# CONTROLLED TRIAL OF SACROILIAC BELT IMPACT ON SPINE PAIN, REGIONAL THIGH DISCOMFORT, AND ERECTOR SPINAE FLEXION-RELAXATION PHENOMENON FOLLOWING A MANUAL LABOR TASK

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## ABSTRACT

**Objective:** The study purpose was to assess the impact of a sacroiliac support belt on relieving spine pain, regional thigh discomfort, and modifying erector spinae muscle activity patterns after a strenuous manual labor task.

**Methods:** Forty-eight college students completed a Nordic Musculoskeletal Questionnaire (NMQ), Numeric pain Rating Scale (NRS) for low back pain, and sEMG Flexion-Relaxation Phenomenon (FRP) test at baseline and again at post-test, with a 10-min manual-labor task phase in between. The study was composed of 3 compared groups: Control group #1 (16 participants without low back pain that did not wear a sacroiliac belt during the manual labor task), control group #2 (16 participants with low back pain that did not wear a sacroiliac belt during the manual labor task), and the experimental group (16 participants with low back pain that wore a sacroiliac belt during the manual labor task).

**Results:** Participants with low back pain that used the sacroiliac belt demonstrated significantly less lower back discomfort at the NMQ post-test (3.06 base to 1.94 post, p = 0.002), while those in both control groups demonstrated greater back discomfort. Additionally, use of the sacroiliac belt by low back pain participants demonstrated it had a protective ability on muscle activation patterns seen during the FRP post-test that warrant further study.

**Conclusions:** The addition of the sacroiliac belt improved participants' lower back musculoskeletal discomfort level. Participants with LBP that wore the sacroiliac belt had more relaxed muscles afterwards during all phases of the FRP post-test. *(J Contemporary Chiropr 2022;5:105-113)*

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**Key Indexing Terms:** Low Back Pain; Patient Outcome Assessment; Ergonomics; Self-Help Devices; Chiropractic

## INTRODUCTION

Low back pain is associated with high levels of disability and healthcare utilization. (1) It is the second most common cause for physician visits. (2) Low back pain costs between $100-200 US billion per year. (3) About 2/3rds of those costs (3) are associated with absenteeism (absent from work) (4-9_ and presenteeism (present at work, but with impaired performance). (10-11) Approximately 149 million days of work per year are missed due to low back pain. (12) Optimal preventative measures should be emplaced to lower these numbers.

Common methods to treat low back pain involve prescription of opioids. National treatment guidelines for low back pain (2012 Institute for Clinical Systems Improvement, 2007 American College of Physicians and the American Pain Society, and the 2006 European Guidelines) (13-15) recommend prescribing opioids in addition to other forms of care. However, the most current research on this topic (16) demonstrates that opioids are not more effective than non-opioid medication at improving patient outcomes. Additionally, opioids often have many negative side effects, including addiction, constipation, drowsiness, respiratory depression, nausea, and paranoia. (16) Safe non-opioid based methods to reduce low back pain during the workday are needed to help employees with pain that are attempting to work.

The Serola sacroiliac belt is designed to help reduce low back pain and sacroiliac pain. (17) On their website the product is marketed to "help prevent and relieve SI joint pain, low back and hip pain caused by exercise or any motion involving lifting, bending, and twisting." Additionally, the product is promoted to support the pelvis of pregnant females and help manage their pelvic pain. To our knowledge, research on this product has not been published in peer-reviewed journals. It is important to understand that this product differs significantly from existing lumbar support belts in its focus and mechanism of action.

The ability of lumbar support belts to reduce low back pain is not clear. (18) In a study by the UCLA School of Public Health and Home Depot, acute low back pain was decreased by approximately 33% across 36,000 employees in their stores by a mandatory requirement to wear support belts when lifting heavy objects. (19) Although the number of injuries was reduced, the number of severe and costly low back injuries increased (19), which was further supported up by a study by Mitchell *et al.* (20) In most follow-up studies significant benefit from wearing lumbar support belts has not been clearly demonstrated. For example, Wassell *et al* studied 13,873 employees and found no correlation between frequent support belt use and reduced incidence of back injury claims. (21) The viewpoint of the National Institute for Occupational Safety and Health (NIOSH) (22) as well as a Cochrane review (23) is that there is not enough information to support or refute the use of back support belts at reducing the incidence of low back pain. Further study is needed to gain clear insight into the true health impact of support devices at decreasing spine pain and dysfunction.

The objective of this study was to investigate the ability of a sacroiliac belt to impact spine pain, thigh/hip pain, and affect erector spinae muscle activation patterns during a functional task. The hypothesis was that the belt provides protective benefits when engaging in strenuous exercise.

## METHODS

This research experiment was reviewed and approved by the Texas Chiropractic College Institutional Review Board for human subjects in accordance with the Declaration of Helsinki and follows the CONSORT guidelines. (24)

*Study Design, Rationale, and Setting*

This controlled trial focused on the immediate impact of a sacroiliac belt on low back pain, spine and hip-related regional body discomfort, and muscle activation patterns after engaging in a manual labor simulation task as shown in figure 1. Forty-eight participants (figure 2, table 1) completed a baseline Nordic Musculoskeletal Questionnaire (NMQ) (25-27), which measures regional body pain/discomfort, as well as a Numeric pain Rating Scale (NRS) for low back pain. After this, they engaged in a surface EMG Flexion-Relaxation Phenomenon (FRP) test (figure 3). (28-32) Sixteen out of the 32 participants with low back pain were randomly assigned to wear the sacroiliac belt (figure 4). Randomization of low back pain participants to control group #2 vs the experimental group was performed by following a pre-generated block randomization list to keep the number of participants between those 2 groups equal.

Next, all participants engaged in a manual labor task designed to simulate what a factory worker might engage in. The physical task involved lifting a series of heavy textbooks that weight approximately 15 pounds off of the floor and placing them on top of a 52″ tall filing cabinet (figure 5). They then placed the books back on the floor and repeated this process over and over for 10 minutes. Afterward, participants completed another NMQ, NRS and FRP test. Participants only attended 1 study session.

This experiment occurred in a research lab with the ambient room temperature set to 74°F. Researchers intentionally avoided playing music in the lab background during the study. This was done to reduce the possibility that music could calm some participants and act as a covariate for perception of pain. (33)

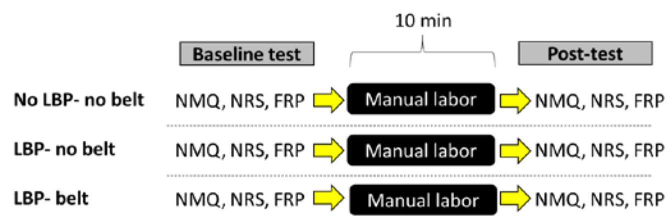


***Figure 1.*** *Illustration of the study design and 3 groups compared at 16 participants per group. The entire study session took approximately 25 minutes per participant. The study included the following groups: control group #1 (No LBP- no belt during the manual labor task), control group #2 (LBP – no belt during the manual labor task), and experimental group (LBP- sacroiliac belt worn during the manual labor task).*

**Inclusion criteria were:**

1) college students 18-65 years of age
2) provide written informed consent
3) participants without low back pain for control group #1
4) participants with low back pain for control group #2 and experimental group

**Study participants with any of the following were excluded from the study:**

1) pregnant
2) spine or lower limb surgery
3) twisted ankle
4) skin disease affecting the lower back
5) sunburn affecting the lower back

***Figure 2.*** *Study inclusion and exclusion criteria*

*Table 1. Baseline participant demographics for the study groups compared. Data compared with a one-way ANOVA. The data demonstrates that all 3 groups were reasonably similar in attributes.*

| | No LBP-no belt control group #1 | LBP-no belt control group #2 | LBP-sacroiliac belt Experimental group | p value |
|---|---|---|---|---|
| Sex (M/F) | 10/6 | 7/9 | 7/9 | |
| Age (y) | 24.6 + 3.6 | 26.5 + 7.3 | 25.4 + 3.9 | 0.595 |
| Mass (kg) | 82.3 + 16.2 | 77.2 + 15.1 | 73.8 + 13.2 | 0.272 |
| Height (m) | 1.71 + 0.12 | 1.70 + 0.08 | 1.71 + 0.05 | 0.896 |
| Body Mass Index (kg/m2) | 28.2 + 4.9 | 26.7 + 4.5 | 25.2 + 4.8 | 0.214 |
| Age range (yrs) | 20-34 | 22-46 | 23-36 | |
| **Most data listed as mean ± SD.** | | | | |

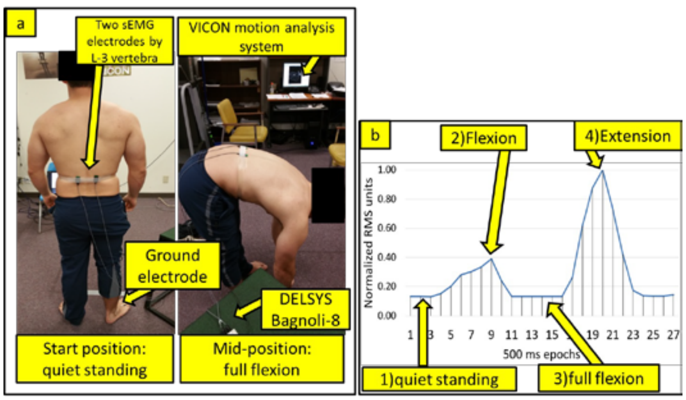


***Figure 3. Illustration of the Flexion-Relaxation Phenomenon test.*** *(a) Participant engaged in a standing toe-touch test to measure the Flexion-Relaxation Phenomenon (FRP) of their erector spinae muscles using surface EMG (sEMG), and (b) a sample graph showing each of the 4 phases of the FRP test summarized in 500 ms root mean square epochs. Data was recorded for approximately 15 seconds per participant as they slowly moved through each of the 4 positions of the FRP test.*

*Participant recruitment*

Prior to enrollment, study applicants were screened to determine whether they met the inclusion and exclusion criteria. They were provided with a copy of the informed consent and inclusion/exclusion criteria in several classes a few weeks in advance of the study. All study applicants provided written informed consent prior to participation. Participants were blinded to the manufacturer's claims for the product being tested, but they were able to observe the product if they were wearing it during the manual task.

*Product's Attributes*

The Serola belt (Serola Biomechanics Inc., IL, USA) was worn low around the waist, snuggly supporting the sacroiliac joints. (34) Participants that wore the belt watched a YouTube video demonstrating how to properly wear the belt before placing it on their waist. (35) For this study the researchers utilized 4 different sizes of the sacroiliac belts to ensure optimal fit for participants. Participants were encouraged to make sure the belt tightly supported their sacroiliac joints.

*Assessments*

The NMQ instrument is used to rate pain or discomfort in 12 bodily regions (eye, neck, shoulder, upper back,

*Figure 4.* Image of the sacroiliac belt worn by a participant. The bottom edge of the belt was located at the crease between the thigh and hip. The belt was pulled snug horizontally across the participants' hips. Then the posterior elastic straps on both sides were pulled anteriorly to further increase the belt snugness.

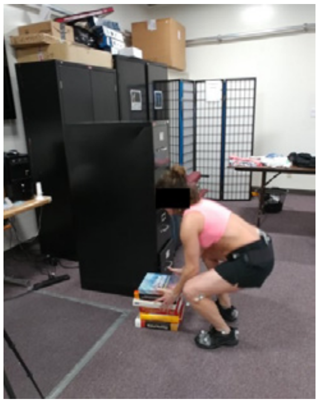

*Figure 5.* Manual labor task. The task consisted of participants placing several books on top of a 52″ filing cabinet and then back on the floor over and over at a rapid pace for 10 minutes. The intent of the task was to simulate an action a factory worker might engage in.

elbow, lower back, arm, wrist/hand, thigh, knee, calf, and feet/ankle) on a 5-point scale. On the scale "1" represents extremely comfortable and "5" represents extremely uncomfortable. (25-26) Although data was collected on all 12 regions at baseline and again at post-test, the focus of the study was limited to the upper back, lower back, and thigh. Researchers intentionally did not reduce the 12 questions to 3 questions in an attempt to make it less likely that participants would remember the exact numbers they filled out at baseline testing.

The Flexion-Relaxation Phenomenon (FRP) test is commonly used in low back pain research to assess the functional electrical activity of the lower back muscles. (36) During the test, the erector spinae is relaxed during quiet standing in most healthy participants. (37) As a participant eccentrically flexes forward (the flexion phase) muscle activity increases. When they are fully flexed (full flexion phase), muscle activity lowers, which is thought to be due to the elastic fibers in the erector spinae muscle supporting the weight of the upper torso. (38) Then as the participant concentrically moves back to the upright position (extension phase) muscle activity increases again. Patients with significant spine pain (36,39) as well as healthy controls that have had spine pain induced (40-41) demonstrate an aberrant FRP pattern or a generalized increase in muscle activity throughout the task due to muscle guarding. Participants were instructed to take approximately 3 seconds to bring their torso to a fully flexed position and to take another 3 seconds to return to an upright position. They were instructed to avoid touching their toes if they were flexible, and instead to bend at their waist as far as they could for the full flexion phase of the FRP test.

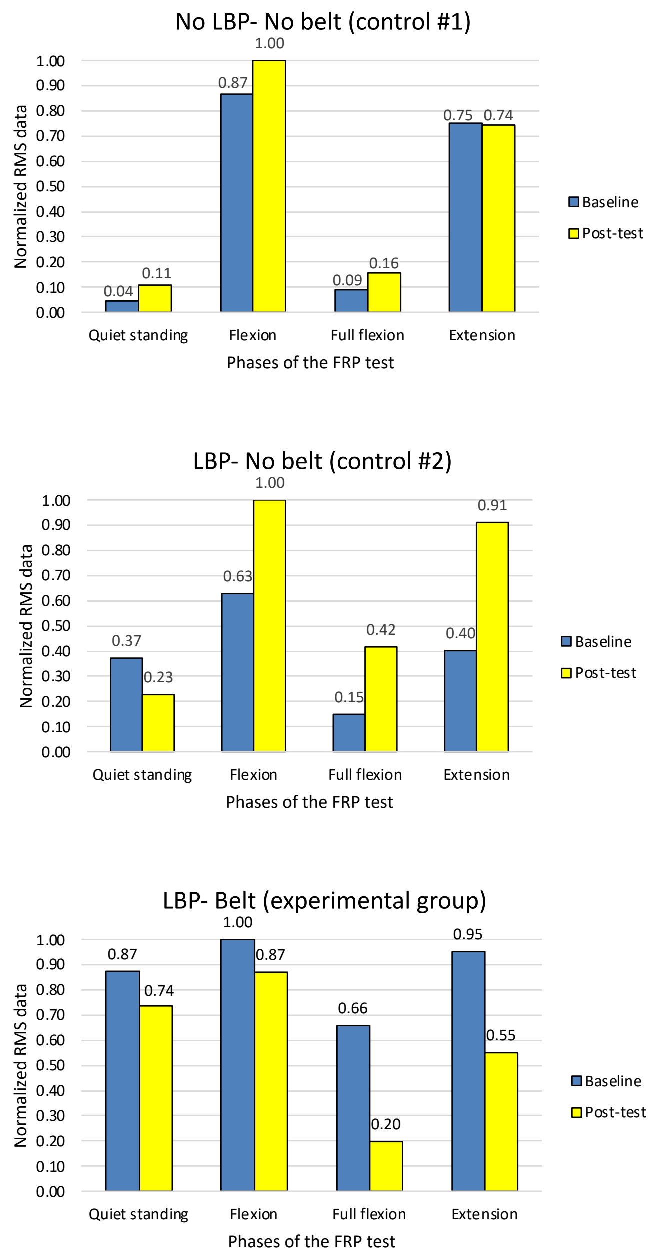


*Figure 6.* Baseline and post-test results for the surface EMG flexion relaxation phenomenon (FRP) test. All data normalized to highest sEMG reading per group amongst the four phases of the FRP test, pre and post. The LBP-No belt group demonstrated statistically significant increases in muscle activation patterns after the manual labor task for the full flexion ($p=0.024$) and extension ($p=0.004$) phases of the FRP test. This suggests that individuals in that group had to try harder to activate their lower back muscles after strenuous manual labor. The sacroiliac belt appeared to be protective against the need for trying harder to recruit the erector spinae for the FRP test.

***Table 2. Baseline and post-test results for the Numeric pain Rating Scale and Nordic Musculoskeletal Questionnaire pain/ discomfort (1-5) scale.*** *NRS compared between groups with an independent samples t-test. Other between group variables compared via one-way ANOVA. Within group variables analyzed through paired samples t-test.*

| | No LBP-no belt control group #1 | LBP-no belt control group #2 | LBP–sacroiliac belt Experimental group | p value |
|---|---|---|---|---|
| LBP NRS-base | | 3.6 + 1.5 | 4.2 + 1.0 | 0.238 |
| LBP NRS-post | | 3.7 + 1.8 | 3.6 + 1.0 | 0.906 |
| p value | | 0.669 | 0.070 | |
| Upper back NMQ-base | 1.81 + 0.98 | 1.69 + 0.60 | 2.25 + 0.77 | 0.125 |
| Upper back NMQ-post | 1.53 + 0.92 | 1.69 + 0.70 | 2.24 + 0.57 | 0.039* |
| p value | 0.189 | 1.00 | 0.977 | |
| Lower back NMQ-base | 1.25 + 0.45 | 2.75 + 1.06 | 3.06 + 0.85 | 0.000* |
| Lower back NMQ-post | 2.07 + 0.80 | 3.13 + 1.36 | 1.94 + 0.93 | 0.005* |
| p value | 0.001* | 0.287 | 0.002* | |
| Thigh NMQ-base | 1.13 + 0.34 | 1.06 + 0.25 | 1.63 + 0.89 | 0.014* |
| Thigh NMQ-post | 1.13 + 0.35 | 1.25 + 0.45 | 1.81 + 0.98 | 0.013* |
| p value | 1.000 | 0.188 | 0.456 | |
| **Data listed as mean + SD.** | | | | |

Surface EMG data was recorded using a Bagnoli 8 unit (Delsys, Natick, MA, USA) and was processed through a VICON motion analysis system (Vicon, Centennial, CO, USA). Data were recorded at 1,000 Hz and processed with a Butterworth filter. The ground electrode was placed on the left lateral malleolus. Root Mean Square (RMS) analysis was utilized to smooth data using 500 ms epochs as shown in figure 3. Final data were normalized in relation to the highest RMS value per phase out of the 4 FRP phases (baseline to post-test, per participant group) in a similar method as Harvey *et al.* (42)

*Statistical Analysis*

The data were exported from VICON as .csv files and initially organized and processed in Excel (Microsoft, Redmond WA, USA). The data were then placed in SPSS version 20.0 (IBM, Armonk, NY, USA) for analysis. Results were reported as mean + standard deviation (SD) unless otherwise specified.

A 1-way ANOVA compared groups anthropometric attributes at baseline. An independent samples t-test was used to compare pain levels between the 2 low back pain groups at baseline and again at post-test. A between-within ANOVA was used to compare dependent variables between the 3 groups at baseline and again post-intervention. An alpha level of $p < 0.05$ was considered statistically significant for all tests. Cohen's d was determined for all statistically significant interactions as recommended by Field to avoid overestimation of effect size. (43)

## RESULTS

This research project utilized a convenience sample of 48 study participants with 16 participants in each group and did not follow an a priori power analysis. No study applicants violated the inclusion/exclusion criteria for this experiment.

The study findings (Figure 6, Table 2) were that pain slightly increased at post-test for the LBP-no belt group (3.6 to 3.7; p=0.669) while pain decreased for the LBP-belt group (4.2 to 3.6; p= 0.070); however, neither value reached a statistically significant level. Upper back discomfort remained essentially stable for both LBP groups and improved slightly for the No LBP group (1.81 to 1.53; p=0.189). Lower back discomfort increased for the No LBP group (1.25 to 2.07; p=0.001) and the LBP-No belt group (2.75 to 3.13; p= 0.287), while it decreased for the LBP-belt group (3.06 to 1.94; p=0.002). Thigh NMQ was essentially not impacted across all groups.

The FRP results demonstrated that the no LBP group had a typical FRP graph at baseline and post-test. At post-test the LBP-belt group demonstrated reduced muscle activation patterns while the LBP-no belt group demonstrated larger sEMG activation patterns. Then as a result, that group may have needed to try harder to activate their tired and/or impaired muscles in the toe-touch task.

## DISCUSSION

Low back pain is a common cause of disability amongst workers. There are various structures that can be the origin of low back pain to include: disc, facets, sacroiliac joints, and lower back muscles. (44) It can lead to impairment in work performance as well as absenteeism. (45) It can be categorized as acute, subacute, transient, recurrent, or chronic. (46) Acute low back pain generally improves significantly over the initial 6 weeks, with slowed improvement thereafter. (46) Some cases of acute low back pain can transition to chronic low back pain which results in long-term impairments and is much more costly to the individual and society.

Research has not demonstrated a clear positive impact of lumbar support belts at reducing the risk of the first episode of low back pain. (47) However, some patients that have had low back pain do appear to benefit to some degree from support belts. (48) Researchers have additionally proposed there may be psychological, neuromuscular, and biomechanical benefits to wearing support belts. (49) The psychological benefits may come from the perceived benefit of wearing the belt. The neuromuscular benefits may be due to increased proprioceptive input from wearing a compressive belt. (50-52) The biomechanical benefits are believed to be a result of altered segmental kinematics from wearing the belt (i.e. they lift differently than before). (53-54)

Sacroiliac belts are worn lower than lumbar support belts as a low-risk form of self-care for low back pain. (52,55-56) As patients walk their sacroiliac joints engage in small amounts of motion. (57-58) Sacroiliac belts are marketed to add further support to the hips by wrapping around them tightly. (59,60) There is significantly less research on the impact of sacroiliac belts than there is on lumbar support belts.

The findings of this study were that lower back discomfort was reduced and that muscle guarding was decreased at post-test by participants wearing the sacroiliac belt during a manual labor task. Similar to this present study, Hammer *et al* observed subjective improvement in patient symptoms amongst participants that were wearing a sacroiliac support belt, but that there were only minor changes in muscle activation. (55) Further testing of sacroiliac support belts over multiple weeks is warranted to corroborate the true benefit of these findings demonstrated in this study.

Some future directions of research that may stem from this study are: 1) analyzing the belt in a longer duration multi-week study at reducing low back pain and sacroiliac pain, 2) comparing the sacroiliac belt directly to a lumbar support belt regarding its impact at lowering spine-related pain and symptoms as well as worker injury rates, and 3) comparing and contrasting various sacroiliac support belts to determine which is most beneficial.

*Limitations*

The participants in this study on average were in their 20s and were borderline overweight based on BMI charts. As a result, the participants in this experiment may not necessarily be reflective of what demographic may wear these products, thus impacting the study's external validity. This study only illustrates a 1-time snapshot of what would occur when wearing a support belt and does not necessarily represent what would occur when worn over several weeks during strenuous activities. This study tested only one sacroiliac belt and did not compare various other manufacturers' products against one another.

After the study was completed, we performed a post-hoc power analysis using G*Power version 3.1.9.2 (Universität Kiel, Germany) to determine the study's power. (61-62) Utilizing the NMQ lower back data to post-hoc analyze differences between two dependent means (matched pairs) for low back pain groups, utilizing 2 tails, an effect size of 0.5 (medium), alpha error probability of 0.05, and total sample size of 16, the power of the study was 0.604.

## CONCLUSION

These preliminary results suggest that the sacroiliac belt improved participants' lower back musculoskeletal discomfort level. Upper back and thigh discomfort, as well as low back pain were not impacted to a statistically significant level. Additionally, participants in the LBP-belt group demonstrated lowered muscle activity patterns during the FRP post-test suggesting muscle guarding may have been diminished to some degree by wearing a sacroiliac belt.

### Funding Sources and Conflicts of Interest

The Serola company provided nominal funding for this study at our lab.

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