilization exercise (CSE) with and without walking was conducted three sessions weekly for 60 minutes per session as the intervention program [23, 24]. The first session of the CSE program was carried out in UPSI Sports Rehabilitation Clinic and all of the participants in both intervention groups were taught how to perform the CSE in proper posture and method. Other sessions of CSEG are performed at home while they are motivated and supported via communication and advisory session at least once a week. Meanwhile, CSEWG performed CSE in an outdoor environment after walking for 30 minutes on a flat pathway. They were advised to walk comfortably at their preferred walking speed. As table 1. shows, stabilization and strengthening exercises were performed as part of the CSE program. The exercises were concentrated on the abdominal muscles including trunk rotations, partial crunches, knee to chest, bridging, hip extension, extended pose, and hand-knee rocking [13, 23]. Moreover, 10 minutes warm-up activity and as well as cool-down activity (5-7 minutes) were considered at the end of each session. The exercise, repetition, set, and resting time between each exercise based on the week and session are shown in Table 1, also.

**Table 1.** A summary of six weeks of Core Stabilization Exercise (CSE)

| Week | Exercise | Session | Self-chosen Rep. & Set | Hold & rest time (Sec) |
|---|---|---|---|---|
| 1 | Trunk rotations*<br>Partial crunches | 1 | 5-8 × 2 | 30 |
| | Knee to chest*<br>Bridging | 2 | 6-8 × 3 | *30<br>40 |
| | Hip Extension<br>Extended pose | 3 | 8-10 × 3 | *40<br>60 |
| 2 | Trunk rotations*<br>Partial crunches | 1 | 6-8 × 4 | *30<br>60 |
| | Knee to chest*<br>Bridging | 2 | 6-8 × 4 | *30<br>60 |
| | Hip Extension<br>Extended pose | 3 | 8-10 × 3 | *30<br>60 |
| 3 | Trunk rotations*<br>Partial crunches | 1 | 8-10 × 4 | *30<br>60 |
| | Knee to chest*<br>Bridging | 2 | 10-12 × 3 | *30<br>60 |
| | Hip Extension<br>Extended pose<br>Hand-knee rocking | 3 | 10-12 × 3 | *30<br>60 |
| 4 | Trunk rotations*<br>Partial crunches | 1 | 10-12 × 4 | *60<br>80 |
| | Knee to chest*<br>Bridging | 2 | 12-15 × 3 | *60<br>80 |
| | Hip Extension*<br>Hand-knee rocking | 3 | 10-12 × 4 | *60<br>80 |
| 5 | Trunk rotations*<br>Partial crunches | 1 | 10-12 × 4 | *80<br>90 |
| | Knee to chest*<br>Bridging | 2 | 10-12 × 4 | * 80<br>90 |
| | Hip Extension<br>Extended pose<br>Hand-knee rocking | 3 | 12-15× 3 | * 90<br>120 |
| 6 | Trunk rotations*<br>Partial crunches | 1 | 12-15× 3 | * 90<br>120 |
| | Knee to chest*<br>Bridging | 2 | 12-15× 4 | *90<br>120 |
| | Hip Extension<br>Extended pose<br>Hand-knee rocking | 3 | 12-15× 4 | * 90<br>120 |

*Statistical Analysis*

The data were collected as "baseline" (before the intervention program) and "post-test" after session 18 of the CSE and CSEW programs. Subsequently, evaluating the normal distribution of data for all variables, the mean and standard deviation for the demography data, pain perception, and LBP disability function were analyzed using IBM SPSS Statistics "ver. 27.0" (IBM Co., Armonk, NY). For each variable main and interactive effects of group and time were determined by using a one-way analysis of variance (ANOVA) if there was a significant difference between CSEG, CSEWG, and CG. The significant level was considered at $p \leqslant 0.05$, also.

## Results

As the primary examination of demography data displayed, there was no significant difference between CSEG, CSEWG, and CG in their age, weight, height, and BMI. As mentioned earlier, 36 participants in three groups completed the post-test of NRPS and modified ODI questionnaire. The average attendance of CSEG and CSEWG was 97 % during 6 weeks (18 sessions). In CG, 16.7% (two persons) of participants stated that they continued their physiotherapy exercise instruction for 15-20 minutes regularly at home every morning.

It should be declared that although CG participants were advised to have no exercise for six weeks, this study was not able to control all of their self-treatment situations. The demographic data (gender distribution, NSLBP experiences, weight, and BMI) of each group is illustrated in Table 2.

In addition, the disability index for NSLBP among CSEG and CSEWG before and after six weeks show in Table 3. It is worth remarking that based on the ODI questionnaire score interpretation, individuals with minimal index can cope with most of their daily activities and generally they do not need treatment, except the advice on lifting, prolonged sitting, physical fitness maintenance, and diet. In moderate index, individuals not only feel more pain and have difficulties with lifting, sitting, and standing, but the travel and social life are also more problems and they may be off from their work [11].

Considering the information in Table 3., the frequency of CSEWG in the moderate index considerably changed to minimal after six weeks of the intervention. However, there was an improvement in the frequency of moderate to minimal index for the CSEG, while there were no notable changes among the control group.

One-way ANOVA test was conducted to analyze the effectiveness of CSE and CSEW on pain perception in the interaction between time and group, $f(2, 33) = 4.95$, $p=0.032$. In addition, the post-hoc analysis found that the time effect was also significant in both intervention groups (CSEG with $p=0.021$; and CSEWG with $p=0.003$), which showed the pain perception significantly diminished after six weeks (18 sessions) for both intervention groups.

The LBP disability (ODI score) significantly lessened among CSEG ($p=0.031$) and CSEWG

**Table 2.** Demographic data of participants by group (Mean±SD)

| Group/Variables | | CSEG | CSEWG | CG |
|---|---|---|---|---|
| Gender | M | 3 (25) | 4 (33) | 5 (42) |
| n (%) | F | 9 (75) | 8 (67) | 7 (58) |
| NSLBP Experience (Year) n (%) | >2 | 4 (33) | 2 (17) | 3 (25) |
| | 1-2 | 5 (42) | 6 (50) | 6 (50) |
| | <1 | 3 (25) | 4 (33) | 3 (25) |
| Age (Years) | | 32.85±7.43 | 29.2±9.13 | 34.8±6.25 |
| Height (cm) | | 163.3±7.2 | 164.68±5.33 | 166.8±6.51 |
| Pre-Weight (kg) | | 63.17±8.31 | 65.4±9.11 | 67.3±8.64 |
| Post-Weight | | 64.43±9.2 | 64.6±8.46 | 66.9±9.93 |
| Pre-BMI ($kg.m^{-2}$) | | 24.78±3.65 | 24.02±4.79 | 23.25±4.18 |
| Post-BMI | | 24.45±4.12 | 23.81±4.79 | 23.01±4.92 |

**Table 3.** Disability index of LBP by the groups and times (n & %)

| Disability Index (0-100) | CSEG | | CSEWG | | CG | |
|---|---|---|---|---|---|---|
| | Baseline | Post-test | Baseline | Post-test | Baseline | Post-test |
| Minimal (0-20) | 5 (41.7) | 8 (67) | 4 (33) | 11 (91.7) | 7 (58.4) | 6 (50) |
| Moderate (21-40) | 6 (50) | 4 (33) | 8 (67) | 1(8.3) | 4 (33.3) | 6 (50) |
| Severe (41-60) | 1 (8.3) | - | - | - | 1(8.3) | - |

**Table 4.** The pain perception and LBP disability before and after the intervention (One-way ANOVA)

| Variable/group | Pain Perception; NPRS; (0-10) | | | | LBP disability; ODI Score (0-100) | | | |
|---|---|---|---|---|---|---|---|---|
| | Baseline | Post-test | F | p | Baseline | Post-test | F | p |
| CSEG (n=12) (n=12) | 5.0±2.4 | 2.3±1.0 | 5.83 | 0.021 | 33.6±6.70 | 17.02±4.33 | 5.02 | 0.031 |
| CSEWG (n=12) | 4.5±2.0 | 1.10±1.0 | 10.35 | 0.003 | 35.4±6.20 | 8.32±5.4 | 8.20 | 0.007 |
| CG (n=12) | 4.7±2.7 | 3.9±2.0 | 1.08 | 0.37 | 32.7±5.70 | 28.9±6.3 | 1.46 | 0.27 |
| F | 0.62 | 4.95 | - | - | 0.19 | 0.83 | - | - |
| p | 0.56 | 0.032 | - | - | 6.52 | 0.015 | - | - |

Note: Data presented as mean ± SD.

(p=0.007) compared to the control group. In other words, the group-by-time interaction effect revealed an improvement in LBP disability after six weeks of both programs (f (2, 33) = 6.52, p=0.015). However, the results of the post-hoc analysis showed no significant changes in these variables after six weeks in the control group (Table 4).

## Discussion

Given NSLBP prevalence and its consequence on public health and the socioeconomic, the present study aimed to examine the impact of the implementation of a six-week CSE with a walking program on pain perception and LBP disability among people who suffer from NSLBP. These findings figured out that a combination of the CSE program together with 30 minutes of walking on a flat pathway with a preferred and comfortable speed could reduce the pain perception and enhance LBP disability. Despite, Hendrick et al. [19] study reported that there is a limited effect of walking on the pain management of acute and chronic NSLBP. This study's findings were in line with recent evidence which similarly found that walking can be an effective treatment program on pain relief and muscle endurance improvement among individuals with NSLBP [12].

Further, Heureux et al. [24] revealed that a combination of favorable rehabilitation exercise and extension of the self-efficacy exercise program is needed for individuals who experienced NSLBP. Then, walking can widely be accepted as the energy efficiency of muscular work to incorporate in general self-efficacy exercise [17]. Furthermore, walking can be considered a helpful rehabilitation program to improve back muscles strengthening and lessening muscle stiffness by inducing isometric contractions of the lower body and increasing muscular activation which consequently resulted in the NSLBP prevention [12].

In addition, these findings are consistent with Sitthipornvorakul et al. [20] study that reported walking can be suggested as an easy and highly accessible to perform in chronic LBP management to reduce the pain and disability. Even though high-quality studies are still needed to provide supplementary evidence [20].

Furthermore, the study by Kapetanovic et al. [23] revealed that core stabilization exercise (CSE) throughout an organized home exercise plan can improve physical function disability among individuals with chronic LBP. Meanwhile, the current study's findings displayed that the combination of CSE and 30 minutes of walking activity had a better consequence on improving pain perception and functional disability index compared to CSEG that only performed CSE as a treatment program.

However, there is not only a significant effect of the correct core strengthening and stabilization in NSLBP prevention [12] but walking can be counselled as one of the effective ways to encourage a higher activation to maintain a proper posture among people with NSLBP [18].

Nevertheless, a walking gait like an inverted pendulum can induce transverse counter-rotation between the thorax and pelvis, particularly when individuals walk with normal velocity and comfortable speed [25]. Therefore, as CSE can improve back extension strength and mobility [18], the combination of walking and CSE can provide excessive endurance, strength, and mobility to improve all sub-sections of LBP disability like personal care, sitting, standing, walking, lifting, and traveling.

Next, according to Trampas et al. [26] findings, CSE has been proposed as an effective treatment to improve spinal stabilities to address chronic NSLBP and impairments of movement coordination for the trunk and thorax [26]. In addition, according to recent studies, walking exercise could amend the endurance of back muscles as well as the core stability [12, 27, 28, 29]. Considering the findings of this study, a combination of CSE and walking exercise can be recommended for people who suffer from NSLBP. Meanwhile, further research with larger sample size, different intensities, and times of walking is required to discover different findings of the packages of core stabilization prescriptions for walking about prevention and rehabilitation of individuals with NSLBP.

## Conclusions

In conclusion, the finding of the present study figured out that people with NSLBP can significantly improve pain perception and low-back pain disability after a six-week (18 sessions) CSE with 30 minutes of walking (preferred speed). Even though the CSE program could enhance pain perception and low-back pain disability, the implementation of walking as an easy, simple, accessible, and pleasurable activity besides core stabilization exercise can be offered as a superior intervention treatment for people who are suffering from NSLBP.

## Acknowledgement

We would like to express our gratitude to the Research Management and Innovation Centre (RMIC), Sultan Idris Education University (UPSI) for their financial and moral support in publishing this article.

## Conflict of interest

The authors reported no potential conflict of interest.

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Cite this article as:

Abadi FH, Tiis NHA, Zainuddin FF, Choeibuakaew W, Elumalai G, Sankaravel M, Motevalli S. The impact of combination of core stabilization exercise and walking on pain perception and low-back pain disability. *Pedagogy of Physical Culture and Sports,* 2022;26(5):276–283.
https://doi.org/10.15561/26649837.2022.0501



Received: 15.08.2022
Accepted: 26.09.2022; Published: 30.10.2022