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The Effect of Lumbar Stabilization Exercise on Pain, Muscle Morphology and Quality of Life in Women with Chronic Menstrual Back Pain

Yu-Jeong Jeong[a], Jang-hoon Shin[b], Wan-hee Lee[b*]

[a]Manual Therapy room, Baraem Clinic, Seoul, Republic of Korea
[b]Applied Physical Therapy Lab, Department of Physical Therapy, College of Health and Welfare, Sahmyook University, Seoul, Republic of Korea

Objective: The purpose of this study was to determine the effect of lumbar stabilization exercise son quality of life, muscle morphology, and pain in women with chronic menstrual back pain.

Design: Randomized controlled trial

Methods: Twenty-eight women with chronic dysmenorrhea were randomly assigned to a lumbar stabilization exercise group or stretching group. Both groups exercised 3times a week for 30 minutes each session for 10 weeks. For effect analysis, quality of life was checked by SF-36, back pain was checked by Oswestry Disability Index(ODI), muscle thickness was checked using Rehabilitative Ultrasound Imaging(RUSI), and pain was checked by Visual Analog Scale(VAS).

Results: As a result of SF-36, there was a significant increase in the time and interaction effect in physical function, vitality, general health, and physical pain($p < 0.05$). In ODI, the lumbar stabilization exercise group showed a significant decrease in time and interaction effects compared to the stretching group($p < 0.05$). Core muscle thickness increased significantly compared to the stretching group in the group, time, and interaction effects($p < 0.05$). Back pain was significantly reduced in the group, time, and interaction effects in the lumbar stabilization exercise group compared to the stretching group($p < 0.05$).

Conclusions: Lumbar stabilization exercise is more effective for quality of life, muscle structure, and pain in women with chronic menstrual pain. This result can be used as data to control back pain during menstruation and provide long-term exercise for women with chronic menstrual pain without side effects.

Key Words: Lumbar stabilization, Chronic menstrual back pain, Quality of life, Muscle morphology

Introduction

The phenomenon in which the endometrium is shed every month at regular intervals in women of childbearing age is called menstruation, and one of the symptoms related to this is menstrual pain, which is a common symptom that occurs in most women who menstruate (34-90%) regardless of race[1-4]. Menstrual pain is mainly divided into primary menstrual pain and secondary menstrual pain[5]. Primary dysmenorrhea is pain experienced during menstruation by women with normal pelvic anatomy. It mainly occurs in adolescence[6], increases in prevalence between ages 15 and 17, and peaks between ages 20 and 24[7]. Menstrual pain lasts for 12-72 hours and is similar to the intensity of pain during childbirth. It is accompanied by symptoms such as depression, cramping pain starting from the pelvis and lower abdomen and radiating to the thighs, diarrhea, vomiting, fainting, headache and back pain, fatigue, dizziness, irritability[8, 9]. Although

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Corresponding author: Wan-hee Lee (**ORCID** https://orcid.org/0000-0001-8030-4853)
Applied Physical Therapy Lab, Department of Physical Therapy, Sahmyook University College of Health Science, Republic of Korea
815, Hwarang-ro, Nowon-gu, Seoul, 01795 Rep. of Korea
Tel: +82-2-3399-1633 **Fax:** +82-2-3399-1639 **E-mail:** whlee@syu.ac.kr

this pain is not life-threatening, it lowers a woman's quality of life, impairs her work performance, and causes continuous absence from society[10].

Among these symptoms of menstrual cramps, back pain is the third most common and is experienced by 46% to 56% of women of childbearing age[11], and the proportion increases with age[12]. In general, back pain is a common adult health problem experienced by 70% to 85% of the population[13], especially 10% to 56% of young adults[12]. Because this causes limitations in physical function and occupational activities, reduces quality of life, and causes socioeconomic losses, prevention of back pain through exercise is on the rise[14].

Since it may be difficult for women with severe menstrual pain to go out to come to the treatment room, a home exercise program consisting of 10 minutes of stretching, 20 minutes of aerobic exercise such as walking or riding a bicycle, and 10 minutes of cool-down exercise resulted in reduced pain. It was also confirmed that it improved overall quality of life[15]. In addition, women with primary menstrual pain were divided into a group that massaged the pelvis and abdomen using lavender oil for two menstrual cycles, and a group that performed isometric exercises on the thigh muscles, abdomen, and pelvic floor muscles twice a day, three times a week for a total of eight weeks. Comparing the effects, it was confirmed that pain and pain duration decreased from the second and third menstrual cycles in both groups, but anxiety levels decreased after the third menstrual cycle in the massage group[16].

On the other hand, vigorous exercise, including treadmill and abdominal strength training applied at an intensity of 70-85% MHR, rather than gentle exercise as above, reduces pain and improves quality of life such as physical, emotional, mental health, social function, and vitality in women[17]. Summarizing these studies, it was confirmed that exercise, a non-pharmacological intervention method rather than medication, helps improve pain and quality of life in patients with primary dysmenorrhea.

Patients with back pain present with weakness in the trunk and abdominal muscles and weakness[18, 19] or insufficient control of deep muscles such as the MF and TrA[20].These muscles are called core muscles, and core muscles are divided into two groups. One is deep muscles such as the MF and TrA, and these muscles provide stability to the spinal segments by activating a co-contraction mechanism[21]. The second group is the superficial muscles, such as the RA, IO, and EO[22], which are not directly attached to the spine but provide additional spinal stability by connecting the pelvis to the ribcage. To offset external forces affecting the spine, these muscle groups must produce high torques[20, 22, 23]. When these core muscles function normally, they can maintain the stability of spinal segments, protect the spine, and reduce stress affecting the lumbar spine and discs. Therefore, their role is important[19].

Lumbar stabilization exercises are often used clinically to strengthen core muscles. Lumbar stabilization exercise is an exercise that helps maintain balance and posture control of muscles around the waist by restoring the function of deep muscles, and improves back pain by reducing stress on the spinal structure[24]. Among those experiencing back pain, lumbar stabilization exercises, stretching, taping, and manual therapy were performed as physical therapy interventions for women who complained of back pain during their menstrual period. However, there is still insufficient research on treatment protocols for women who experience back pain during menstruation.

Accordingly, this study aimed to investigate back pain and muscle structural changes during menstruation through lumbar stabilization exercises and stretching, which are among the physical therapy interventions that can be performed on one's own without the help of others, and to determine how these affect the quality of life. It is judged that this study will help manage back pain during menstruation using non-pharmacological methods and reduce discomfort in daily life.

Method

Participants

This study recruited 37 women aged 20 to 24 from Gaksi dance academy located in Yangcheon-gu, Seoul, who suffered from primary dysmenorrhea and suffered from back pain during their menstrual period, by distributing leaflets one month before the start of the experimentin July, 2019. To select subjects for the experiment, a visual index test based on back pain during the menstrual period was performed, whether or not they performed regular exercise, menstrual cycle, presence or absence of anemia, presence or absence of back pain during periods other than the menstrual period, whether or not they were taking contraceptives, and aquestionnaire was used regarding experience with pelvic orspinal diseasesand the presence or absence of reproductive system diseases. Through this screening test, 30 subjects were selected, and the specific selection criteria were those who had no experience of childbirth, did not normally do any other exercise, had a regular menstrual cycle (more than 3 months, 25-35 days), and did not have anemia. Those with a VAS score of 4 or higher based on back pain during menstruation. Exclusion criteria were those with irregular menstrual cycles, those taking oral contraceptives, those with reproductive system diseases, those who exercised regularly, those who had undergone spinal surgery, and those with a history of fractures in the spine or pelvis.

The sample number of experimental subjects was calculated using the sample number calculation program (G*Power, 3.1), and the mean and standard error values of the Oswestry Back Pain Disability Scale measured in the previous study were entered to obtain a power of 98%, significance level of 0.05, and sample size of 98%. The number of people was 26. In this study, the final sample size was calculated to be 30 people considering dropout, and to randomly assign study subjects to each group, 30 pieces of paper with 'S' or 'E' written on them were placed in a box and a lottery was made. The subjects were divided into 15 people in the stretching exercise group and 15 people in the lumbar stabilization exercise group. The experiment started with 30 subjects, but during the experiment, one person dropped out of the lumbar stabilization exercise group due to difficulty in adjusting the schedule, and one person dropped out of the stretching exercise group due to a long trip, resulting in a total of two people dropping out.In the end, 28 people participated in the study, and after fully explaining this study to the subjects in advance so that they could understand, and explaining that they could stop the study at their own volition, consent forms were obtained. This study was conducted with approval from the Institutional Review Board of Sahmyook University (IRBNo. 2-7001793-AB-N-012019 072HR).

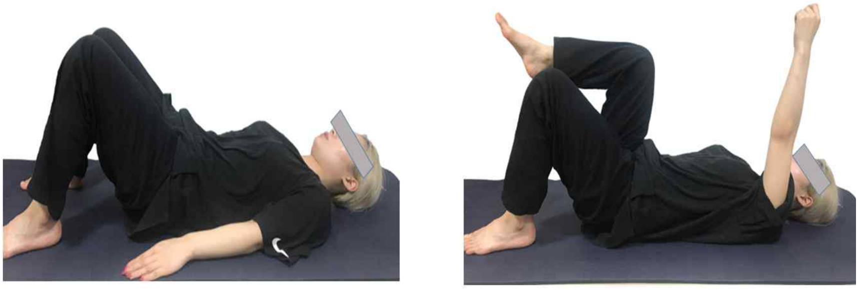
Procedure

Subjects who expressed their intention to participate in the study and signed a consent form underwent a pre-examination based on the most painful day among the first three days of the first menstrual cycle. Tests included VAS, rectus abdominis (RA), transverse abdominis (TrA), multifidus (MF), external oblique (EO), internal oblique (IO) muscle thickness measurement using rehabilitation imaging ultrasound, Oswestry Low Back Pain Disability Scale test, and SF-36. After 10 weeks, a post-test was performed the same as the pre-test based on the most painful day among the first 3 days of the third menstrual cycle. Pre- and post-tests were conducted identically at the location where the experiment was conducted. As for the exercise program, the stretching exercise group performed a stretching exercise program 3 times a week for 30 minutes per session, and the lumbar stabilization exercise group performed a lumbar stabilization exercise program 3 times a week for 30 minutes per session. During the exercise period, the participants rested for a week during the menstrual period every month, and the experiment was repeated after the menstrual period ended, so the actual period of exercise program implementation was 8 weeks.

Exercise program

1. Lumbar stabilization exercise

To reduce errors due to the participant's lack of understanding of the lumbar stabilization exercises in this experiment, belly pulling exercises were performed once in a supine position before the experiment.In addition, each subject exercised while watching the ultrasound image until they were able to perform accurate contractions. Afterwards, when they were able to exercise voluntarily without looking at the ultrasound image, the exercise of pulling the belly button and moving the limbs at the same time was



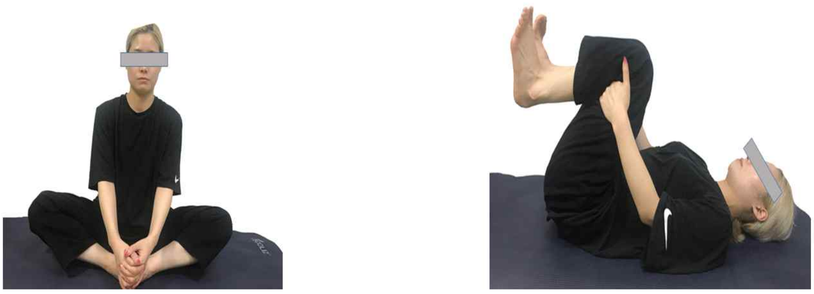
Pulling belly Moving the limbs asymmetrically pulling belly

Figure 1. lumbar stabilization exercise

added.The level of difficulty was raised according to the individual, and the progression from easy to difficult progressed through the stages of moving the arms while pulling the belly button, moving the legs while pulling the belly button, and moving the arms and legs asymmetrically simultaneously while pulling the belly button.Each movement was held for 7 seconds for a total of 20 minutes of spine stabilization exercise, and as a finishing exercise, deep breathing and abdominal breathing were performed for 10 minutes in a lying position (Figure 1)[25].

2. Stretching exercise

The study subjects were educated about exercise once before the exercise, and then a total of five stretching movements were performed. Butterfly pose, where you sit with your feet together, pulling your knees toward your chest while lying down, spinal twist pose where you lie on your back and cross your legs to the other side, and down dog pose, where you put the soles and palms of your feet on the floor and raise your buttocks and hold them, the posture of relaxing the quadriceps muscle, holding the wall with one hand and bending the opposite leg behind the hip, was maintained for 15 seconds each for a total of 20 minutes. Afterwards, the finishing exercise was abdominal breathing for 10 minutes in a lying position (Figure 2)[13].



Butterfly pose Pulling the knees toward the chest

Spinal twist pose Downward-facing dog, standing Quadriceps stretching

Figure 2. stretching exercise

Experimental protocol

1. Pain

Pain test was performed using aVAS. A 10cm horizontal line was drawn on the paper, and the scale was marked from 0 to 10, with 0 being 'no pain at all' and 10 being 'pain enough to kill' to indicate the degree of pain[26]. The test-retest reliability of the test method used in the study was ICC = -0.97[27].

2. Muscle thickness

Muscle thickness was measured using rehabilitation imaging ultrasound (MySono U5, Samsung Medison, Seoul, Korea, 2010). Regarding the reliability of this test, the interrater reliability ICC was 0.87–0.97, while the intra-rater reliability ICC was 0.78–0.95 in younger people[28]. Ultrasound imaging used B-mode, curvedprobe, and a frequency of 47 to 63 Hz. In this study, the EO, IO, TrA, RA, and MF muscles were measured at rest and maximum contraction. When measuring the EO, IO, and TrA muscles, a foam roller with a diameter of 15 cm and a length of 90 cm was placed under the knee, and the probe was placed vertically on the mid-abdomen between the border of the 11th rib cartilage and the ilium gap. Resting muscle thickness was measured at the end of the subject's exhalation. Muscle thickness during contraction is measured at the end of exhalation while inserting the belly button. For the EO, IO, and TrA muscles, the thickness was measured by drawing a vertical line within 2 cm from the vertex of the medial fascia[29]. In the case of the RA muscle, the thickness was measured by placing a ruler horizontally above the navel and drawing a vertical line within 2 cm of the starting border from the linea alba of both abdominal muscles. At this time, resting muscle thickness was measured at the end of exhalation. The contraction thickness was measured in the same manner as the resting period at the end of exhalation in a position with the navel in full position. In the case of the MF muscle, a pillow was placed under the abdomen to gently soften the lower back, a probe was placed horizontally at the level of L4, and measurement was performed at the end of breathing during resting period[30]. In the case of contraction thickness, it was measured at the end of exhalation while the opposite arm was held open at 120 degrees. All muscles were measured three times at rest and during contraction, and the average value was derived[31].

3. Quality of life

The ODI is an index consisting of 10 items that indicates the degree of disability felt by the patient on a scale of 0-5, which was converted into a percentage and compared. It consists of items such as current pain level related to movements related to daily life, self- care such as bathing and dressing, lifting objects, walking, sitting, standing, sleeping, social life, and travel. The ODI questionnaire used was the Korean version, and lower scores indicate improved function. The intra-examiner reliability was r = 0.9168 and the test-retest reliability was r = 0.9332[32].

4. SF-36(Short-form 36 item health survey)

SF-36 consists of 36 items in 8 categories. The 8 items indicating health level are expressed on a Likert scale, and each item is summed and converted into a score. The physical health domain of physical function, physical role limitations, physical pain, and the mental health domain of vitality, social functioning, role limitations due to emotional problems, and mental health[33]. A higher score means better function. The SF-36 used in this study is the Korean version, and the reliability for each domain is r = 0.69 - 0.92. The presence of a psychological disorder can be identified using a threshold of ≤ 38 in the mental health domain of the SF-36, which is equivalent to probable major depressive disorder or possible generalized anxiety disorder, and the sensitivity and specificity are 88% and 80% for patients respectively[34].

Data analysis

All statistical work and analyzes in this study were performed using SPSS ver. This was done using 18.0 (SPSS for windows, SPSS Inc., Chicago, IL, USA). Normality was tested for the subjects' general variables and characteristics using the Shapiro-Wilk test. Two- way repeated measure ANOVA was used to investigate changes in dependent variables over time and differences between groups. The significance level was set at 0.05.

Results

There were 28 study subjects, and as a result of comparing age, height, weight, BMI, age at menarche, menstrual period, and menstrual cycle between the spinal stabilization exercise group and the stretching group, there was no significant difference between the groups at the start of the study (Table 1).

There was a significant difference between groups in the change in back pain according to exercise method (p = 0.03), a significant difference over time (p = 0.00), and a significant interaction effect (p = 0.00) (Table 2).

There was no significant difference between the two groups in the change in back pain disability scale according to exercise method (p = 0.156), but there was a significant difference depending on time (p = 0.00), and there was also a significant difference in the interaction effect (p = 0.00) (Table 3).

There was a significant difference between groups in the muscle thickness of the EO muscle during the rest period (p = 0.02), a significant difference after 10 weeks (p = 0.047), and the interaction effect was also significant (p = 0.001). When relaxed, there was a

Table 1. The general characteristics of the subjects (n = 28)

Variable	LSG (n = 14)	SG (n = 14)	t(*p*)
Age (y)	22.07±1.50[a]	21.86±1.51[a]	-.378 (0.709)
Height (m)	1.63±0.03[a]	1.61±0.04[a]	-1.339 (0.192)
weight (kg)	55.29±3.27[a]	55.86±3.01[a]	.481 (0.634)
BMI (kg/m^2)	20.83±1.09	21.53±0.92	1.857 (0.075)
Age of menarche (y)	13.79±1.37	12.93±1.00	-1.894 (0.069)
Menstrual period (day)	5.07±0.83[a]	4.79±0.80[a]	-.927 (0.362)
Menstrual cycle (day)	29.14±0.95[a]	29.14±1.03[a]	-.189 (0.852)

LSG: Lumbar stabilization group; SG: Stretching group; BMI: Body mass index
[a] Values are expressed as mean ± Standard deviation

Table 2. Changes in back pain during menstruation depending on exercise method (n = 28)

Variable	LSG (n = 14)	SG (n = 14)	F(*p*)		
			Group	Time	Group xTime
Pre-test	5.29±0.99[a]	5.28±0.99[a]	5.2999 (0.03)	291.258 (0.00)	20.858 (0.00)
Post-test	2.07±0.47[a]	3.36±0.63[a]			
Difference	3.21±0.70[a]	1.93±0.92[a]			

LSG: Lumbar stabilization group; SG: Stretching group
[a] Values are expressed as mean ± Standard deviation

Table 3. Oswestry disability scale during menstruation depending on exercise method (n = 28)

Variable	LSG (n = 14)	SG (n = 14)	F(*p*)		
			Group	Time	Group x Time
Pre-test	50.00±8.66[a]	47.70±8.22[a]	2.148 (0.156)	261.762 (0.00)	24.123 (0.00)
Post-test	21.67±4.25[a]	31.83±8.34[a]			
Difference	28.25±6.31[a]	15.87±7.14[a]			

LSG: Lumbar stabilization group; SG: Stretching group
[a] Values are expressed as mean ± Standard deviation

Table 4. Changes in muscle thickness depending on exercise method (n=28)

Variable	LSG (n=14)			SG (n=14)			F(*p*)		
	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Group	Time	Group x Time
EO at rest	0.35±0.08[a]	0.41±0.07[a]	0.06±0.03[a]	0.32±0.08[a]	0.31±0.05[a]	-0.002±0.03[a]	6.120(0.02)	4.346(0.047)	12.927(0.001)
EO contraction - rest	0.07±0.04[a]	0.08±0.03[a]	0.01±0.04[a]	0.06±0.03[a]	0.07±0.04[a]	0.01±0.05[a]	0.680(0.417)	3.422(0.076)	.081(0.779)
IO at rest	0.55±0.12[a]	0.66±0.12[a]	0.10±0.08[a]	0.60±0.08[a]	0.56±0.07[a]	0.03±0.07[a]	.325(0.573)	35.842(0.00)	58.827(0.00)
IO contraction - rest	0.10±0.07[a]	0.16±0.06[a]	0.06±0.10[a]	0.08±0.03[a]	0.13±0.07[a]	0.05±0.07[a]	3.616(0.068)	10.401(0.003)	.217(0.645)
TrA at rest	0.35±0.06[a]	0.42±0.06[a]	0.07±0.04[a]	0.30±0.08[a]	0.27±0.06[a]	-0.03±0.05[a]	17.872(0.00)	4.855(0.037)	34.793(0.00)
TrA contraction - rest	0.09±0.04[a]	0.16±0.12[a]	0.08±0.13[a]	0.09±0.11[a]	0.11±0.06[a]	0.05±0.07[a]	1.406(0.246)	3.266(0.082)	.978(0.332)

LSG: Lumbar stabilization group; SG: Stretching group; EO: External oblique; IO: Internal oblique; TrA: Transverse abdominis

[a] Values are expressed as mean ± Standard deviation

Table 4. Changes in muscle thickness depending on exercise method(Continue) (n=28)

Variable	LSG (n=14)			SG (n=14)			F(*p*)		
	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Group	Time	Group x Time
Left RA at rest	0.82±0.16[a]	0.97±0.17[a]	0.15±0.07[a]	0.89±0.21[a]	0.80±0.21[a]	-0.10±0.15[a]	.506(0.483)	1.578(0.22)	31.604(0.00)
Left RA contraction - rest	0.24±0.16[a]	0.30±0.15[a]	0.06±0.08[a]	0.21±0.15[a]	0.24±0.16[a]	0.04±0.26[a]	.492(0.489)	1.775(0.194)	.130(0.721)
Right RA at rest	0.79±0.18[a]	0.97±0.17[a]	0.18±0.02[a]	0.95±0.15[a]	0.84±0.20[a]	-0.11±0.11[a]	.053(0.82)	2.561(0.122)	41.938(0.00)
Right RA contraction - rest	0.19±0.11[a]	0.29±0.13[a]	0.10±0.09[a]	0.23±0.16[a]	0.33±0.31[a]	0.10±0.33[a]	.393(0.536)	4.652(0.04)	.001(0.982)
Left MF at rest	2.31±0.15[a]	2.49±0.18[a]	0.15±0.10[a]	2.42±0.40[a]	2.49±0.26[a]	0.07±0.24[a]	.255(0.618)	9.800(0.004)	1.293(0.266)
Left MF contraction - rest	0.74±0.31[a]	1.06±0.21[a]	0.32±0.28[a]	0.65±0.30[a]	0.62±0.23[a]	-0.06±0.18[a]	8.868(0.006)	10.484(0.003)	15.618(0.001)
Right MF at rest	2.38±0.23[a]	2.51±0.18[a]	0.13±0.18[a]	2.46±0.45[a]	2.56±0.32[a]	0.10±0.29[a]	.316(0.579)	6.279(0.019)	.104(0.749)
Right MF contraction - rest	0.71±0.33[a]	1.05±0.23[a]	0.34±0.25[a]	0.61±0.36[a]	0.57±0.33[a]	-0.06±0.24[a]	6.877(0.014)	11.929(0.002)	18.583(0.00)

LSG: Lumbar stabilization group; SG: Stretching group; RA: Rectus abdominis; MF: Multifidus

[a] Values are expressed as mean ± Standard deviation

significant difference in muscle thickness of the IO muscle over time after 10 weeks in the two groups ($p=0.00$), and a significant interaction effect was also observed ($p=0.00$). There was a significant difference only in time between the two groups after 10 weeks in the difference value obtained by subtracting the thickness of the IO muscle in the rest from the contraction ($p=0.003$). At rest, there was a significant difference in the muscle thickness of the TrA between the two groups ($p=0.00$), and after 10 weeks, there was a significant difference over time ($p=0.037$), and a significant interaction effect was also observed ($p=0.00$). There was a significant difference value obtained by subtracting the thickness of the left MF muscle in the rest from the contraction ($p=0.006$), over time ($p=0.003$) and interaction effect ($p=0.001$). In the case of the right MF, there was a significant difference between the two groups ($p=0.014$), a significant difference over time ($p=0.002$), and a significant difference in the interaction effect ($p=0.00$) (Table 4).

There were significant differences in time and group x time interaction effects in physical function, role restriction due to physical health problem, role restriction due to emotional problem, vitality, mental health, social function, body pain, general health score of SF-36 (Table 5).

Discussion

This study was conducted on 30 women with primary dysmenorrhea who had back pain during menstruation and performed lumbar stabilization exercises and stretching for 10 weeks to determine the effects on back pain, muscle structure, and quality of life during menstruation. A total of 28 people, 14 in

Table 5. Changes in quality of life depending on exercise (n=28)

Variable	LSG (n=14)			SG (n=14)			F(*p*)		
	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Group	Time	Group x Time
Physical function	70.71±13.43[a]	88.93±5.94[a]	18.21±8.90[a]	73.93±14.96[a]	82.86±9.14[a]	8.93±8.13[a]	.127 (0.724)	70.972 (0.00)	8.306 (0.008)
Role restriction due to physical health problem	35.71±21.29[a]	75.00±13.87[a]	39.29±18.69[a]	32.14±15.28[a]	53.57±16.58[a]	21.43±16.58[a]	5.221 (0.031)	81.674 (0.00)	7.065 (0.013)
Role restriction due to emotional problem	14.28±21.54[a]	76.21±15.61[a]	61.94±17.81[a]	14.28±21.54[a]	38.09±25.70[a]	23.81±20.38[a]	6.942 (0.014)	140.503 (.000)	27.769 (0.00)
Vitality	36.07±13.89[a]	72.86±6.99[a]	36.79±12.03[a]	42.14±15.53[a]	54.64±10.83[a]	12.50±8.49[a]	2.098 (0.159)	156.890 (0.00)	38.094 (0.00)
Mental health	41.14±12.46[a]	78.00±7.15[a]	36.86±14.48[a]	43.14±15.15[a]	56.57±8.57[a]	13.43±10.71[a]	7.596 (0.011)	109.130 (0.00)	23.689 (0.00)
Social function	37.50±12.97[a]	79.46±9.31[a]	41.96±13.52[a]	43.75±13.65[a]	53.57±12.43[a]	9.82±14.02[a]	6.651 (0.016)	98.941 (0.00)	38.118 (0.00)
Body pain	35.89±17.56[a]	76.43±8.81[a]	40.54±16.41[a]	44.46±16.76[a]	57.68±7.56[a]	13.21±14.5[a]6	1.500 (0.232)	84.027 (0.00)	21.711 (0.00)
General health	42.86±20.54[a]	73.93±8.81[a]	31.07±19.92[a]	49.29±13.28[a]	58.93±10.22[a]	9.64±7.71[a]	.931 (0.343)	50.857 (0.00)	14.088 (0.001)

LSG: Lumbar stabilization group; SG: Stretching group

[a] Values are expressed as mean ± Standard deviation

the lumbar stabilization exercise group and 14 in the stretching group, performed exercise for 10 weeks. As a result, the lumbar stabilization exercise group showed significantly betterimprovement in menstrual back pain, muscle structure (muscle thickness), and quality of life than the stretching group. Back pain is a major problem for individuals, healthcare systems and society[35] and is associated with lack of neuromuscular control, such as delayed muscle contractions and reduced responses[36], and changes in deep muscle thickness[37-39].

Lumbar stabilization exercises have been widely used as an intervention method for back pain, and are effective in improving neuromuscular control, muscle strength, and endurance of the muscles that maintain trunk stability[40]. As relaxin hormone is secreted during menstruation, ligament looseness increases[41, 42]. This causes a decrease in the role of the passive subsystem that provides spinal stability in the lumbar stabilization system[43]. By using the active and neurogenic subsystems, lumbar stabilization exercises can compensate for the insufficient function of the passive subsystem to provide trunk stability[25].

Stretching is also used as an intervention method for back pain that occurs during menstruation. Stretching increases blood flow to stretched muscles, improves elasticity, and increases the speed at which lactic acid spreads, thereby reducing back pain experienced during menstruation[44]. This study applied these two exercises to women suffering from back pain during their menstrual period. The lumbar stabilization exercise consisted of lumbar stabilization exercise (navel pull, navel pull and limb movement) and finishing exercise (abdominal breathing)[25]. Stretching was performed by applying static stretching, consisting of stretching (butterfly posture, pulling the knees toward the chest while lying down, spinal twist posture, down dog posture) and finishing exercise (abdominal breathing)[13].

In other studies, the development of exercises for women with back pain during menstruation was not actively developed[25], and only patients' subjective variables were recorded through questionnaires[45]. This made it difficult to prove the objective effectiveness of the intervention method. Therefore, this study attempted to more objectively compare the effects of the two exercise groups through muscle measurement using rehabilitation imaging ultrasound as well as subjective measurement tools.

In this study, changes in the MF among deep muscles were noticeable through lumbar stabilization exercises. In the case of chronic back pain patients who complain of back pain, the deep muscles of the lower back become weak and the stability of the spine decreases[46]. In particular, in the case of the MF muscle, it maintains lordosis of the lower back and prevents movement due to external forces, and this action plays a role in providing stabilization of the lower back[21]. By increasing the muscle thickness of the MF and improving muscle contraction ability, it prevents additional injuries when performing other movements by stably holding the lower back at the beginning of movement[47]. In addition, in the case of the TrA muscle, another deep muscle, the muscle thickness of 96 healthy women aged 22.3 ± 5.0years at rest was measured and found to be 0.33 ± 0.09cm [48]. In this study, the muscle thickness at rest in the lumbar stabilization exercise group after intervention was 0.42 ± 0.06cm, which was significantly increased compared to women of similar age.However, in the stretching group, it decreased from 0.30 ± 0.08cm to 0.27 ± 0.06cm. These results are similar to the results of the study of the effects of stretching and segmental stabilization exercise on patients with chronic low back pain twice a week for 30 minutes each time for 6 weeks, and found that activation of the TrA muscle was significantly improved only in the segmental stabilization exercise group[49].

Several studies have shown that passive methods such as stretching do not translate into lasting changes in musculoskeletal structures because they do not involve active learning of coordinated body movements[50] and conscious postural performance that can prevent recurrence of back pain[51, 52]. In the ODI, the lumbar stabilization exercise group significantly decreased the time according to exercise type ($p = 0.00$) and the interaction effect ($p = 0.000$) compared to the stretching group. It decreased from 50.00±8.66% to 21.67±4.25% after exercise, and the stretching group decreased from 47.70±8.22% before exercise to 31.83±8.34% after exercise. This showed that in the lumbar stabilization exercise group, back pain disability was alleviated from severe disability to moderate disability, and in the stretching group, moderate disability was maintained both before and after exercise. In particular, the lumbar stabilization exercise group showed a change to a value close to 20%, which is the threshold indicating minimal disability after exercise, and the degree of back pain disability was found to be significantly reduced more than the stretching group.

In the SF-36, physical function, vitality, body pain, and general health scores showed a significant increase ($p < 0.05$) in the time and interaction effects. There was a significant increase in the group, time, and interaction effects in role limitations due to physical health problems, role limitations due to emotional problems, mental health, and social functioning scores ($p < 0.05$). In the SF-36, the mental health domains (mental component summary, MCS) of role limitations due to emotional problems, mental health, social functioning, and vitality scores improved significantly. Matcham reported that scores below the threshold of 38 in the mental health domain indicate probable major depressive disorder (pMDD) or probable depressive disorder (pGAD)[34]. The lumbar stabilization exercise group showed an increase in role limitation scores due to emotional problems, vitality score, mental health, and social function score, which means improvement in the mental health area of quality of life.Women who experience menstrual pain have a lower quality of life compared to women who do not experience it[53], and they develop psychological disorders such as depression and anxiety[54]. Depression is the most common disability in the world and one of the 10 leading causes of disability[55]. Depression increases the impact of pain on social and occupational functioning, reduces an individual's responsiveness to medications, and increases sensitivity to pain[56]. Therefore, psychological factors can worsen the pain and problems caused by primary dysmenorrhea in adolescents and young women[54].

As an intervention method, this study implemented lumbar stabilization exercises, which control the delicate movements of the MF and TrA muscles[57] and increase the thickness of the two muscles, thereby reducing pain and activity limitations[58]. As a result, lumbar stabilization exercises contribute to improving health-related quality of life by alleviating psychological disorders in women with primary dysmenorrhea who have back pain during menstruation.

The results of this study confirmed that lumbar stabilization exercises were effective for women with primary dysmenorrhea who had back pain during their menstrual period. Limitations of this study include the inability to determine changes in hormone levels that affect pain through exercise, and although the effect of exercise was confirmed after completing 10 weeks of exercise, its sustainability thereafter was unknown. Therefore, in a follow-up study, it would be necessary to conduct a follow-up evaluation after 10 weeks of exercise to determine how long the effect lasts and to check for changes in hormone levels.

Conclusion

This study aimed to investigate the effects on pain, muscle structure, and quality of life by applying lumbar stabilization exercises to women with primary dysmenorrhea who suffer from back pain during menstruation. As a result of the study, it was confirmed that lumbar stabilization exercises were effective in reducing back pain and improving muscle thickness and quality of life in women with primary dysmenorrhea. Therefore, for women with primary dysmenorrhea who have back pain during menstruation, lumbar stabilization exercises can be suggested as a treatment that can reduce pain, improve muscle thickness, and quality of life.

Conflicts of interest

The author has no potential conflicts of interest in relation to the authorship and/or publication of this article.

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