

Yoga for menstrual pain in primary dysmenorrhea: A meta-analysis of randomized controlled trials

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ABSTRACT

Objectives: To assess the overall effect size of the impact of yoga on menstrual pain in primary dysmenorrhea. **Methods:** Randomized controlled trials that were published in the English language until December 2018 in PubMed, EMBASE, Web of Science, and the Cochrane Library electronic databases were searched. The methodologies from 4 trials conducted on 230 participants with primary dysmenorrhea were included in this meta-analysis to compare the effects that performing a yoga program has on menstrual pain ($n = 129$) to the effects of not performing yoga ($n = 101$). **Results:** The overall effect size of the impact of a yoga program on menstrual pain in primary dysmenorrhea was high with a standardized mean difference of -2.09 (-3.99 to -0.19) ($p = 0.031$) among the effect sizes of the 4 trials (95% confidence interval). **Conclusions:** Yoga is an effective intervention for alleviating menstrual pain in women with primary dysmenorrhea.

1. Introduction

Menstrual pain is the most common symptom associated with primary dysmenorrhea [1]. The pathogenesis of menstrual pain is commonly believed to stem from an abnormal elevation in the production of vasoactive prostaglandins in the endometrium, which may induce myometrial hyperactivity, uterine tissue ischemia, and pain [2,3]. Menstrual pain leads to socioeconomic problems and to physical and psychological health problems [4]. Therefore, various measures, such as using medical plants, drugs, and complementary and alternative therapies, have been employed to alleviate menstrual pain [5–8]. The most important aspect of a menstrual pain therapy is the focus on pain relief.

According to previous studies, from among the complementary and alternative therapies available, yoga seems to suppress menstrual pain by reducing the level of prostaglandin production and myometrial ischemia via the “down-regulation of the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system” [3,8–12]. As have stated, the mechanism behind the effect yoga has on menstrual pain relief has been demonstrated. In addition, the effectiveness of yoga in relieving menstrual pain has also been put forward via studies involving randomized controlled trials (RCTs) [7,12–17]. However, despite the growing amount of information available on the favorable effects of yoga and the scientific mechanism behind the physical and

physiological variables involved while practicing yoga, it has still not been widely adopted as part of a regimen to prevent menstrual pain by women with primary dysmenorrhea. This implies that adequately powered and well-designed RCTs are required to identify the effectiveness of yoga on menstrual pain in women with primary dysmenorrhea. Furthermore, analytical methods are needed to remedy the methodological deficiencies of previous studies on the effects of yoga on menstrual pain associated with primary dysmenorrhea. Therefore, a meta-analysis was performed in this study to evaluate the effectiveness of yoga on menstrual pain assessed by menstrual pain intensity levels in women with primary dysmenorrhea.

2. Materials and methods

2.1. Search strategy

This meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [18] and the Consolidated Standards of Reporting Trials (CONSORT) guidelines for reporting parallel group randomized trials [19]. A search was performed to identify all the RCTs conducted to evaluate the effects of practicing yoga in relation to menstrual pain published until December 2018 in PubMed, EMBASE, Web of Science, and the Cochrane Library electronic databases. The search terms used

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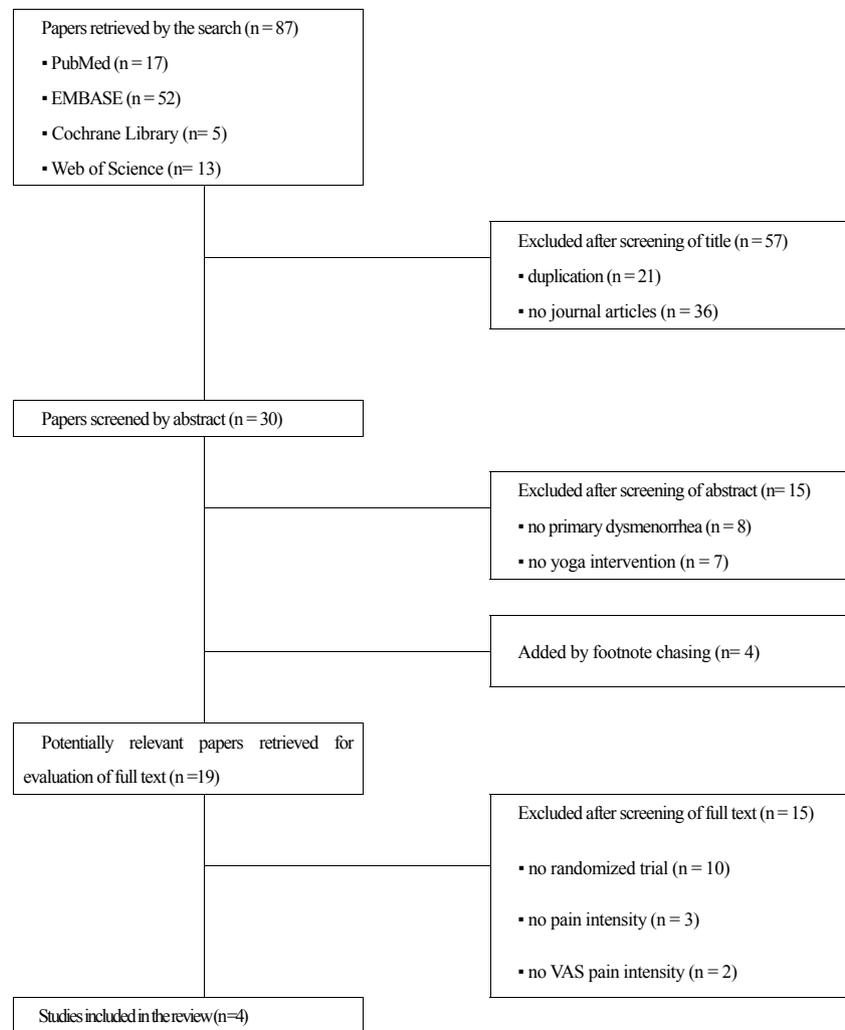


Fig. 1. Flowchart of included studies through the literature searches.

were “yoga,” and “menstrual cramps,” “menstrual pain,” or “primary dysmenorrhea.” Footnote chasing was conducted to identify any additional references [20]. All potentially eligible studies and their corresponding full-text articles were retrieved and reviewed to determine whether they met the inclusion criteria. The flow chart for the meta-analysis is represented in Fig. 1.

2.2. Selection of eligible studies

To be eligible, a study had to meet specific inclusion criteria that were evaluated using the criteria recommended by the Cochrane Menstrual Disorders and Subfertility Group and the Consolidated Standards of Reporting Trials [8,18,21]. The first criterion was the type of study: RCTs that were published as full papers in the English language. The second criterion was the type of participants involved: subjects with pain either affecting daily activities or with a high baseline score, within reproductive age, and having primary dysmenorrhea. The third criterion was the type of intervention being studied to manage the pain: studies involving using yoga as an intervention to reduce the pain associated with primary dysmenorrhea. The fourth criterion was comparison studies: RCTs comparing the outcome of using yoga as a treatment for primary dysmenorrhea versus not using yoga. The final criterion was the method used to measure the outcome: studies in which pain intensity was measured by a visual analogue scale (VAS).

2.3. Data extraction

Data on the characteristics of the participants (inclusion criteria, sample size, age, dropouts, etc.), characteristics of the intervention and control (interventions, delivery methods, duration, interventionist, etc.), outcome measures, adverse effects, and limitations were extracted.

2.4. Quality assessment

Quality appraisal of included trials was conducted by a critical appraisal Cochrane risk of bias tool RCTs, which was recommended by the Cochrane Handbook for systematic Reviews of Interventions [22]. The Cochrane risk of bias tool is consisted of six-items such as random sequence generation, allocation concealment, blinding, incomplete outcome data, selective reporting data, and other bias. Each item was rated as yes, no, or unclear [22]. “The quality of included trials in this review were evaluated in three levels according to the Cochrane Handbook” [22,23]. “If the study design met all six-items, it is evaluated A level, which means the low risk of bias” [22,23]. “If one or more criteria were partly met, it would be assigned B level. If one or more criteria were not met, the study would be defined as C level, implying high risk of bias” [22,23].

2.5. Data synthesis

Data synthesis and all statistical analyses were performed using Review Manager version 5.3 (<https://www.meta-analysis.com>). All the available trials with reporting data were summarized. Tests for heterogeneity among the included trials were carried out using Cochran's Q test statistic and I^2 test statistic. If significant homogeneity was found, a fixed-effects model was used to confirm the trial results, and in case of significant heterogeneity, a random-effects model. The results measuring the outcomes are reported as a standardized mean difference (Hedge's effect sizes) with 95% confidence intervals [20]. The results of this study were considered to be significant at $p < 0.05$.

3. Results

3.1. Study description

The literature retrieval process is presented in Fig. 1. A total of 87 titles related to the search terms were screened. Among these, 17 potential trials were identified from PubMed, 52 from the EMBASE, 5 from the Cochrane Library, and 13 from the Web of Science databases. After the titles were retrieved, a total of 57 studies were excluded either because they were duplicates or they did not have journal articles. Following this, the abstracts of the 30 remaining titles were retrieved. After assessing the abstracts, 15 studies were excluded because they did not involve primary dysmenorrhea or a yoga intervention. Four potential trials were added to the study by footnote chasing. Nineteen potential trials were identified in the search conducted until December 2018, and their corresponding, potentially relevant, papers were retrieved for an evaluation of the full texts. After the evaluation, 15 studies were excluded because 10 of them did not involve RCTs, 3 did not involve menstrual pain intensity, and 2 did not use VAS to measure the pain intensity.

3.2. Participants

The characteristics of the participants included in the 4 selected studies are presented in Table 1. The 4 RCTs corresponding to the included studies were conducted in Korea, Iran, Japan, and Thailand, respectively. The enrolled participants were recruited by interviews at 3 universities and by telephone calls to child-care centers. The sample sizes in the 4 trials ranged from 34 to 98 participants and totaled to 230 participants collectively. The participants' mean ages among the groups from the 4 trials ranged from 20.0 years to 33.6 years.

3.3. Intervention

The yoga traditions were heterogeneous between the studies: 1 RCT used surya namaskara; another used yoga nidra, surya namaskara, and yoga asanas such as the cat and fish poses; yet another used surya namaskara and yoga asanas such as the cat and child poses; and the final RCT used yoga asanas such as the cobra, cat, and fish poses. The surya namaskara program includes postures such as the prayer pose, raised-arms pose, standing forward bend pose, equestrian pose, stick pose, salute with eight parts, cobra pose, and downward facing dog pose. The yoga nidra program includes resolve; rotation of consciousness; awareness of the breath, feelings, and sensations; visualization; ending the practice with resolve; etc. The length and frequency of the yoga sessions and the program duration for 1 of the trials was 30 min, 2 sessions a week for 12 weeks; for another trial, 120 min, 5 sessions a week for 12 weeks; for yet another trial, 4 sessions a week for 4 weeks; and for the final trial, a 20 min session a day for 14 days. The yoga program was performed under the guidance of a yoga expert in 1 of the trials, while the participants in 2 of the trials were given a booklet on yoga, and the final trial involved using a yoga instruction DVD. The 4 RCTs compared practicing yoga to not using any treatment for

menstrual pain.

3.4. Outcome measures

The effect sizes and forest plots measuring the impact of yoga on menstrual pain control corresponding to the included trials are outlined in Fig. 2. There was statistical heterogeneity among the trials ($Q = 87.69$, $p < 0.001$, $I^2 = 96.6$); random-effects models were used in the analysis. The mean overall effect size (95% CI) among the trials was -2.09 (-3.99 to -0.19 , $p = 0.031$).

3.5. Critical appraisal of quality

Assessments on each methodological quality item for all included trials are described in Table 2. Four trials were quality level A and quality critical appraisal had a low risk of bias.

3.6. Publication bias

Publication bias was estimated by using the fail-safe N (FSN) statistic [24,25]. The FSN was calculated using Review Manager version 5.3 (<https://www.meta-analysis.com>). The FSN for menstrual pain was 155 and is presented in Table 1. These results indicate that publication bias was unlikely in this meta-analysis.

3.7. Adverse effects

None of the included trials reported data on the adverse effects of yoga.

4. Discussion

The findings from this meta-analysis based on Hedge's criteria [20], involving 230 study participants, demonstrate a high effect size between practicing a yoga program and menstrual pain levels in women with primary dysmenorrhea. These findings imply that compared to not practicing yoga, a yoga intervention led to favorable results by significantly lowering menstrual pain levels. Similarly, a systematic review on the correlation between practicing yoga and primary dysmenorrhea also pointed out that a yoga intervention had a positive effect on reducing the pain associated with primary dysmenorrhea [4]. However, there are few evidence-based studies supporting these findings. Yoga is generally known to play a role in pain relief via the down-regulation of the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system [3,10]. According to previous studies, yoga interventions have been shown to reduce prostaglandin and homocysteine levels and also to stimulate the secretion of beta-endorphins acting as a non-specific analgesic [2,4,8,11,26–28]. Similar to these studies, evidence-based studies supporting these results need to be continued by adjusting the physiological parameters. Furthermore, meta-analyses by quantified statistical methods are needed to identify the physiological parameters that are affected by yoga as evidence that it plays an important role in pain relief in women with primary dysmenorrhea. Quality appraisal of the included trials showed high quality. However, 2 of the included trials had no double blinding. No double blinding in RCTs may act as a reporting bias “among the researchers directing the yoga program or among the participants during social interactions” [23]. Therefore, future trials are needed the double-blind design.

Apart from no double blinding, another aspect encountered in this meta-analysis was the heterogeneity among the subgroups in the included trials. The participants in the 4 included trials were from Korea, Iran, Japan, and Thailand, respectively. Further, the participants comprised of 162 university students in 3 trials collectively and 98 nursery school teachers in 1 trial. The different locations in which the trials were carried out are significant in terms of the generalization of the

Table 1
Characteristics of the included randomized controlled trials for meta-analysis.

Study, year, location	Participants	Interventions		Outcomes	Adverse events	Limitations	FSN
		Experimental group	Control group				
	Population Sample size (N: EG, CG) Mean age (age range) Drop out n (%)	Interventions Delivery method Duration Interventionist					
Yonglitthipagon et al., 2017, Thailand	University student (N = 34 (EG: 17, CG: 17)) 20 years (18–22) 0 (0.0)	Surya namaskara 30 min per day, twice per week 12 weeks Booklet of yoga was given	None	VAS pain intensity (p < 0.05) Flexibility (p < 0.00001) Back muscle strength (p < 0.05) Leg muscle strength (p < 0.0001) SF-36 (p < 0.05)	None	Participants were non-athlete students No any follow up after the 12 weeks yoga A small sample sizes Lack of blinding Subjective outcome measures	
Yang & Kim, 2016, Korea	University student (N = 36 (EG: 18, CG: 18)) 22 years (20–23) 0 (0.0)	Surya namaskara, yoga nidra, yoga asanas such as cat and fish poses 120 min per day, 5 days per week 12 weeks Yoga expert	None	VAS pain intensity (p < 0.001) Pain duration (p > 0.05) Menstrual distress (p < 0.0001)	None	No double blind No given treatment in control group No measured biochemical variables No control in diet and lifestyle	
Sakuma et al., 2012, Japan	Nursery school teachers (N = 68 (EG: 44, CG: 24)) 33 years (20–64) 30 (30.6)	Surya namaskara, yoga asanas such as cat and child's poses 7 times per week for 4 weeks Home-based yoga program with DVD instruction	None	Weight (p > 0.05) BMI (p > 0.05) Grip strength (p > 0.05) Flexible (p > 0.05) Function reach test (p > 0.05) Low back pain (p > 0.05) Upper and arm pain (p > 0.05) VAS pain intensity (p < 0.05)	None	No clear how accurately the yoga was practiced at home No double blind	
Rakhshae, 2011, Iran	University students (N = 92 (EG: 50, CG: 42)) 20 years (18–22) 28 (30.4)	Yoga asanas such as cobra, cat, and fish poses 120 min per day, 14 days for menstrual cycle Booklet described the yoga	None	VAS pain intensity (p < 0.05) pain duration (p < 0.05)	None	The obtained data is based on female adolescent participants' responses.	
Pooled studies							155

CG, control group; EG, experimental group; FSN, fail-safe N; N, number.

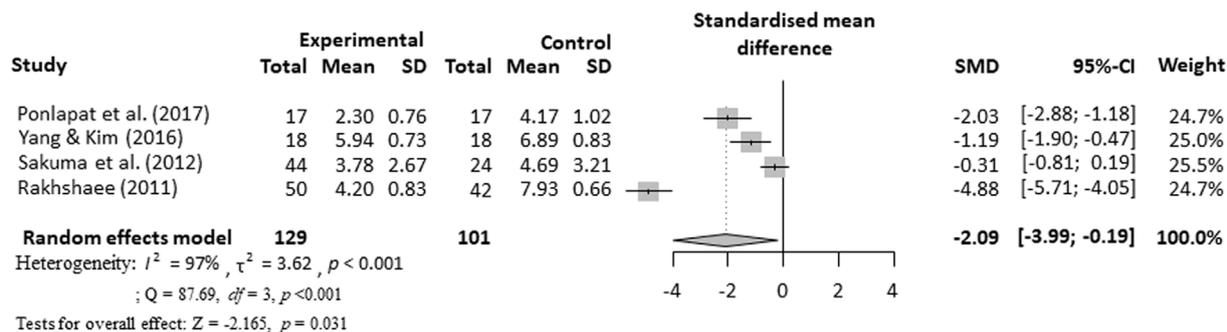


Fig. 2. Forest plot of yoga and control.

Table 2
Quality appraisal of all included studies.

Study, year	Sequence generation	Allocation concealment	Blinding	Incomplete outcome data	Selective outcome reporting	Other bias	Quality level
Yonglitthipagon et al., 2017	Yes	Yes	Yes	No	No	No	A
Yang & Kim, 2016	Yes	Yes	Yes	No	No	No	A
Sakuma et al., 2012	Yes	Yes	Yes	No	No	No	A
Rakhshae, 2011	Yes	Yes	Yes	No	No	No	A

Yes, criteria met and high quality; no, criteria not met and low quality; unclear, unclear whether criteria were met.

research. However, since the life patterns between university students and nursery school teachers are heterogeneous too, there may be a problem in interpretation of the meta-analysis. Therefore, because of the heterogeneity of the studies involved, we applied a random-effects model to this meta-analysis. As was the case with the characteristics of the participants, the types of yoga programs were heterogeneous among the studies too. The yoga programs assessed in the included trials were yoga asanas in 3 RCTs, surya namaskara in 3 RCTs, and yoga nidra in 1 RCT. Further, the yoga asana—the cat pose—was used in 3 trials. The yoga program surya namaskara was the most applied in the included trials. The surya namaskara has been recommended for menstrual pain relief by Bihar Yoga Bharati in India [27]. However, the length and frequency of the yoga sessions and the program durations of the included trials were heterogeneous too. The session lengths varied from 20 min to 120 min; the program durations were 14 days, 4 weeks, 12 weeks, etc. The frequencies of the yoga sessions were 2 or 5 sessions per week. The means via which guidance on practicing the yoga programs was provided to the participants were also heterogeneous; a booklet describing the yoga program was provided in 2 trials, a yoga expert conducted the program in 1 trial, and an instruction DVD was used in 1 trial. If the yoga program and guidance are not standardized, clients may be confused as to whether to choose yoga for menstrual pain relief. As described above, the subgroup analysis in the included trials may not be of scientific value due to the clinical heterogeneity between the trials. Therefore, additional studies that include subgroup parameters which take into consideration both participant and yoga characteristics are needed to confirm the effects of standardized yoga programs on primary dysmenorrhea. None of the included trials reported data on the adverse effects of yoga. Further, the dropout rate from the included trials was 20.1% due to participants having an irregular course of menstruation and withdrawing or not responding due to personal reasons. Publication bias was assessed to confirm if there were any unpublished studies on the efficacy of yoga on menstrual pain relief. Statistically insignificant studies tend to be unpublished. The FSN analysis revealed the number of additional studies needed to make the overall effect insignificant. The figure used in our study is not large enough, but would be credible if the number of studies was 5 x number of studies + 10 or more [25]. That is, this meta-analysis includes 4 studies, so it is credible if the number of studies was $5 \times 4 + 10 = 30$ or more. In this meta-analysis, the FSN calculation result is 155, and therefore, it can be said that publication bias was unlikely to occur in this meta-analysis.

This meta-analysis has several strengths. Firstly, only studies involving RCTs were included in the meta-analysis, which enhances the quality of our results. Secondly, the present study may be the first meta-analysis study conducted on RCTs to examine the effects of yoga on menstrual pain in women with primary dysmenorrhea using publications until 2018. Furthermore, this meta-analysis also has limitations. Firstly, publication bias or language bias may be possible because this meta-analysis reviewed studies only published in the English language. However, the results of the FSN for menstrual pain intensity by the Rosenthal's method indicated that publication bias was not observed among the included studies. Secondly, due to small sizes of the participants groups within the studies, the heterogeneity among their findings may interfere with the actual effect sizes. Therefore, we used a random-effects model to remedy this limitation.

5. Conclusions

In summary, a yoga intervention showed favorable outcomes on menstrual pain relief among participants with primary dysmenorrhea. These improvements were mainly in the participants' subjective parameters, such as menstrual pain intensity in primary dysmenorrhea. Factors like double blinding of the study qualities and intervention characteristics should be taken into consideration, and additional high quality RCTs are needed to confirm and further elucidate the effects of

standardized yoga programs on populations with primary dysmenorrhea.

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Disclosure statement

Conflicts of interest: none.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ctcp.2019.06.006>.

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