Journal of
Modern Rehabilitation
April 2019, Volume 13, Number 2

Research Paper: Effect of Core Stability Exercises on Primary Dysmenorrhea: A Randomized Controlled Trial

Shahnaz Shahrjerdi[1], Fahimeh Mahmoudi[2], Rahman Sheikhhoseini[3*], Samira Shahrjerdi[4]

1. Department of Corrective Exercises & Sport Injury, Faculty of Physical Education, Arak University, Arak, Iran.
2. Department of Health and Sport Medicine, Faculty of Physical Education and Sport Sciences, University of Tehran, Tehran, Iran.
3. Department of Corrective Exercises & Sport Injury, Faculty of Physical Education and Sport Sciences, Allameh Tabataba'i University, Tehran, Iran.
4. Department of Physiotherapy, Faculty of Medicine, Tarbiat Modares University, Tehran, Iran.

Use your device to scan and read the article online

Citation: Shahrjerdi Sh, Mahmoudi F, Sheikhhoseini R, Shahrjerdi S. Effect of Core Stability Exercises on Primary Dysmenorrhea: A Randomized Controlled Trial. Journal of Modern Rehabilitation. 2019; 13(1):113-122. http://dx.doi.org/10.32598/JMR.13.1.113

http://dx.doi.org/10.32598/JMR.13.1.113

Article info:
Received: 11 Nov 2018
Accepted: 23 Feb 2019
Available Online: 01 Apr 2019

Keywords:
Pain, Dysmenorrhea, Exercise, Lumbosacral region

ABSTRACT

Introduction: Primary dysmenorrhea is characterized by pain during menstruation without any pelvic pathology. It is a common problem among females in their reproductive age. However, exercise is a known intervention to relieve the symptoms. This study aimed to assess the effect of core stability exercises on pain severity, pain duration, and drug consumption in primary dysmenorrhea in adult females.

Materials and Methods: Thirty-four non-athletic, unmarried girls, aged 18-25 years, who suffered from moderate to severe primary dysmenorrhea, were randomly assigned to the experimental (n=17) and control groups (n=17). The experimental group performed 8 weeks of core stability exercise (3 sessions/week, 45-60 min/session). Before and after the exercise program, pain intensity, pain duration, and the medication usage of the participants were assessed by "Numeric Pain Scale" (10-point scale), "the number of hours that the pain continued" and "the total amount of painkiller consumption for the pain reduction" for 2 days prior to menstruation, and 2 days after menstruation onset. The statistical analysis was performed using ANCOVA and dependent t-test. The confidence interval was considered at 0.95 (α<0.05).

Results: In comparison with the control group, there was a significant decrease in pain intensity (P=0.008), pain duration (P=0.021), and the number of painkillers consumed (P=0.018) in the experimental group.

Conclusion: Core stability exercises may be effective in reducing pain intensity, pain duration, and consumed painkillers.

*** Corresponding Author:**
Rahman Sheikhhoseini, PhD.
Address: *Department of Corrective Exercises & Sport Injury, Faculty of Physical Education and Sport Sciences, Allameh Tabataba'i University, Tehran, Iran.*
Tel: *+98 (918) 8668284*
E-mail: *rahman.pt82@gmail.com*

1. Introduction

Dysmenorrhea is one of the most prevalent gynecological problems among women [1]. The prevalence of dysmenorrhea is between 20% and 90% in various populations [2]. This wide variation could be related to the ethnic, sociocultural [3], or biological factors [4] or various definitions of dysmenorrhea in the previous studies. Although primary dysmenorrhoea is not life-threatening, it has several socioeconomic burdens such as increased sick leave, health care costs, interruption in regular daily activities, and social isolation [5]. In the United States, the annual economic damage attributed to dysmenorrhea pain has been estimated as 600 million hours of work loss or two billion dollars [6].

Primary dysmenorrhea refers to the lower abdominal pain during the menstrual bleeding in the absence of obvious pelvic pathology [6]. It begins before or concurrent with the menstrual bleeding onset and decreases gradually after 12–72 hours [7]. Studies indicate that releasing prostaglandin F2α from the endometrium during the ovulatory cycle is associated with the intense uterine contractions, reduced blood flow, and the increased peripheral nerve hypersensitivity, which may be accompanied with pain at the onset of the menstruation cycle [6]. Pain may be experienced mainly in the inguinal region, the lower back, and the posterior thigh [8]. Dysmenorrhea can also be associated with vomiting, nausea, diarrhea, constipation, hyperventilation, fatigue, fever, irritability, myalgia, dizziness, and headache [2].

Several interventions are applied to manage the symptoms of dysmenorrhea, including medication [9], acupuncture [10], local application of heat or massage [11], herbal therapy [12], transcutaneous nerve stimulation [13], and prescription of various vitamins and minerals such as vitamins B1, B6, E, and magnesium [6]. Among these interventions, the Nonsteroidal Anti-inflammatory Drugs (NSAIDs) and the prostaglandin inhibitors are considered the first-line agents for the treatment of primary dysmenorrhea [14]. However, several side effects, including nausea, digestive system dysfunction, diarrhea, and fatigue, have been commonly reported for these medications [6].

Exercise and physical activities are also considered effective and safe interventions in managing dysmenorrhea [15]. It is well proven that increased circulation, hormonal changes, and the increment of endorphin levels as a result of various exercise protocols increase the dysmenorrhea pain threshold [16]. Although it seems that physical activity could relieve dysmenorrhea symptoms, there are some controversial findings too. Several studies have demonstrated the beneficial effects of various kinds of exercise, such as stretching [17], yoga [18], and aquatic exercise programs [19] on primary dysmenorrhea. Nevertheless, some other studies have reported no significant changes in dysmenorrhea pain by aerobic exercise [20]. Additionally, a review study concluded that there were no apparent effects of exercise on primary dysmenorrhea, although the positive effects of exercise on health should be considered [21].

Core stability exercise has been known as a beneficial intervention in the management of several medical problems. Core stability exercises strengthen and coordinate the muscles around the abdominal, lumbar, and pelvic regions [22]. Because it has been suggested that the core stability exercises mainly affect the lumbosacral muscles and increase blood supply in lumbosacral structures [22], we hypothesized that the core stability exercises might be effective in reducing primary dysmenorrhea symptoms. On the other hand, to our knowledge, the effect of these exercises on primary dysmenorrhea has not been studied yet. Thus, we aimed to investigate the impact of the core stability exercises on the symptoms of primary dysmenorrhea in female adults.

2. Materials and Methods

This study was a randomized clinical trial that was performed at Arak University during 2013-2014 and registered at the Human Ethics Committee of Arak Medical University (IRCT Code 2016103119024N2).

Considering the research objectives, a similar previous study [17], α=0.05, the power of 80%, and the pain intensity variable, the sample size was determined as 8 subjects for each group by using G × Power software (Erdfelder, Faul, & Buchner, 1996, version 3.1) [23]. But we selected a larger sample size to prevent the possible effect of dropouts on the results. Finally, 34 subjects were chosen from nonathletic females, 18 to 25 years old from university students, who suffered from moderate to severe primary dysmenorrhea (based on the numeric pain scale, i.e. the participants with reported pain between 5 and 10). All participants were selected based on a medical examination conducted by a gynecologist and an interview based on the English version of the modified menstrual symptom questionnaire [24]. Then, all participants were randomly assigned to the intervention group (n =17) or the control group (n=17) based on the simple blocked randomization method (based on sample size in

each group) by an investigator who was unaware of the groups' assignment.

The participants would be included in the study if they had persistent primary dysmenorrhea of more than 6 months, lacked a history of pregnancy, musculoskeletal or neurological disorders, chronic low back pain or sacroiliac dysfunction, diabetes, polycystic ovary disease, and pelvic infection or pelvic pain. The exclusion criteria were not tolerating exercise or participation in any additional physical activity at the same time, attending regular exercise training in the last 6 months, taking medications or vitamin and mineral supplements due to other medical conditions, developing irregular menstrual cycle or becoming reluctant with continuing the study protocol for any reason.

The research procedure was explained to all participants, and written informed consent was obtained from all participants before the data collection and intervention. The severity of primary dysmenorrhea pain was recorded two days before the menstruation and two days after the menstruation onset [7], and the mean average of these records was considered as the severity of the pain. Both assessments were performed in the morning before taking any painkillers. The Numeric Pain Scale (NPS) rating was used to describe the pain severity based on previous pain experiences [25]. This scale is utilized widely for various pains, such as low back pain and dysmenorrhea pain [17].

Previous studies have proven the reliability and validity of this pain measuring tool [26]. According to NPS, the mean value of the reported pain of participants in both assessments was considered as the pain severity [25]. The participants reported the duration of pain in hours during the experimental period (2 days before the menstruation and two days after the menstruation onset), and the sum of the hours experiencing pain was considered as the total duration of pain. The dosage of pain medication during the menstruation period was also recorded based on the patients' report. The participants were allowed to take only NSAIDs as medication, and the number of medicines taken per day was considered as a pain consumption scale. A pretest was administered during a menstruation cycle before the initiation of training program. After performing the training program, post-test measures were recollected again at the first menstruation cycle. All participants were assured that the results of the tests would remain confidential and if they did not wish to continue the study, they could freely leave the study. The same evaluation processes were done for both groups. The pretest and post-test evaluations were done by an examiner who was unaware of groups' assignment.

The participants in the intervention group took part in an 8-week core stability exercise program under the direct supervision of a sports specialist. The program featured 14 stabilization exercises that focused on the transverse abdominal muscles, the lumbar multifidus, pelvic floor muscles, and the hip muscles, which were practiced using a Swiss Ball (Table 1) [23, 27, 28]. Each session lasted about 45-60 minutes, which started with 10 minutes of warm-up, followed by 25-40 minutes of the main program, and ended with 10 minutes of cool-down. The warm-up and cool-down consisted of general stretching exercises and slow running. The exercise program was designed as progressive, so it started with one set of 10 repetitions of every exercise in the first week, and every two weeks, it increased based on the ability of the participants. The progression of the exercise program was only followed by increasing the number of repetitions and sets, not by adding resistance or extending time.

The exercise programs were prescribed at the luteal phase between the two menstruations over three menstrual cycles [17]. The females' hormones fluctuate across the menstruation cycle [27], and it can affect the exercise metabolism and performance in different menstruation cycles [28]; therefore, the luteal phase was selected for training. The participants in the control group were asked neither to take any physical activity or exercise nor any medical intervention during the three menstrual periods. After the end of the study, they had the chance to attend the same exercise protocol as the intervention group and under the supervision of the same trainer. Additionally, both groups followed the dietary hygiene guideline [29]. The data regarding pain intensity, the pain duration, and the drug consumption before and after the intervention of both groups were collected and analyzed.

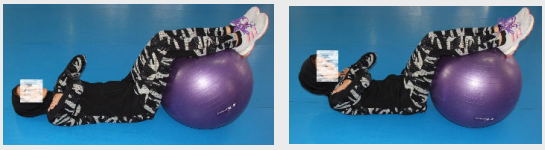
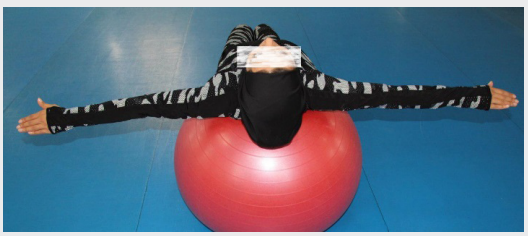
Statistical analysis

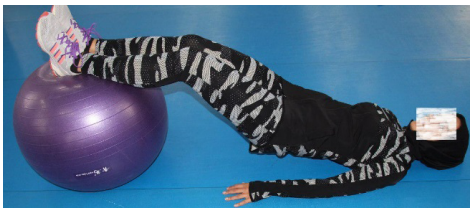
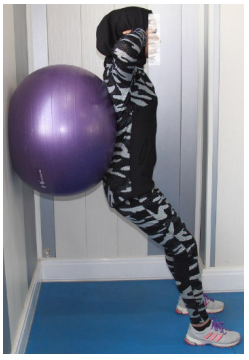
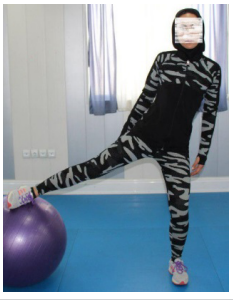
The Shapiro-Wilk test assessed the normal distribution of data. The obtained data were analyzed by the descriptive statistics, dependent t-test, and ANCOVA in SPSS V. 21. The power of test and effect size were calculated for ANCOVA. Moreover, $P<0.05$ was considered as statistically significant.

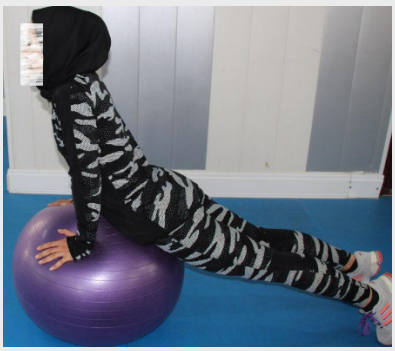
3. Results

Table 2 presents the demographic data of both groups. There were no observed statistically significant differences between the groups.

Table 1. The procedure, intensity, and photos of the exercises done by the experimental group

	Exercises	Procedure	Intensity	Photo
1	Ball crunch	Lie on your lower back on the exercise ball and place your hands behind your ears. Roll your shoulder blades up and lower yourself back down after a short pause. To avoid straining your neck, look straight up instead of looking at your knees.	10-40 repetitions for 1-2 sets	
2	Crunch with feet on the ball (legs elevated)	Lie on your back, calves on top of the exercise ball, and arms across your chest. Roll your shoulder blades up and lower yourself back down after a short pause. To avoid straining your neck, look straight up instead of looking at your knees.	10-40 repetitions for 1-2 sets	
3	Leg curl on the ball	Lie on your back, feet on top of the exercise ball, legs and back straight. Roll the exercise ball towards you by bending your knees and allow it to return slowly after a short pause. Keep your back straight throughout.	6-25 repetitions for 2-3 sets	
4	Ball bridge t fall-off	Lie on your shoulder blades on top of the exercise ball, knees at 90-degree angles, back straight, and extend your arms out to keep balance. Roll-off the ball slightly to one side and return after a short pause. Alternate sides between each repetition. Keep your back straight throughout.	10-40 repetitions for 1-2 sets	
5	Ball pendulum	Sit on a mat and place a stability ball between your legs (at your calves/ankles). Squeezing the ball in place, lie back onto the floor, and extend legs straight up into the air. Keep knees slightly bent and arms out to the sides for support. Keeping upper body and glutes stationary, lower your legs down to the right, as close to the ground as possible. Return to start and repeat to the left side to complete one rep. Make sure your back stays firmly planted and that your legs swing in line with your hips (not above or below them).	10-40 repetitions for 1-2 sets	

	Exercises	Procedure	Intensity	Photo
6	Bridge	Lie on your back with your feet on top of the exercise ball, knees, and thighs bent. Lift your back from the floor by extending your legs and slowly lower yourself back down after a short pause. Keep your back straight throughout.	10-40 repetitions for 2-3 sets	
7	Oblique ball crunches	Sit on the exercise ball. Walk forward on the ball and lie back on the ball with shoulders and head hanging off, and knees and hips bent. Gently hyperextend back to the contour of the ball. Hold plate behind your neck or on the chest with both hands or use no weight. Flex your waist to raise the upper torso. Return to the original position. Repeat.	10-40 repetitions for 1-2 sets	
8	Wall squat	Crouch with your back pressed against the exercise ball against the wall, knees at 90-degree angles, and place your hands behind your ears. Raise yourself by extending your legs and slowly lower your back after a short pause. Breathe out while raising yourself and breathe in while returning to the starting position.	10-40 repetitions for 2-3 sets	
9	Ball squat; sideways; single-leg	Crouch on one leg with your side pressed against the exercise ball, itself against the wall with your knee at a 90-degree angle. Raise yourself by extending your leg and slowly lower yourself back after a short pause. Alternate sides after each set. Breathe out while raising yourself and breathe in while returning to the starting position.	10-40 repetitions for 2-3 sets	
10	Ball hip adduction	Stand on your right leg and put your left foot on top of the exercise ball, leg extended to your side. Roll the exercise ball towards you by bringing your leg in and slowly roll it back after a short pause. Alternate sides after each set. Breathe out while rolling in and breathe in while returning to the starting position.	10-40 repetitions for 2-3 sets	

	Exercises	Procedure	Intensity	Photo
11	Ball squeeze	Sit on the exercise ball with your thighs on each side and place your hands across your chest. Squeeze the exercise ball between your legs by bringing your thighs closer to each other and slowly unsqueeze them after a short pause. Breathe out while squeezing and breathe in while returning to the starting position.	10-40 repetitions for 2-3 sets	
12	Back extension	Kneel in front of the exercise ball, your belly pressed on top of it, and place your hands on each side of the ball. Extend your back by extending your arms and legs and return to the starting position after a short pause. Breathe out while extending and breathe in while returning to the starting position.	6-12 repetitions for 3-6 sets	
13	Knee tuck from plank	Place your ankles on top of the exercise ball, legs extended, chest facing the floor, and extend your arms to lift yourself from the floor. Keeping your weight on your extended arms, roll the ball in by bending your knees and hips and extend your legs back after a short pause. Breathe out while rolling the ball in and breathe in while returning to the starting position.	10-40 repetitions for 1-2 sets	
14	Opposition rise (alternating)	Lie prone on top of the exercise ball, your belly pressed against it, and maintain balance with your feet and hands on the floor. Extend your left arm and right leg out and up and lower them back after a short pause. Alternate sides after each repetition. Breathe out while extending and breathe in while returning to the starting position.	6-12 repetitions for 3-6 sets	

JMR

In comparison with the control group, the results of the study demonstrated a significant difference after eight weeks of the training program in the intervention group. There was a significant reduction in pain intensity (P=0.008), pain duration (P=0.021), and the number of consumed painkillers (P=0.018) in the intervention group compared to the control group (Table 3).

Table 2. The subject's demographics and pre-intervention characteristics in the experimental (n=17) and control (n=17) groups

Variables	Experimental		Control		P
	Mean±SD	Median	Mean±SD	Median	
Age (y)	21.71±0.99	21.50	22.43±0.85	22.00	0.051
Menarche age (y)	12.86±1.40	12.50	13.21±1.18	13.00	0.425
BMI (kg/m²)	20.89±1.75	20.68	21.79±3.75	21.79	0.474
Pain intensity (NPS score)	6.71±1.63	7.00	6.92±2.01	6.50	0.760
Pain duration (h)	15.46±14.64	8.00	15.14±12.29	12.00	0.951
Use of drugs (No.)	2.57±2.73	2.50	1.43±1.55	1.00	0.186

JMR

4. Discussion

The study aimed to evaluate the effect of the core stability exercise program on the primary dysmenorrhea symptoms. The results showed statistically significant changes in the primary dysmenorrhea symptoms after 8 weeks of core stability exercises. Furthermore, no changes occurred in the control group after the period.

The outcomes of the present study are consistent with the results of some previous studies, which suggested that various forms of exercise like stretching [17], aquatic exercise [19], and yoga may reduce the symptoms of primary dysmenorrhea. Interestingly, the intervention programs of the majority of studies that observed significant effects of exercise on the primary dysmenorrhea have focused on general exercises [17-19, 30]. Hence, it appears that these benefits could be related to the general effects of physical activity on health such as stress reduction [31], sympathetic irritability decrement [21], and endorphin increment [32]. Indeed, systematic response to various types of exercise is the increase in the steroid and endorphin hormones in blood circulation, which leads to a significant increase in the pain threshold [16]. Besides, the sympathetic system could increase the uterine muscle contraction which aggravates the symptoms of primary dysmenorrhea [6]. Admittedly, stress may result in increased sympathetic system activity. So, exercise may decrease the symptoms of primary dysmenorrhea by reducing stress [16, 17, 32].

The present study has surveyed the effect of core stability exercise program on primary dysmenorrhea symptoms. Some of the main core muscles are diaphragm (superior), the rectus abdominus, internal and external oblique (anterior-lateral), the multifidus and gluteus maximus, gluteus medius and gluteus minimus (posterior), and the pelvic floor (inferior) muscles. These

Table 3. Comparison of the pretest and posttest data in the experimental (n=17) and control (n=17) groups, results of the dependent t-test and ANCOVA

Variable	Group	Mean±SD		ANCOVA			
		Pre-test	Post-test	t-test: P	P	Power	Effect Size
Pain intensity (NPS score)	Experimental	78.54±5.11	51.69±3.65	<0.001*	0.008*	0.801	0.272
	Control	83.38±4.48	81.15±3.38	0.856			
Pain duration (h)	Experimental	16.50±4.70	7.31±8.95	0.046*	0.021*	0.661	0.211
	Control	16.23±12.07	15.62±11.13	0.596			
Use of drugs (No.)	Experimental	1.92±2.81	0.38±0.51	0.070	0.018*	0.684	0.220
	Control	1.46±1.61	1.38±1.56	0.776			

* Statistically significant differences were observed.

JMR

muscles include both local and global muscles and have a corset-like stabilization effect on the trunk and spine [30]. The core stability exercises cause the core muscles conditioning via the neural drive increment and effective contraction [22]. Therefore, it seems that the core muscle conditioning might increase the circulation and metabolism in the pelvic region and results in the improvement of primary dysmenorrhea.

The findings of this study showed that the length of menstruation pain reduced significantly in the experimental group after 8 weeks of training. This finding provides support for previous studies [17, 30] as well. Physical activity could enhance circulations [16] and consequently shorten the menstruation pain duration.

The present findings also showed that the number of drugs consumed by the experimental group decreased after participating in the core stability exercise program. This result was in line with the results of other studies [17, 30] that could be related to the severity of pain. Therefore, exercise training may reduce pain severity, thus reducing the need for drugs.

Generally, dysmenorrhea is a multi-dimensional problem with various aspects such as physiological [7], psychological [14], and sociocultural [6]; therefore, the better management of this condition may need several approaches. Undoubtedly, it is necessary to provide a safe and accessible solution to this problem. However, the usage of drugs for pain reduction may have some side effects like nausea, vomiting, dizziness, purpura, petechiae, hyperkalemia, peripheral edema, peptic ulcer, and gastric bleeding [6]. On the other hand, based on our knowledge, no adverse effects have been reported for core stability exercise yet [11], so the effectiveness of core stability exercises on primary dysmenorrhea may be exciting news for both patients and physicians.

This study can be criticized in terms of the small sample size. The current research was limited regarding the duration of the intervention and the lack of follow-up, too. Concerning the research design, it is impossible to decide that the general effects of core stability exercises may result in symptom relief. In particular, these exercises have also affected core muscles resulting in symptom relief. Therefore, more studies are needed to clarify the issue.

The present study suggests that the prescription of core stability exercises may be effective in relieving the pain intensity, pain duration, and drug consumption in adult unmarried females with primary dysmenorrhea.

Ethical Considerations

Compliance with ethical guidelines

This study was a randomized clinical trial that was performed at Arak University during 2013-2014 and registered at the Human Ethics Committee of Arak Medical University (IRCT Code: 2016103119024N2).

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors contributions

Conceptualization, methodology, software, formal analysis, investigation, resources, data curation and writing-original draft preparation: All authors; Project administration and supervision: Shahnaz Shahrjerdi.

Conflict of interest

The authors have no conflict of interest in this study.

References

[1] Gagua T, Tkeshelashvili B, Gagua D. Primary dysmenorrhea: Prevalence in adolescent population of Tbilisi, Georgia and risk factors. Journal of the Turkish German Gynecological Association. 2012; 13(3):162-8. [DOI:10.5152/jtgga.2012.21] [PMID] [PMCID]

[2] Iacovides S, Avidon I, Baker FC. What we know about primary dysmenorrhea today: A critical review. Human Reproduction Update. 2015; 21(6):762-78. [DOI:10.1093/humupd/dmv039] [PMID]

[3] Chung FF, Yao CC, Wan GH. The associations between menstrual function and life style/working conditions among nurses in Taiwan. Journal of Occupational Health. 2005; 47(2):149-56. [DOI:10.1539/joh.47.149] [PMID]

[4] Ju H, Jones M, Mishra G. The prevalence and risk factors of dysmenorrhea. Epidemiologic Reviews. 2014; 36:104-13. [DOI:10.1093/epirev/mxt009] [PMID]

[5] Unsal A, Ayranci U, Tozun M, Arslan G, Calik E. Prevalence of dysmenorrhea and its effect on quality of life among a group of female university students. Upsala Journal of Medical Sciences. 2010; 115(2):138-45. [DOI:10.3109/03009730903457218] [PMID] [PMCID]

[6] Dawood MY. Primary dysmenorrhea: Advances in pathogenesis and management. Obstetrics and Gynecology. 2006; 108(2):428-41. [DOI:10.1097/01.AOG.0000230214.26638.0c] [PMID]

[7] Harel Z. Dysmenorrhea in adolescents. Annals of the New York Academy of Sciences. 2008; 1135:185-95. [DOI:10.1196/annals.1429.007] [PMID]

[8] Holtzman DA, Petrocco-Napuli KL, Burke JR. Prospective case series on the effects of lumbosacral manipulation on dysmenorrhea. Journal of Manipulative and Physiological Therapeutics. 2008; 31(3):237-46. [DOI:10.1016/j.jmpt.2008.02.005] [PMID]

[9] Chantler I, Mitchell D, Fuller A. Diclofenac potassium attenuates dysmenorrhea and restores exercise performance in women with primary dysmenorrhea. The Journal of Pain. 2009; 10(2):191-200. [DOI:10.1016/j.jpain.2008.08.006] [PMID]

[10] Smith CA, Crowther CA, Petrucco O, Beilby J, Dent H. Acupuncture to treat primary dysmenorrhea in women: A randomized controlled trial. Evidence-Based Complement Alternat Medicin. 2011; 2011:612464. [DOI:10.1093/ecam/nep239] [PMID] [PMCID]

[11] Kim JS, Jo YJ, Hwang SK. [The effects of abdominal meridian massage on menstrual cramps and dysmenorrhea in full-time employed women (Korean)]. Journal of Korean Academy of Nursing. 2005; 35(7):1325-32. [DOI:10.4040/jkan.2005.35.7.1325] [PMID]

[12] Atallahi M, Amir Ali Akbari S, Mojab F, Alavi Majd H. Effects of wheat germ extract on the severity and systemic symptoms of primary dysmenorrhea: A randomized controlled clinical trial. Iranian Red Crescent Medical Journal. 2014; 16(8):e19503. [DOI:10.5812/ircmj.19503] [PMID] [PMCID]

[13] Proctor M, Farquhar C, Stones W, He L, Zhu X, Brown J. Transcutaneous electrical nerve stimulation and acupuncture for primary dysmenorrhoea. The Cochrane Database of Systematic Reviews. 2002; 2002(1):CD002123. [DOI:10.1002/14651858.CD002123]

[14] Proctor M, Farquhar C. Diagnosis and management of dysmenorrhoea. British Medical Journal. 2006; 332(7550):1134-8. [DOI:10.1136/bmj.332.7550.1134] [PMID] [PMCID]

[15] Jahromi MK, Gaeini A, Rahimi Z. Influence of a physical fitness course on menstrual cycle characteristics. Gynecological Endocrinology. 2008; 24(11):659-62. [DOI:10.1080/09513590802342874] [PMID]

[16] Stoddard JL, Dent CW, Shames L, Bernstein L. Exercise training effects on premenstrual distress and ovarian steroid hormones. European Journal of Applied Physiology. 2007; 99(1):27-37. [DOI:10.1007/s00421-006-0313-7] [PMID]

[17] Shahr-jerdy S, Sheikh Hosseini R, Gh Maghsoud E. Effects of stretching exercises on primary dysmenorrhea in adolescent girls. Biomedical Human Kinetics. 2012; 4(1):127-32. [DOI:10.2478/v10101-012-0024-y]

[18] Rakhshaee Z. Effect of three yoga poses (cobra, cat and fish poses) in women with primary dysmenorrhea: A randomized clinical trial. Journal of Pediatric and Adolescent Gynecology. 2011; 24(4):192-6. [DOI:10.1016/j.jpag.2011.01.059] [PMID]

[19] Rezvani S, Taghian F, Valiani M. The effect of aquatic exercises on primary dysmenorrhoea in nonathlete girls. Iranian Journal of Nursing and Midwifery Research. 2013; 18(5):378-83.

[20] Jarrett M, Heitkemper MM, Shaver JF. Symptoms and self-care strategies in women with and without dysmenorrhea. Health Care for Women International. 1995; 16(2):167-78. [DOI:10.1080/07399339509516167] [PMID]

[21] Daley AJ. Exercise and primary dysmenorrhoea: A comprehensive and critical review of the literature. Sports Medicine. 2008; 38(8):659-70. [DOI:10.2165/00007256-200838080-00004] [PMID]

[22] Willardson JM. Core stability training: Applications to sports conditioning programs. Journal of Strength and Conditioning Research. 2007; 21(3):979-85. [DOI:10.1519/00124278-200708000-00054] [PMID]

[23] Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods. 2007; 39(2):175-91. [DOI:10.3758/BF03193146] [PMID]

[24] Matteson KA. Menstrual questionnaires for clinical and research use. Best practice & research, Clinical Obstetrics & Gynaecology. 2017; 40:44-54. [DOI:10.1016/j.bpobgyn.2016.09.009] [PMID]

[25] Chiarotto A, Maxwell LJ, Ostelo RW, Boers M, Tugwell P, Terwee CB. Measurement properties of visual analogue scale, numeric rating scale, and pain severity subscale of the brief pain inventory in patients with low back pain: A systematic review. Journal of Pain. 2019; 20(3):245-63. [DOI:10.1016/j.jpain.2018.07.009] [PMID]

[26] Ferreira-Valente MA, Pais-Ribeiro JL, Jensen MP. Validity of four pain intensity rating scales. Pain. 2011; 152(10):2399-404. [DOI:10.1016/j.pain.2011.07.005] [PMID]

[27] Velloso CP. Regulation of muscle mass by growth hormone and IGF-I. British Journal Pharmacology. 2008; 154(3):557-68. [DOI:10.1038/bjp.2008.153] [PMID] [PMCID]

[28] Oosthuyse T, Bosch AN. The effect of the menstrual cycle on exercise metabolism: Implications for exercise performance in eumenorrhoeic women. Sports Med. 2010; 40(3):207-27. [DOI:10.2165/11317090-000000000-00000] [PMID]

[29] Balbi C, Musone R, Menditto A, Di Prisco L, Cassese E, D'Ajello M, et al. Influence of menstrual factors and dietary habits on menstrual pain in adolescence age. European Journal of Obstetrics, Gynecology, and Reproductive Biology. 2000; 91(2):143-8. [DOI:10.1016/S0301-2115(99)00277-8]

[30] Vaziri F, Hoseini A, Kamali F, Abdali K, Hadianfard M, Sayadi M. Comparing the effects of aerobic and stretching exercises on the intensity of primary dysmenorrhea in the students of universities of bushehr. Journal of Family & Reproductive Health. 2015; 9(1):23-8.

[31] Wang L, Wang X, Wang W, Chen C, Ronnennberg AG, Guang W, et al. Stress and dysmenorrhoea: A population based prospective study. Occupational and Environmental Medicine. 2004; 61(12):1021-6. [DOI:10.1136/oem.2003.012302] [PMID] [PMCID]

[32] Koseoglu E, Akboyraz A, Soyuer A, Ersoy AO. Aerobic exercise and plasma beta endorphin levels in patients with migrainous headache without aura. Cephalalgia. 2003; 23(10):972-6. [DOI:10.1046/j.1468-2982.2003.00624.x] [PMID]

This Page Intentionally Left Blank