The effect of *Hatha Yoga* on pain intensity in severe primary dysmenorrhea among students: A randomized controlled trials

Ignatio Rika Haryono[1*], Jessica Putri Sudarman[1], Nawanto A. Prastowo[1], Lilis Lilis[2]

[1]Department of Physiology, School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia
[2]Department of Anatomical Pathology, School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia
Pluit Selatan Raya 19, North Jakarta, Indonesia, 14440

Corresponding author: ignatio.rika@atmajaya.ac.id

ABSTRAK

Latar Belakang: Yoga dikenal sebagai salah satu terapi alternatif untuk mengurangi nyeri. Manfaat latihan yoga terhadap penurunan skala nyeri sudah terbukti. Nyeri dismenorea seringkali dirasakan oleh wanita. Pengaruh Yoga terhadap nyeri dismenorea belum banyak diteliti.
Tujuan: Penelitian ini bertujuan untuk mengetahui pengaruh hatha yoga terhadap nyeri pada dismenorea primer (PD).
Metode: Ini adalah penelitian terkontrol acak yang melibatkan 50 mahasiswi, masing-masing 25 orang di kelompok kontrol (C) dan kelompok yoga (Y). Dismenorea primer didiagnosis dengan menggunakan instrument kuesioner untuk menilai Kinerja Pekerjaan, Lokasi, Intensitas (skala Wong-Baker), dan Durasi Nyeri Dismenorea (WaLIDD questionnaire). Intensitas nyeri dinilai dengan Numeric Rating Scale (NRS). Pelatihan hatha yoga dilakukan selama 12 minggu. Uji statistik yang dipergunakan adalah Uji-t tidak berpasangan, ANOVA dan Tukey post hoc, dan uji korelasi Pearson. Hasil bermakna bila p<0,05.
Hasil: Karakteristik antar kelompok tidak berbeda. Uji ANOVA menunjukkan skor NRS pada kontrol tidak berubah, sedangkan yoga berkurang (p=0,02). Tukey post hoc menunjukkan bahwa NRS kedua dan ketiga lebih rendah dari NRS basal (masing-masing p=0,038 dan 0,01). NRS ketiga juga lebih rendah dibanding NRS kedua (p=0,039). NRS kedua dan ketiga pada kelompok yoga lebih rendah daripada kelompok kontrol (masing-masing p=0,027 dan <0,01). Besarnya perubahan NRS kedua secara signifikan berbeda dibanding NRS pertama pada yoga (1,92 ±2,4 vs 3,09 ± 2,8, p=0,018). Besarnya penurunan NRS yang pertama (0,06±1,1 vs 1,92±2,4, p=0,013) dan kedua (0,02 ± 1,6 vs 3,09 ± 2,8, p= 0,004) pada yoga secara signifikan lebih besar dibanding kelompok kontrol.
Kesimpulan: Skor NRS tidak berkorelasi dengan usia, IMT, dan usia menarche. Latihan hatha yoga menurunkan intensitas nyeri pada dismenore primer pada mahasiswi.

KATA KUNCI: *latihan otot panggul; relaksasi otot; pose yoga; pereda nyeri; dismenore primer*

ABSTRACT

Background: Yoga has been known as an alternative therapeutic modality for reducing pain. The benefits of yoga for reducing pain have been proven. Women often suffer pain due to dysmenorrhea. The effect of Yoga on dysmenorrhea pain has not been widely studied
Objectives: This study aimed to investigate the effect of hatha yoga on pain in primary dysmenorrhea (PD).
Methods: This was a randomized controlled study (RCT) involving 50 female students, 25

each in control (C) and yoga group (Y). PD was diagnosed by Working ability, Location, Intensity (Wong-Baker scale), and Days of the Pain of Dysmenorrhea (WaLIDD) questionnaire. Pain intensity was assessed by the Numeric Rating Scale (NRS). Hatha yoga training was conducted for 12 weeks. The unpaired t-test, ANOVA and Tukey post hoc, and Pearson correlation test was applied. Significance was set at $p<0.05$.

Results: The characteristics between groups were not different. ANOVA indicated the NRS score in control was not changed, while yoga was diminished ($p=0.02$). Tukey post hoc showed that the second and third NRS were lower than basal NRS ($p=0.038$ and 0.01, respectively). The third was also lower than the second NRS ($p=0.039$). The second and the third NRS in yoga were lower than in control ($p=0.027$ and <0.01, respectively). The second magnitude of change of NRS was significantly different from the first in yoga (1.92 ± 2.4 vs. 3.09 ± 2.8, $p=0.018$). The magnitude of NRS changes in the first (0.06 ± 1.1 vs. 1.92 ± 2.4, $p=0.013$) and second (0.02 ± 1.6 vs. 3.09 ± 2.8, $p= 0.004$) in yoga was significantly greater than the control. NRS score was not correlated with age, BMI, and age of menarche.

Conclusions: Hatha yoga exercise ameliorate pain intensity in primary dysmenorrhea among female university students.

INTRODUCTION

Dysmenorrhea is highly prevalent with a wide range of prevalence. It is estimated that the prevalence varies from 45% to 95% (1).The prevalence of dysmenorrhea among schoolgirls was about 43%-91%, as reported by previous studies (2). A study in Indonesia reported that about 87.5% of women in Jakarta had dysmenorrhea (3). This wide range might be due to different definitions of the dysmenorrhea condition (1).

A typical symptom of dysmenorrhea is abdominal pain before and during menstruation (4). However, the symptoms of dysmenorrhea vary across time and between individuals due to various influencing factors (5). Dysmenorrhea symptoms often harm women's daily activities. Primary dysmenorrhea often causes physical activity restriction and increases absenteeism from work and school (5). In more severe symptoms, anxiety, and depression, could arise (6).

Nevertheless, despite this considerable impact on quality of life and general well-being, only a few women seek primary dysmenorrhea (PD) treatment as they are less confident in the usual treatment. While the treatment of PD may not get appropriate attention as PD may not be seen as a legitimate health issue by women and healthcare providers (5). Pharmacokinetic treatment is the most common option for dysmenorrhea. Pharmacokinetics drugs aim to relieve pain or symptoms by altering the physiologic mechanisms causing pain and symptoms (7). Drugs such as NSAIDs reduce pain by inhibiting prostaglandin production by decreasing the activity of cyclo-oxygenase

pathways (7), whereas oral contraceptive reduces pain by inhibiting ovulation (8). However, some women may be unresponsive to NSAIDs, and pharmacokinetic drugs can have some adverse effects (9).

Alternative treatments for dysmenorrhea have been studied. *Yoga* is an increasingly popular alternative medicine. A previous study reported that specially designed poses of yoga effectively improved pain and quality of life in non-athlete women aged 18-22 with PD (10). *Hatha yoga*, with some poses such as *bhujangsana, shavasana,* and *vajrasana*, was also claimed to improve pain due to dysmenorrhea (11). *Yoga* movements may reduce pain through relaxation of the pelvic muscles and natural sedatives by increasing the release of the endorphins hormone (10).

The COVID-19 pandemic forced the government to issue strict policies to reduce the spread of infection. Large-scale social restrictions make people engage in limited social activities and physical distancing. Most social activities turn into online activities, including physical exercise, sports, and school classes. Therefore, this study aimed to investigate the effect of hatha *yoga* online training on the reduction of primary dysmenorrhea pain in female college students.

MATERIALS AND METHODS

This study aimed to investigate the effect of Yoga exercise on pain scale reduction in students with dysmenorrhea. Pain scale was an independent variable. Pain and dysmenorrhea were evaluated using established questionnaire tools. The results were examined using appropriate statistical test.

This study involved fifty healthy females, students of the School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia. Participants were divided into two groups using a block randomization method to ensure a balance sample size in each group, the *yoga* group (n=25) and the control group (n=25). This study was held during the COVID-19 social activity restriction period (May to August 2021). All participants gave their informed consent by signing a consent form. The study protocol was approved by the Ethics Committee of Atma Jaya Catholic University (Approval number: 65/04/KEP-FKUAJ/2021)

The participants who were healthy and had no sexual hormones disturbances were included. Participants with spinal deformities, musculoskeletal and cardiopulmonary disorders, and balance, coordination, and vestibular disturbances were excluded. Participants who exercised regularly for at least three months before the study were also excluded. Participants were asked to refrain from taking analgesics at least three days prior to pain evaluation. Also, participants had to discontinue hormonal medication and hormonal status-affecting drugs at least a month before and during the study.

Dysmenorrhea was evaluated using a scale-type questionnaire consisting of four items: working ability, location, intensity (Wong-Baker scale), and days of the pain of dysmenorrhea (WaLIDD). The WaLIDD score is a valid, reliable new tool to diagnose PD (12). Each item provided a score ranging from 0-3; thus, the total score ranged from 0 to 12. The WaLIDD score was classified as no dysmenorrhea for a score of 0, mild dysmenorrhea for a score of 1 to 4, moderate dysmenorrhea for a score of 5 to 7, and severe
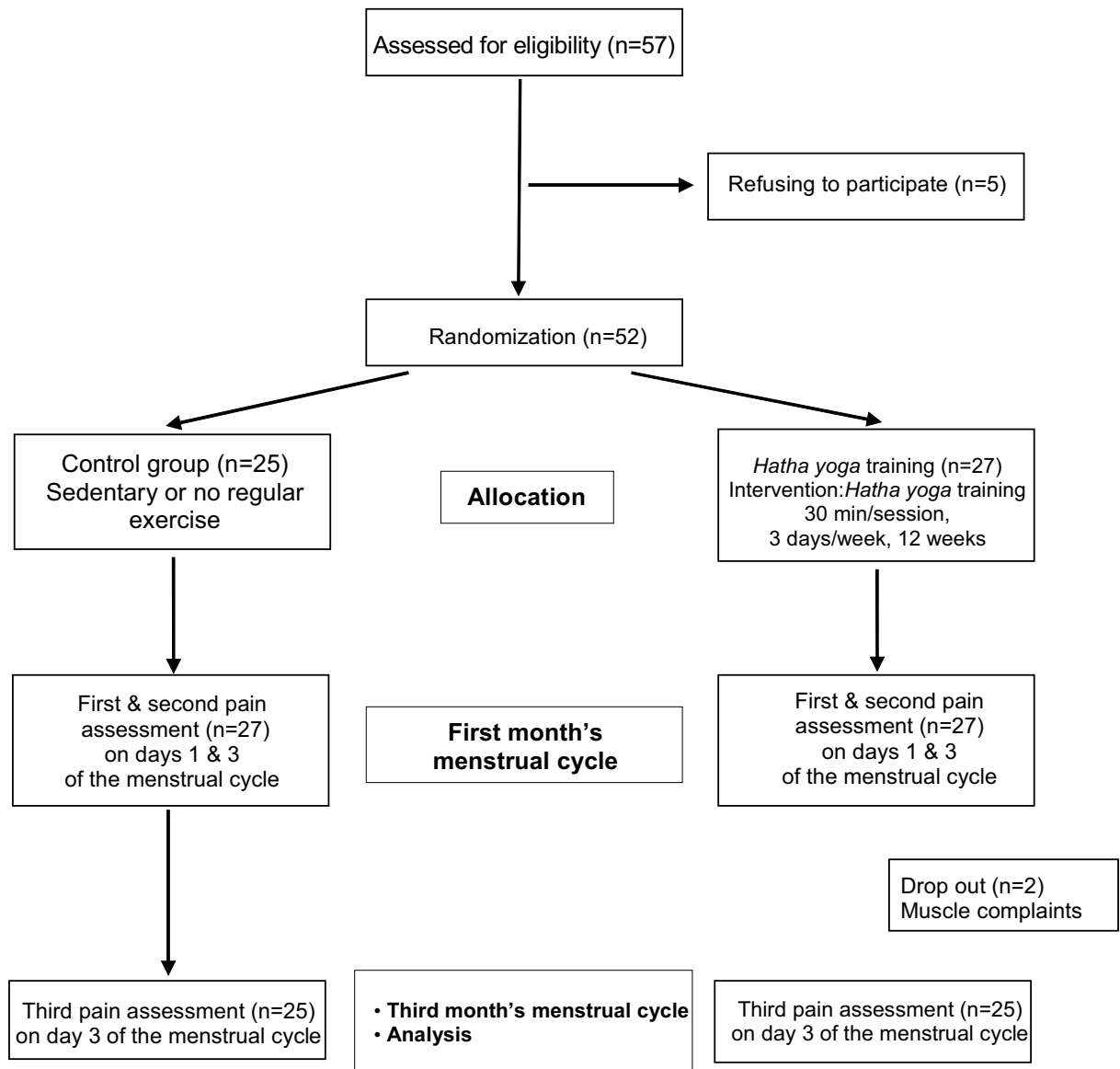
Figure 1. Flow diagram of the participants in the study

dysmenorrhea for a score of 8 to 12. The Wong-Baker scale is a four scale that describes the intensity of the pain (no hurt, little bit hurts, hurts even more, and hurst worst) (2,12). WaLIDD score was taken once during the first month's menstrual cycle. A score ≥8 was included in this study. .

The pain was assessed using the Numerical Rating Scale (NRS). The NRS has a good validity and reliability (13). Participants were asked to choose the number between 0 to 10 that fits best describes their pain intensity. 'Zero' usually refers to 'no pain at all'

whereas 'ten' refers to 'the worst pain ever possible' (13). The pain was evaluated three times, day 1 (basal) and day 3 of the first month's menstrual cycle (second), and day 3 of the third month's menstrual cycle (third).

Before the training program, the eligibility of the participants to participate in the *yoga* training was evaluated using a Physical Activity Readiness Question (PAR-Q) consisting of seven simples 'yes/no questions. Answered 'yes' to any question; the participant would not be allowed to participate in the training (14).

Training preparation for Hatha *yoga* was made for a week, a few weeks before the next menstrual cycle. In the preparation training, participants were taught to do *yoga* poses. *Yoga* preparation and training were delivered as online training using a personal device via the zoom application. The participants must turn on their gadgets and the camera during the practice. The training was conducted under the guidance of videos of *yoga* poses from a certified instructor recorded earlier. The certified instructor supervised poses and corrected every incorrect pose performed by the participants.

The *Hatha yoga* training was carried out for 12 weeks, three days a week, and 30 minutes for each session. Each *yoga* training session consists of warm-up asanas, the *Hatha yoga* (main training), *pranayama* (breathing exercise), closing *asanas*, and *savasana*. The warm-up *asanas* consisted of 5 *asanas* and were completed in 2.5 min. *Hatha yoga* consists of four poses, *Vajrasana, Ustrasana* (camel pose), *Bhujangasana* (cobra pose), and *Supta Baddha Konasana*. Each pose was performed for 3 minutes; thus, it took 12 minutes for all *Hatha* yoga poses. *Pranayama* exercise consisted of *ujjayi* and *nadhi shodhana*, took 3 minutes. Closing *asanas* contained five *asanas* which lasted for 2.5 minutes. The *yoga* practice session ended with *savasana*, a deep relaxation, which took 10 minutes. The overall practice duration for each session was 30 minutes.

Data were presented in numeric scale. Characteristic differences and changes in NRS between groups and the magnitude of NRS change were analyzed using the unpaired student t-test. Changes in NRS within groups were examined by ANOVA and followed by the Tukey post hoc test. The correlation between pain and possible influencing factors was analyzed using the Pearson correlation. A significant difference was accepted if $p < 0.05$. Statistic tests were accomplished using SPSS version 17.

RESULTS AND DISCUSSION
RESULTS

The characteristics of the participants are described in **Table 1**. The average BMI was within the normal value, with four participants (8%) classified as overweight and obese. There was no significant difference in the characteristics between the control and *yoga* groups (all $p > 0.05$). The basal NRS score between the control and *yoga* group was not significant (7.48 ± 1.9 vs. 7.52 ± 1.8, $p=0.681$)

Table 1. The characteristic differences between groups

Variables	Overall	Control (n=25)	*Yoga* group (n=25)	*P*
Age (years)	19.4 ± 1.0	19.3 ± 1.1	19.6 ± 0.9	0.408
Weight	56.1 ± 10.6	59.1 ± 12.2	52.9 ± 7.6	0.035
Height	161.2 ± 6.4	163.5 ± 6.5	158.7 ± 5.4	0.006
BMI (kg/m2)	21.3 ± 3.2	22.0 ± 3.7	20.4 ± 2.6	0.130
Menarche (years)	12.5 ± 1.3	12.3 ± 1.3	12.5 ± 1.3	0.590
Menstrual period (days)	5.6 ± 0.9	5.6 ± 0.8	5.6 ± 1.0	0.875
Basal NRS score	7.49 ± 1.9	7.48 ± 1.9	7.52 ± 1.8	0.681

BMI-body mass index; NRS-numeric rating scale

Table 2 illustrate the NRS score change in the control and *yoga* group. There was no difference in basal NRS between the control and *yoga* groups (p=0.681). The *yoga* group's second and third NRS were significantly below the control group (*p*=0.027 and <0.01, respectively). No difference in NRS over time was found in control (*p*=0.889). NRS over time was significantly changed in *yoga* (p=0.02). Tukey post hoc indicated that the second and third NRS were lower than basal NRS (p=0.038 and 0.01, respectively). The third was also lower than the second NRS (*p*=0.039)

Table 2. NRS score changes over time

Group	Basal NRS	Second NRS	Third NRS	*p**
Control	7.48 ± 1.9	7.54 ± 1.7	7.50 ± 1.9	0.889
Yoga group	7.52 ± 1.8	5.60 ± 1.8§	4.43 ± 1.9§?	0.02
p?	0.681	0.027	<0.01	

Note: *Anova, ?Unpaired student, §Compared to basal, ?Compared to second

NRS-numeric rating scale

The magnitude of NRS change (Δ) is presented in **Table 3**. The first ΔNRS was basal NRS subtracted from the second NRS, while the second ΔNRS was basal NRS subtracted from the third NRS. An unpaired student t-test was applied to test the significance. Within the group, there was no difference between the first ΔNRS and the second ΔNRS in the control (*p*=0.416). The second ΔNRS was significantly greater than the first ΔNRS in *yoga* (p=0.018). Between-group, first and second ΔNRS in *yoga* was greater than in control (*p*=0.013 and 0.004, respectively)

Table 3. The magnitude of NRS change

Group	first ΔNRS	second ΔNRS	*p*
Control	0.06 ± 1.1	0.02 ± 1.6	0.416
Yoga group	1.92 ± 2.4	3.09 ± 2.8	0.018
p	0.013	0.004	

NRS-numeric rating scale

Several associated factors might influence pain. Three possible factors were analyzed to identify their correlation with pain. Age, BMI, and age at menarche did not correlate with the first, second, and third NRS. The p-value of the correlation is presented in **Table 4**.

Table 4. The correlation between NRS score and possible influencing factors

	1st NRS	2nd NRS	3rd NRS
Age	0.543	0.499	0.437
BMI	0.498	0.700	0.372
menarche	0.211	0.215	0.270

NRS-numeric rating scale

DISCUSSION

A positive effect of *yoga* among females with primary dysmenorrhea has been demonstrated in previous studies. Many *yoga* exercises have been delivered to diminish or relieve pain in primary dysmenorrhea. *Hatha yoga* is a type of yoga that participants frequently practice. *Hatha yoga* has many exercises or poses, while only a few body poses are applied and varies between studies. The present study applied *Hatha yoga* with certain poses (*Vajrasana, Ustrasana, Bhujangasana*, and *Supta Baddha Konasana*) for twelve weeks involving fifty female students of medical school. The results revealed a significant reduction in pain intensity, as measured by NRS, compared to the control. Pain reduction was not associated with age, BMI, and age at menarche.

The effect of exercise on the decrement of menstrual disorders symptoms has been documented. Moderate-intensity aerobic exercise has been reported to attenuate premenstrual syndrome (PMS) ('15). Another type of aerobic exercise also positively affected menstrual disorders. Cycling exercise for eight weeks in female students demonstrated a decrease in the amount and duration of bleeding and decreased pain in primary dysmenorrhea (16). Further study was developed to investigate the impact of specific exercises, such as *yoga*, on pain due to primary dysmenorrhea. A meta-analysis of randomized controlled trial studies found that *yoga* was effective in alleviating menstrual pain in women with primary dysmenorrhea (17). It was also documented that the effect of *yoga* did not just relieve pain but also improved physical fitness and quality of life (QOL) in a young female with primary dysmenorrhea (–10).

Hatha yoga is a type of *yoga* that consists of a set of *yoga* poses (physical posture) and breathing exercises. Typical *Hatha yoga* is conducted more slowly and more static poses maintained than other types of *yoga*. Hence, *Hatha yoga* emphasizes the force of the body. In this study, 50 female medical students were instructed to exercise *yoga* for 30 minutes each session, 3 days a week, for 12 weeks. The findings of a recent study indicated that Hatha *yoga* exercise could significantly reduce dysmenorrhea pain in female college students. Prior research involved nursing students with PD and employed *yoga* training for 60 minutes each session, once a week, for 12 weeks (18). They reported that menstrual cramps and distress were significantly relieved (18). Tele *Hatha yoga* exercises were performed in a previous study (19). The tele exercise was conducted using the Zoom application, 45 minutes each session, twice a week, for 6 weeks. The results indicated that *yoga* exercise improved menstrual symptoms, depression, quality of life, and body awareness (19).

Mechanisms of *yoga* in alleviating dysmenorrhea pain due to exercise have been hypothesized, which appears to be similar to the effect of other physical exercises. Pain intensity was associated with stress level, anxiety, and depression in women experiencing primary dysmenorrhea (20,21). Increased stress levels, anxiety, and depression could trigger the release of a neurotransmitter associated with pain (22). Consequently, diminishing stress levels, anxiety, and depression can alleviate pain intensity. Studies have shown that exercise regularly can ameliorate pain levels due to its effect on neurotransmitters, hormonal change, and increased endorphin release,

improving mood and pain perception (23,24).

The recent study employed some poses in the Hatha *yoga* training program, which train the large muscles around the hip. *Vajrasana* poses train pelvic floor muscles, while *Ustrasana*, a camel-like pose, trains the back, quadriceps, abdomen, chest, and shoulders muscles. *Bhujangasana*, a cobra-like pose, train buttocks, back, abdomen, and shoulders muscle, whereas *Supta Baddha Konasana* train thigh and pelvic muscles (25,26). We assumed the above poses could stretch the muscles, increasing muscle flexibility and strength. Muscle cramps around the pelvis are thought to be related to pain in PD (27). Therefore, performing *yoga* poses as above will train pelvic muscles to increase flexibility and strength, release spasms, and reduce pain in PD.

Many factors are associated with dysmenorrhea. Age, BMI, and age at menarche had been believed as associated risk factors for dysmenorrhea (25,28,29). However, the correlation between the associated risk factors with pain in PD lacks evidence. A study on the relationship between pain and age has been investigated, but it observed chronic pain in orofacial disorder (30). The association between BMI and chronic pain has also been confirmed (31). To our knowledge, the association between Age, BMI, and acute pain, especially in PD, is less evident. Despite many studies on the relationship between menarche's age and dysmenorrhea, pain intensity predictors have yet to be much explored and reported. A study on pain intensity in PD and its predictors has been performed (32). They found some predictors of pain but did not find the age of menarche to be a predictor of pain (32). Our finding also confirmed no correlation between age, BMI, and age of menarche and pain intensity.

This study had several limitations. Symptoms of PD and the benefits of *Hatha yoga* exercise cover many aspects and have been well documented. By providing pain as a single parameter, the comprehensive treatment effect of *yoga* exercise could not be seen, e.g., the effect on mood, anxiety, body awareness, quality of life, etc. Besides, no other possible influencing factors were included. Alteration in pain perception might be affected by several factors or more prominent in certain circumstances. By including those factors, their contribution to change in pain perception can be observed. Also, predictors of pain are necessary to investigate. By recognizing the pain predictors, pain in PD could be attenuated, and absenteeism from work and school could be minimized.

CONCLUSION AND RECOMMENDATION

This RCT study investigated the effect of *Hatha yoga* on pain reduction in female university students with PD. Overall, we concluded that *the Hatha yoga* exercise improved the severity of pain and suggested that *Hatha yoga* can be considered non-pharmacological therapy for PD. We recommend the further research including more independent variables (mood, anxiety, quality of life) to see the comprehensive effect of *Hatha Yoga*.

REFERENCES

1. Yesuf TA, Eshete NA, Sisay EA. Dysmenorrhea among University Health Science Students, Northern Ethiopia: Impact and Associated Factors. *International Journal of Reproductive*

Medicine. 2018;2018:1–5. Available from: /pmc/articles/PMC5828460/

2. OSAYANDE AS, MEHULIC S. Diagnosis and Initial Management of Dysmenorrhea. *American Family Physician*. 2014 Mar 1 ;89(5):341–6. Available from: https://www.aafp.org/pubs/afp/issues/2014/0301/p341.html.

3. Juniar D, Epidemiology JD. Issue 1 Article 4 4-1-2015 of Dysmenorrhea among Female Adolescents in Central Jakarta. *Makara Journal of Health Research* (*MJHR*). 2015;19(1):21. Available from: https://scholarhub.ui.ac.id/mjhr.

4. Classification of Chronic Pain, Second Edition (Revised) - International Association for the Study of Pain (IASP). Available from: https://www.iasp-pain.org/publications/free-ebooks/classification-of-chronic-pain-second-edition-revised/

5. Iacovides S, Avidon I, Baker FC. What we know about primary dysmenorrhea today: a critical review. *Human Reproduction Update*. 2015 Nov 1;21(6):762–78. Available from: https://academic.oup.com/humupd/article/21/6/762/628858.

6. Fernández-Martínez E, Onieva-Zafra MD, Parra-Fernández ML. The Impact of Dysmenorrhea on Quality of Life Among Spanish Female University Students. *International Journal of Environmental Research* and *Public Health* 2019, Vol 16, Page 713. 2019 Feb 27;16(5):713. Available from: https://www.mdpi.com/1660-4601/16/5/713/html

7. Marjoribanks J, Ayeleke RO, Farquhar C, Proctor M. Nonsteroidal anti-inflammatory drugs for dysmenorrhoea. Cochrane Database of Systematic Reviews. 2015 Jul 30 ;2015(7). Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD001751.pub3/full

8. Damm T, Lamvu G, Carrillo J, Ouyang C, Feranec J. Continuous vs. cyclic combined hormonal contraceptives for treatment of dysmenorrhea: a systematic review. Contracept X [Internet]. 2019 Jan 1 [cited 2023 Apr 12];1:100002. Available from: /pmc/articles/PMC7286154/

9. Oladosu FA, Tu FF, Hellman KM. NSAID resistance in dysmenorrhea: epidemiology, causes, and treatment.

10. Yonglitthipagon P, Muansiangsai S, Wongkhumngern W, Donpunha W, Chanavirut R, Siritaratiwat W, et al. Effect of yoga on the menstrual pain, physical fitness, and quality of life of young women with primary dysmenorrhea. [Journal of Bodywork and Movement Therapies](http://www.bodyworkmovementtherapies.com/article/S1360859217300177/fulltext) 2017 Oct 1;21(4):840–6. Available from: http://www.bodyworkmovementtherapies.com/article/S1360859217300177/fulltext.

11. Prabhu S, Nagrale S, Shyam A, Sancheti P. Effect Of Yogasanas On Menstrual Cramps In Young Adult Females With Primary Dysmenorrhea. International Journal of Physiotherapy and Research. 2019 Aug 11;7(4):3129–34.

12. Teherán AA, Piñeros LG, Pulido F, Mejía Guatibonza MC. WaLIDD score, a new tool to diagnose dysmenorrhea and predict medical leave in university students. *International Journal of Women's Health and Wellness*. 2018 ;10:35. Available from: /pmc/articles/PMC5775738/

13. Ameade EPK. Menstrual Pain Assessment: Comparing Verbal Rating Scale (VRS) with Numerical Rating Scales (NRS) as Pain Measurement Tools.

International Journal of Women's Health and Wellness. 2016 Mar 31;2(1).

14. Warburton D, Jamnik V, Bredin S, Gledhill N. The Physical Activity Readiness Questionnaire (PAR-Q+) and electronic Physical Activity Readiness Medical Examination (ePARmed-X+). *Health & Fitness Journal Can.* 4(2):3–23.

15. Ravichandran H, Janakiraman B. Effect of Aerobic Exercises in Improving Premenstrual Symptoms Among Healthy Women: A Systematic Review of Randomized Controlled Trials. *International Journal of Women's Health and Wellness.* 2022 ;14:1105–14. Available from: https://pubmed.ncbi.nlm.nih.gov/35996479/

16. Pemberdi Intasir M, Sumarni E, Raja M, Haji A, Studi P, Biologi P, et al. Relationship of Physical Activity to Primary Dysmenorrhea. Journal Midwifery. 2022 Dec 27;7(2):94–7. Available from: http://jom.fk.unand.ac.id/index.php/jom/article/view/514.

17. Kim SD. Yoga for menstrual pain in primary dysmenorrhea: A meta-analysis of randomized controlled trials. Complementary Therapies in Clinical Practice Overview. 2019 Aug 1;36:94–9.

18. Yang NY, Kim SD. Effects of a Yoga Program on Menstrual Cramps and Menstrual Distress in Undergraduate Students with Primary Dysmenorrhea: A Single-Blind, Randomized Controlled Trial. https://home.liebertpub.com/acm. 2016 Sep 1;22(9):732–8. Available from: https://www.liebertpub.com/doi/10.1089/acm.2016.0058.

18. Günebakan Ö, Acar M. The effect of tele-yoga training in healthy women on menstrual symptoms, quality of life, anxiety-depression level, body awareness, and self-esteem during COVID-19 pandemic. Irish *Journal of Medical Science.* 2023 Feb 1;192(1):467. Available from: /pmc/articles/PMC8945871/.

19. Mickle AM, Garvan C, Service C, Pop R, Marks J, Wu S, et al. Relationships Between Pain, Life Stress, Sociodemographics, and Cortisol: Contributions of Pain Intensity and Financial Satisfaction. Chronic Stress 4:1–1.
Available from: https://us.sagepub.com/en

20. Sheng J, Liu S, Wang Y, Cui R, Zhang X. The Link between Depression and Chronic Pain: Neural Mechanisms in the Brain. *Neural Plasticity* 2017 Jun 19;2017. Available from: /pmc/articles/PMC5494581

22. Haase J, Brown E. Integrating the monoamine, neurotrophin and cytokine hypotheses of depression - A central role for the serotonin transporter? *Pharmacology & Therapeutics.* 2015;147:1–11.

23. Motahari-Tabari N, Shirvani MA, Alipour A. Comparison of the Effect of Stretching Exercises and Mefenamic Acid on the Reduction of Pain and Menstruation Characteristics in Primary Dysmenorrhea: A Randomized Clinical Trial. Oman Medical Journal. 2017 Jan 1;32(1):47. Available from: /pmc/articles/PMC5187401/

24. Giri C. Perception of the therapeutic benefit of exercise on primary dysmenorrheal among post-pubertal students in a Northwestern city of Nigeria. 2017;4(1):14–22. Available from: https://www.researchgate.net/publication/

280886459_Perception_of_the_therapeutic_benefit_of_exercise_on_primary_dysmenorrheal_among_post-pubertal_students_in_a_Northwestern_city_of_Nigeria

25. Akbarzadeh M, Tayebi N, Abootalebi M. The Relationship between Age at Menarche and Primary Dysmenorrhea in Female Students of Shiraz Schools. Shiraz E-Medical Journal 2017 189 [Internet]. 2017 Sep 1;18(9):14520. Available from: https://brieflands.com/articles/semj-14520.html

26. Coulter, David. ANATOMY OF HATHA YOGA. A manual for students, teachers, and practitioners. 2017. Honesdale, PA: Body and Breath. USA.

27. Oladosu FA, Tu FF, Farhan S, Garrison EF, Steiner ND, Roth GE, et al. Abdominal skeletal muscle activity precedes spontaneous menstrual cramping pain in primary dysmenorrhea. *American Journal* of *Obstetrics and Gynecology* . 2018 Jul 1;219(1):91.e1-91.e7. Available from: https://pubmed.ncbi.nlm.nih.gov/29733841/

28. Gutman G, Nunez AT, Fisher M. Dysmenorrhea in adolescents. *Current Problems in Pediatric and Adolescent Health Care*. 2022 May 1;52(5):101186.

29. Duman NB, Yıldırım F, Vural G. Risk factors for primary dysmenorrhea and the effect of complementary and alternative treatment methods: Sample from Corum, Turkey. *International Journal* of *Health Sciences* (Qassim). 2022;16(3):35. Available from: /pmc/articles/PMC9092532/

30. Boggero IA, Geiger PJ, Segerstrom SC, Carlson CR. Pain Intensity Moderates The Relationship Between Age And Pain Interference In Chronic Orofacial Pain Patients. Experimental *Aging* Research 2015 Aug 8;41(4):463. Available from: /pmc/articles/PMC4526253/

31. Qian M, Shi Y, Yu M. The association between obesity and chronic pain among community-dwelling older adults: a systematic review and meta-analysis. *Geriatric Nurse*. 2021 Jan 1;42(1):8–15.

32. Abu Helwa HA, Mitaeb AA, Al-Hamshri S, Sweileh WM. Prevalence of dysmenorrhea and predictors of its pain intensity among Palestinian female university students. BMC Womens Health. 2018 Jan 15 ;18(1). Available from: https://pubmed.ncbi.nlm.nih.gov/29334974/