Effect of Therapeutic Exercises on Sacroiliac Joint Pain and Asymmetry in Postpartum Women: A Randomized Controlled Trial

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Abstract

Background: Sacroiliac joint (SIJ) dysfunction is a frequently reported problem among both pregnant and postpartum women, that is accompanied by pelvic asymmetry. Because of its direct link with pelvic girdle and lumbopelvic pain, it is considered a debilitating condition that needs attention.**Purpose:** This study was conducted to determine the effect of a specific program of exercises on SIJ pain and asymmetry in women having SIJ dysfunction delivered by two different methods. **Methods:** Forty primiparous women, complaining of SIJ with an age ranging from 20 to 35 years, with a body mass index was less than 30 Kg/ m^2 and a waist/hip ratio of more than 0.85, were selected from Fakous general hospital outpatient clinic. They were randomly assigned according to their mode of delivery into two equal groups; group (A) which included women delivered vaginally with mediolateral episiotomy and group (B) which included women delivered with elective cesarean section. Both groups received a physical therapy program, including muscle energy technique, core stability exercises, and pelvic floor exercises, 3 times/week for 6 weeks in addition to instructions concerning SIJ pain. Evaluation of study outcomes was conducted using the visual analog scale, pressure algometer, and palpation meter to measure pain severity and threshold, pelvic tilting, and iliac rotation asymmetry, before and after 6 weeks of interventions. **Results:** Forty primiparous women were involved. They had mean ± standard deviation (SD) of age (years) and body mass index (Kg/ m2) of 26.5 ± 4.3 and 26.1 ± 1.9, respectively for the group (A) and 26.0 ± 3.9 and 25.7 ± 2.3, respectively for the group (B). At baseline, there was no statistically significant difference ($p > 0.05$) in any demographic data. There was a statistically significant difference ($p < 0.05$) in all study variables, comparing pretest to post-test results, and a significant difference between groups in favor of the vaginal delivery group (A).**Conclusion:** Performing an exercise program of muscle energy techniques, core stability exercises, and pelvic floor exercises could positively affect SIJ pain and asymmetry in postpartum women, regardless of their mode of delivery. Also, women delivered vaginally showed higher improvement than women delivered with elective cesarean section in terms of decreased pain severity and pelvic asymmetry as well as, increased pain threshold.

KeyWords: Therapeutic exercises, mode of delivery, iliac rotation asymmetry, sacroiliac joint, postpartum.

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Introduction

Sacroiliac joint (SIJ) dysfunction is a term used to describe the pain of the SIJ. It is usually caused by abnormal motion (i.e., hyper-, or hypo-mobile) or malalignment of the sacroiliac joint [1]. The prevalence of SIJ pain has been reported between 13-30%. Specifically, 13% of the individuals with low back pain have the origin of their pain from SIJ. In most women, pregnancy-related SIJ pain resolves with time after pregnancy, but in some females, the pain lingers on [2].

SIJ dysfunction in postpartum women often goes unreported due to the daily demands of motherhood, and they likely only seek medical care when the discomfort significantly impacts daily life. Patients with SIJ pain report some of the lowest quality-of-life scores of any chronic disease. There is also a large economic burden involved in treating chronic back pain [3]. Therefore, SIJ dysfunction in postpartum women perhaps is more prevalent than previously described. Thus, understanding the potential of continued SIJ dysfunction during the postpartum period can help healthcare providers educate patients on the signs and symptoms, which could lead to higher rates of interventions [4].

Optimal stability in the lumbopelvic region depends on an efficient interaction between active, passive, and neural subsystems. Altered dynamic stability of the lumbopelvic region could occur due to mechanical and hormonal changes during pregnancy. Hormonally induced ligament laxity associated with mechanical changes results in hypermobility of the SIJ that alters load transmission across pelvic joints and disturbs lumbopelvic stability [5]. These changes are reflected in the range of motion of the trunk, pelvis, lower limbs, and other body segments, affecting locomotion and some of these changes may persist to the postpartum period [6].

The pelvic floor muscles, another component of the local stabilizing system, in association with deep abdominal and multifidus muscles, play a critical role in lumbopelvic stability. Pelvic floor muscle insufficiency can occur because of pain, trauma, surgery, poor movement patterns, and childbirth [7]. Previous studies reported that compared with healthy subjects, pelvic floor muscles' endurance time decreases in patients with pregnancy-related low back pain. In addition, motor control of these muscles is altered in presence of SIJ pain [8]. Likewise, in cases of cesarean section, a disruption of the abdominal muscles' core occurs, leading to altered biomechanical properties of the pelvis. Thus, corrective specific stabilization exercises for core muscle activity following cesarean delivery can serve to address any biomechanical deficiencies and restore optimal function [9, 10].

Initial treatment for SIJ dysfunction consists of conservative management, including physical therapy, chiropractic care, and medical therapy. Non-steroidal anti-inflammatory drugs are typically utilized for pain relief. Once pain relief is attained, return to ambulation, utilizing assistive devices or physical therapy, is crucial to prevent a recurrence. With noted pelvic instability, a sacroiliac belt may be temporarily utilized for support [11]. Posture should also be corrected, and patients should be instructed on proper object lifting. Patients must also be educated on lifestyle modifications, including healthy weight and exercise. When conservative management fails to improve symptoms within 6 weeks, other treatment options are suggested, including intra-articular/peri-articular injections, nerve blocks, and radiofrequency [12].

Lumbar stabilization exercises and Kegel exercises are considered effective treatments for reducing low back pain, improving functional activities, and solving the urine leakage problem in postpartum women [13]. Additionally, muscle energy techniques have been proved to be effective in managing SIJ pain, increasing joint range of motion, and enhancing disability in patients with SIJ dysfunction, low back pain and joint hypomobility, compared to conventional therapy of ultrasound and transcutaneous electrical nerve stimulation [14].

Several studies have reported the effects of core stability exercises on the pain and range of motion of postpartum women with low back pain and SIJ dysfunction. Also, few studies have examined the effects of pelvic floor exercises on cases of low back pain. Though studies are scarce regarding the effect of a specific exercise program, consisting of muscle energy technique, core stability exercises, and pelvic floor exercises, on the pelvic biomechanical aspects. So, this study aimed to investigate the effect of that exercise program on the SIJ pain, pelvic tilting, and iliac rotation symmetry of postpartum women with SIJ dysfunction.

Subjects and Methods

Study design and settings

This study was carried out as a prospective pre-test post-test, randomized controlled trial. The study was approved by the research ethical committee of the faculty of physical therapy, Cairo University, before starting the study [No: P.T.REC/012/002985]. Each woman signed informed consent before starting after knowing the study's aim, and nature and explaining the procedures. They were informed of their rights to refuse or discontinue at any time. The study was done at Fakous general hospital outpatient clinic, Sharkia between July 2020 to December 2021.

Participants

Fifty-six primiparous postpartum breastfeeding women were initially selected as a convenient sample among those having right-sided SIJ dysfunction from the outpatient clinic of Fakous general hospital. Their ages ranged from 20 to 35 years and their body mass index (BMI) was < 30 Kg/m2 and their waist/hip ratio (WHR) was > 0.85. They were included in study 3-6 months after delivery by either vaginal delivery with mediolateral episiotomy or by elective lower segment C-section with spinal anesthesia.

They were screened for eligibility and women with ongoing pregnancy, previous abortions, assisted vaginal delivery, third or fourth-degree perineal tear during labor, leg length discrepancy, feet deformities, having a history of previous surgeries in the pelvis or back, serious spinal injury before or at time of the study (disc prolapse, spondylolisthesis), history of a systematic disease (e.g., preeclampsia, diabetes mellitus), depression or postpartum depression, women who had preterm labor (before 37 weeks) and twins, who underwent cesarean delivery after starting the delivery process, who had a newborn with a birth weight more than 4000 grams and those who received treatment for SIJ pain in the last three months were excluded from the study.

Study interventions

All women in both groups received an exercise program composed of muscle energy techniques, core stability exercises, and pelvic floor exercises, 3 times/week for 6 weeks in addition to instructions concerning SIJ pain.

Muscle energy technique: each woman was asked to isometrically contract the agonist muscle (i.e., iliopsoas and lower back muscles) for 10 seconds then relax for 2-3 seconds. Following that, the examiner stretched the contracted muscle in the opposite direction for 10 seconds. The procedure was repeated 3 times for each muscle [15].

Core stability program: each woman performed a series of five exercises, presented in random order. Each exercise was done for 10 repetitions, holding each position for 10 seconds. The exercises involved a supine bridge, prone cobra, side bridge, quadruped drawing in maneuver, and diagonal crunch [16], Figure 1.

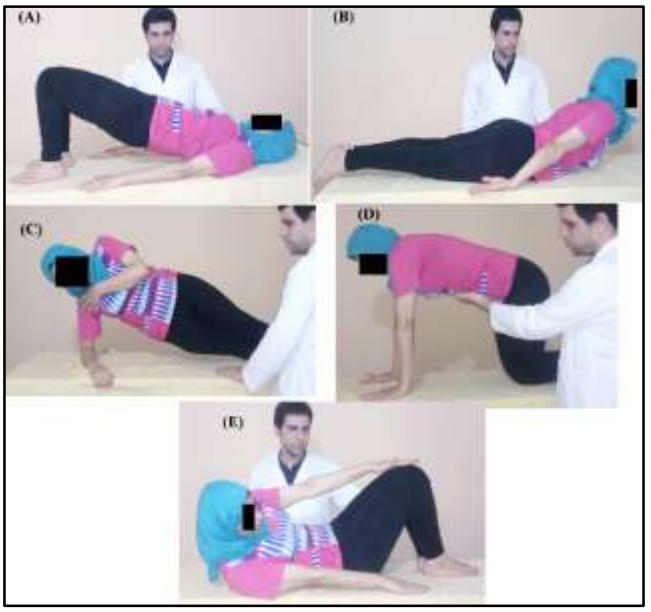

Figure 1. Core stability exercises;**(A)** supine bridge, **(b)** prone cobra, **(c)** side bridge, **(d)** quadruped drawing in maneuver, and **(e)** diagonal crunch.

Pelvic floor exercises: the woman assumed the crock-lying position with only one stretched layer of clothes on her lower abdomen to allow clear observation for the lowering of the lower abdomen and thighs. Thighs were slightly apart to avoid substitution by the hip adductors. While standing beside the woman at the level of her pelvis, both hands of the therapist were under the glutei with the tips of fingers around the anus. The therapist's eyes were looking at the lower abdomen to observe the contraction of the pubo-vaginalis part. The woman was asked to contract as if she controls bowel action, urethral orifice to draw the vagina up, concentrate in this action, to hold then to relax. This exercise was done for 10 repetitions [17].

Outcome measures

A detailed history was taken from each woman in both groups, involving age, BMI, waist/hip ratio as well as past, present, and obstetrical history were

obtained from each woman and were kept in adatasheet. Measurements were performed by the same investigator, who was blinded to the patients' group distribution to assure standardized conditions and decrease the risk for bias. Assessment of the study outcomes was done pre and 6 weeks post-treatment. The primary outcomes for this study were SIJ pain severity measured by the visual analog scale (VAS), and pain threshold, measured by the pressure algometer. The secondary outcomes were iliac rotation asymmetry and pelvic tilting, both of which are assessed by palpation meter (PALM).

Pain severity assessment: Pain was assessed using VAS which allows for continuous data analysis by using a 10 cm line with 0 "no pain" written at one end and 10 "worst pain" on the other end. Each woman was asked to mark a point on the line that represented her intensity of pain [18].

Pain threshold assessment: The Baseline 1200-304 (Push-Pull Force Gauge®, Fabrication Enterprises, Inc.) handheld pressure algometer was used for evaluating the patients' pressure pain threshold (PPT), defined as the amount of pressure required to elicit a sensation of pain distinct from pressure or discomfort. To understand the measurement process, a measurement trial was performed using the algometer on the woman's hand to coach her on how to differentiate between tactile and painful stimuli [19].

Then, the algometric measurements were performed from the prone lying position to measure the PPT perceived at the level of the right posterior inferior iliac spines. The algometer probe was lowered at a constant rate of approximately 1 lb./s and the woman was instructed to report when her sensation of "merely pressure" changed to the beginning of pain. Reaching that point, the algometer pressure was immediately released, and the plunger was retracted by the therapist. Two algometer measurements were taken and averaged, with a 30-second interval between each [20], Figure 2.

Assessment of anterior pelvic tilt and iliac rotation asymmetry: Before the measurements were taken, the woman was asked to stand erect with a one-foot distance between her feet, and to uncover the lumbosacral area, with arms crossed over her chest. The therapist stood facing her side with the PALM suspended at his neck by the adjustable cord to free his fingers for holding PALM's arms.

Figure 2. Measuring PPT with the algometer

Anterior pelvic tilt was measured bilaterally from both sides (right and left) by placing the pad of the index finger of each hand on the caliper tip to guide into proper contact with the ipsilateral anterior and posterior superior iliac spines (ASIS and PSIS). Then, the degree was read from the inclinometer scale. ASIS was located about 45 degrees inferior and laterally to the umbilicus and `PSIS was seen as a large dimple located when traced the ilium around from the ASIS to the woman's back. The mean of both sides' measurements [(right side + left side)/2] was defined as anterior pelvic tilt angle, while the difference between them (right-left) was defined as iliac rotation asymmetry [21], Figure 3.

Figure 3. Measuring of the pelvic tilt angle using PALM.

Dataanalysis

All statistical measures were performed through the statistical package for social studies (SPSS), version 23 for Windows. Data were checked for normality and homogeneity of variance and results showed that the data were normally distributed. Data were expressed using mean, and standard deviation (SD). The percentage of change was calculated by assessing the pre-post treatment difference value for each group and comparing it between both groups using the independent samples t-test to detect the effect size. A two-way repeated measures ANOVA was conducted to detect the effect of time, tested group, and the interaction between the tested group & time factors. Then, multiple pairwise comparison tests were conducted to compare pre and post-test results within and between groups. The level of significance for all statistical tests was set at $p < 0.05$.

Results

In this study, fifty-six postpartum women having right-sided SIJ pain were selected and checked for eligibility criteria. Four women refused to participate, while 12 women were excluded due to high BMI, spinal problems, and history of previous abortion. A total of 40 women were involved and continued study assessment and treatment procedures. They were assigned into 2 groups (n=20 for each).

Physical characteristics of the women

The mean ± SD for demographic data of all women in both groups is presented in Table 1. Test results showed no statistically significant difference in the mean values of any of the physical characteristics between groups.

Table 1. Physical characteristics for all patient women for both groups (A&B).

Variables	Group	Mean	±SD	t-value	P-value*
Age (yrs.)	Group (A)	26.50	±4.273	0.384	0.703
	Group (B)	26.00	±3.960		
Height (cm)	Group (A)	158.90	±6.077	0.786	0.437
	Group (B)	157.70	±5.155		
Weight (kgs.)	Group (A)	65.75	±5.533	1.056	0.298
	Group (B)	63.80	±6.135		
BMI (kg/m^2)	Group (A)	26.06	±1.916	0.488	0.628
	Group (B)	25.74	±2.276		
Waist-to-hip ratio	Group (A)	0.905	±0.054	0.888	0.380
	Group (B)	0.917	±0.034		

SD: standard deviation, **P:** probability, ***:** significant at $P < 0.05$

Two-way repeated measures ANOVA

Table 2. shows the values of two-way repeated measures ANOVA for the study variables. Results revealed that there were significant between-subject (group (A) / group (B)) and within-subject (pre-test/post-test) effects for all study variables (pain severity and threshold, the degree of anterior pelvic tilt, and iliac rotation asymmetry). Also, there was a significant interaction between the two independent variables (tested group & time factors).

Table 2. A two-way repeated measures ANOVA of the different study variables in both groups.

Variables	Tested group factor		Time factor		Group× time interaction	
	F-value	P-value	F-value	P-value	F-value	P-value*
VAS	25.372	0.001	68.392	0.001	9.154	0.004
PPT	21.411	0.001	43.158	0.001	6.459	0.015
Pelvic tilt angle	8.251	0.007	46.895	0.001	9.362	0.004
Pelvic asymmetry	9.042	0.005	35.481	0.001	5.366	0.026

VAS: visual analog scale; **PPT:** pressure pain threshold; **F:** two-way repeated measures ANOVA value; **P:** probability; ***:** significant at $P < 0.05$.

Study dependent variables:

The mean ± SD of pre and post-treatment values of pain severity and threshold as well as the degree of pelvic tilting and iliac rotation asymmetry in both groups (A&B) is presented in Table 3. Considering the pairwise test results, there were significant differences ($P < 0.05$) comparing pre and post-test values within both groups (A&B) for all variables. In comparing both groups, there was a statistically significant difference ($P < 0.05$) between both groups in all study variables in favor of the vaginal delivery group (A), compared to the cesarean delivery group (B).

Table 3. Pairwise comparison tests of the different study variables for both groups (n=20 for each).

Variables	Statistics	Mean ±SD		P-value*
		Vaginal delivery group	Cesarean section group	
VAS	Pre	6.15±1.424	7.35±1.531	0.014
	Post	3.35±1.496	6.05±1.356	0.0001
	MD (%)	-2.80 (45.52 % ↓)	-1.30(17.68% ↓)	
	P-value	0.0001	0.001	
PPT	Pre	5.07±1.482	3.88±1.623	0.020
	Post	7.45±1.558	4.93±1.367	0.0001
	MD (%)	2.37(46.94 % ↑)	1.05(27.06% ↑)	
	P-value	0.0001	0.007	
Pelvic tilt angle	Pre	17.50±2.856	19.20±2.330	0.046
	Post	15.80±2.353	18.55±2.459	0.001
	MD (%)	-1.70(9.71% ↓)	-0.65(3.38% ↓)	
	P-value	0.0001	0.011	
Pelvic asymmetry	Pre	2.65±1.663	3.70±1.525	0.044
	Post	1.40±1.095	3.15±1.814	0.001
	MD (%)	-1.25(47.16% ↓)	-0.55(14.86% ↓)	
	P-value	0.0001	0.014	

SD: standard deviation; **MD (%):** mean difference (percentage change); **VAS:** visual analog scale; **PPT:** pressure pain threshold; ***:** significant at $P < 0.05$.

Measuring the percentage of change

The vaginal delivery group (A) showed a statistically significantly greater improvement than the cesarean section group (B) in all aspects of the study, as revealed by the independent samples T-test, Table 4.

Table 4. Independent t-test for percentage change of the different study variables between both groups.

Variables	Groups	X̄ ± SD	MD (%)	T- VALUE	P-VALUE*
VAS	Vaginal delivery	-2.80±1.823	1.50 (53.57 %)	-3.026	0.005
	Cesarean section	-1.30±1.260			
PPT	Vaginal delivery	2.37±1.929	1.32 (55.69 %)	2.541	0.016
	Cesarean section	1.05±1.308			
Pelvic tilt angle	Vaginal delivery	-1.70±1.128	-1.05 (61.76%)	-3.060	0.004
	Cesarean section	-0.65±1.039			
Pelvic asymmetry	Vaginal delivery	-1.25±0.716	-0.70 (56 %)	-2.316	0.027
	Cesarean section	-0.55±1.145			

x̄: mean; **SD:** standard deviation; **MD (%):** mean difference (percentage of change) **T:** independent t-test; **VAS:** visual analog scale, **PPT:** Pressure pain threshold; ***:** significant at P < 0.05.

Discussion

The present study showed that our exercise program was effective for both groups in improving SIJ pain as they demonstrated a significant decrease in VAS and an increase in pressure algometer scores between pre and post-treatment values within each group, with greater improvement in the vaginal delivery group. Also, there was a significant improvement in iliac rotation asymmetry and pelvic tilting angle in both the vaginal delivery and cesarean section groups, with more improvement of the asymmetry in the vaginal delivery group.

The program of exercises applied in the current study was comprised of muscle energy techniques, core stability exercises, and Kegel exercises. The improvement in both pain severity and threshold observed in the study in response to the applied exercises was previously reported by Shawky et al. [22], and Rana et al. [23]. Both concluded that the muscle energy technique could be utilized as an effective treatment in post-partum females with SIJ dysfunction to decrease pain and disability [22,23]. Similarly, García-Peñalver et al. [24] reported that the muscle energy technique had a significant effect on the management of sacroiliac joint dysfunction in athletes with SIJ dysfunction. Additionally, Kumar et al. [25] reinforced the effectiveness of muscle energy techniques in diminishing pain and disability in post-partum females with chronic low back pain when given 3 times a week for 3 weeks. These beneficial effects of the muscle energy techniques could be explained by Sachdeva et al. [26], who suggested that intense muscle contraction, as opposed to an equivalent counterforce, triggers the Golgi tendon organ. The afferent nerve impulse from the Golgi tendon organs arrives at the dorsal root of the spinal cord and encounters an inhibitory motor neuron. This leads to a consequent decrease in the tone of the agonist's muscle afterward, causing what is known as post-isometric relaxation.

Regarding the significant decrease in pain severity and increased PPT observed in both groups engaging in the lumbar stabilization protocol, these findings were confirmed by Suh et al. [27]. They found that a program of 5-minute stretching and 25-minute lumbar stabilization exercises, practiced for 6 weeks, could greatly improve low back pain at rest and during activity, decrease medication intake, and increase exercise frequency. Also, Hlaing et al. [28] concluded that back pain and functional disability reduction together with improved balance, proprioception, and increased core muscle thickness could be obtained after 4 weeks of core stabilization exercises. These findings were explained by Van Criekinge et al. [29], who claimed that core stabilizing exercises restore spinal muscles' symmetry and increase back muscles' strength. Also, that type of exercise causes sensory and motor receptor stimulation that improves neuromuscular control and increases spinal stability [30].

The added effect of Kegel exercises for SIJ pain relief was documented by Afrin et al. [13], who stated that lumbar stabilization exercises and Kegel exercises had a significant effect on reducing low back pain, improving functional activities, and solving the urine leakage problem in postpartum women. Moreover, Ehsani et al. [7] concluded that the transverse abdominis and pelvic floor muscles' activities improved in women with postpartum low back pain, who performed specific lumber stabilization exercises. The link between pelvic floor weakness and spinal problems was proved by the findings of Arab et al. [31], who deducted that individuals with low back pain have a significant decrease in pelvic floor function compared to healthy individuals.

Concerning the post-treatment biomechanical alternations, represented by iliac rotation and pelvic tilting, Sanika et al. [32] stated that a 4-week exercise program of gluteus maximus activation, flexion bias exercise program, and muscle energy technique was effective in enhancing functional

activities, decreasing pain and standardization of pelvic tilting angle in subjects with frontally rotated SIJ dysfunction. Furthermore, Carpes et al. [33] conducted a pilot study to explore the impact of a training program, to increase muscle strength and endurance, on spinal and pelvic kinematics. They found an increase in trunk rotation as well as right pelvic tilting, while lumbar lordosis decreased [33]. That finding agreed with that of the present study as anterior pelvic tilting significantly decreased in both groups following the exercise program, indicating less degree of lumbar lordosis.

Pelvic asymmetry was found in women of both groups, regardless of the mode of their delivery. Women have relatively small and flat SIJs and combined with the hormonal weakening of the ligaments, those two factors could increase the possibility of joint alignment distortion and augment pelvic asymmetry during pregnancy. This constitutes a risk factor for pregnancy-related SIJ pain during pregnancy and after childbirth Morino et al. [34]. On the other hand, the discrepancy noticed between groups both pre- and post-treatment could be attributed to the nature of the cesarean section mode of delivery. C- section involves the incising of abdominal muscles that represent a critical part of dynamic stability. Doing so could inevitably cause pelvic biomechanical changes, and muscle tension alterations [35].

The present study has multiple strength points. The tools used for the assessment are valid and reliable, which helped with the accuracy of the results. The examiner was independent of the study protocol which decreased the risk for bias. Also, the study protocol of treatment combined many exercise forms, all of which are known for their beneficial effects on SIJ dysfunction. Though, the study had some limitations. The study lacks a period of follow-up, which could help with assessing the interventions' long-term effects. Future research may concern collecting more demographics for the patients delivered by different modes to assist with finding an association between the mode of delivery and the study variables.

Conclusion

This study concluded that postpartum women with right-sided SIJ pain delivered by elective lower segment cesarean section with spinal anesthesia had greater SIJ joint pain, anterior pelvic tilt, and iliac rotation asymmetry than vaginal delivery with mediolateral episiotomy. Also, an exercise program composed of muscle energy techniques, core stability exercises, and pelvic floor exercise, performed 3 times a week for 6 weeks, in addition to instructions concerning SIJ pain, was an effective method for improving SIJ joint pain, anterior pelvic tilt and iliac rotation asymmetry in postpartum women with right-sided SIJ pain regardless their mode of delivery, with women vaginally delivered showing greater improvement than those delivered by cesarean section in all aspects.

Author Contributions

EL-Sayed R. Teaima: Research concept and design, data collection, statistical analysis, interpretation of data, preparation & critical review of the manuscript. **Amal M. Youssef:** Research concept and design, data collection, statistical analysis, preparation of the manuscript.**FahemaMetwallyOkeel:** Research concept and design, interpretation of data, preparation & critical review of the manuscript.**Kamelia Ibrahim Attia Ali:** Research concept and design, interpretation of data, preparation & critical review of the manuscript.**Mahitab M. Yosri:** Data collection, interpretation of data, preparation & critical review of the manuscript.

Conflict of interest

Authors declare no conflict of interest.

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