STUDY PROTOCOL

Meditation and yoga impact on dysmenorrhea (MY-ID): a study protocol [version 1; peer review: awaiting peer review]

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Abstract

Primary dysmenorrhea is one of the most prevalent gynecologic condition affecting women, especially adolescent girls. Among adolescents, associated symptoms of dysmenorrhea impact the general health status, negatively influence the quality of life, resulting in school absenteeism and decreased academic performance. This study protocol was developed to estimate the prevalence of dysmenorrhea and evaluate the effectiveness of Meditation and Yoga intervention on dysmenorrhea among adolescent girls. In phase 1, data will be collected from adolescent girls (N=5000) aged between 13 and 18 years to estimate the prevalence of dysmenorrhea and in the second phase, Cluster-Randomized Controlled Trial will be conducted to evaluate the impact of Meditation and Yoga on dysmenorrhea. From the first phase, those adolescent girls (N=400) with high pain intensity (numerical pain rating scale ≥ 4) from each school, with schools as clusters, will be assigned to the interventional and control arm. The interventional arm will receive the proposed Meditation and Yoga intervention for 12 weeks under supervision and the control arm will continue with standard routine care. The outcomes such as pain intensity, stress, academic performance, self-efficacy and biomarker levels (Hb, Progesterone, Estrogen, Prostaglandins F2α and E2) will be assessed at baseline and 12 weeks after the intervention. Yoga's
popularity and medical benefits have grown with the growing interest in alternative and complementary medicine. There is insufficient evidence to support yoga as a treatment for dysmenorrhea symptoms. This research contributes to the evidence on the impact of meditation and yoga on primary dysmenorrhea among adolescent girls.

**Keywords**
Primary dysmenorrhea, yoga, meditation, pain, adolescent

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1. Introduction

Dysmenorrhea, characterized by painful menstruation, is the most prevalent gynecologic condition affecting women, especially adolescent girls. Primary dysmenorrhea is associated with a normal ovulatory cycle during menstruation without an identifiable cause (Ferries-rowe, Corey, & Archer, 2020) and occurs in the absence of pelvic pathology. Increased prostaglandins and leukotriene levels mediate the inflammation, causing uterine contractility, cramping pain and discomfort (Mckenna, Fogleman, & Lancaster, 2021). The prevalence of dysmenorrhea ranges from 16% to 90% (Acheampong et al., 2019; Mckenna et al., 2021), with higher rates reported among adolescent girls. Furthermore, the estimated prevalence rate of dysmenorrhea is 85% in the United States of America (Acheampong et al., 2019), 84.2% in India (Kural, Noor, Pandit, Joshi, & Patil, 2015) and 83.6% in Ghana (Paul, Ameade, Amalba, & Mohammed, 2018).

Dysmenorrhea causes varying intensities of discomfort and pain ranging from minor discomfort to severe restriction in the ability to perform daily activities (Ferries-rowe et al., 2020). It is also associated with a decreased quality of life (Mckenna et al., 2021). An estimated 15% of adolescent females report significant pain, negatively influencing their quality of life (Dharmapuri, 2019). In menstrual-related symptoms, lower abdominal and back pain were more strongly associated with absenteeism from school and decreased efficacy among adolescent girls (Ferries-rowe et al., 2020). Greater school absenteeism is yet another concern and one-half of female students miss school at least once due to dysmenorrhea (Mckenna et al., 2021), missing school for 1 to 3 days per menstrual cycle (Dharmapuri, 2019) and 10% to 15% of them with frequent absence (Mckenna et al., 2021). According to studies, dysmenorrhea is also related to decreased academic performance, poor sleep quality, mood changes (Dharmapuri, 2019) and a higher risk of depression and anxiety (Dharmapuri, 2019; Mckenna et al., 2021). Dysmenorrhea is the most prevalent menstrual disorder and probably the most common gynecological disorder; however, the true burden is not very well known (Chhabra S, 2018). A study among Japanese women aimed to estimate the health care resource utilization describing treatment patterns and associated costs showed approximately 2–3-times higher annual healthcare costs in patients with dysmenorrhea than women without the condition (Akiyama, Tanaka, Cristeau, Onishi, & Osuga, 2017). Evidence supports that dysmenorrhea has been linked to an increased incidence of chronic pelvic pain syndrome (Tu & Hellman, 2021).

Many adolescent girls experience dysmenorrhea as a common problem. Suffering from severe spasmodic dysmenorrhea interrupts their academic and social life (Agarwal & Agarwal, 2010). Myometrial contractions, hypersensitization of pain nerve fibers, vasoconstriction, and ultimately the pain is mediated by prostaglandins F2α (PGF2α) and E2 (PGE2). Higher circulating levels of PGE2 and PGF2α are reported in women with dysmenorrhea compared with asymptomatic women during menstruation. These prostaglandin levels peak during the first 48 hours of menstruation when symptoms zenith (Iacovides, Avidon, & Baker, 2015). The severity of menstrual pain is also directly proportional to the release of prostaglandins (Dawood, 2006; Iacovides et al., 2015).

Findings from various studies reveal that primary dysmenorrhea is the leading cause of school absenteeism (Karanth & Liya, 2018; Omidvar, Bakouei, Amiri, & Begum, 2016), and has a negative impact on academic and daily activities (Yesuf, Estete, & Sisay, 2018). Several other symptoms, such as sleep disturbances (Agarwal & Agarwal, 2010; Karanth & Liya, 2018), low quality of life (Karanth & Liya, 2018), nervousness, depression, loss of appetite, headache and impact on general health status (Agarwal & Agarwal, 2010) were also reported by the adolescent girls along with painful menstruation. Dysmenorrhea significantly influences women’s lives, indicating a substantial public health burden (Zhu et al., 2021). Thus, the evidence from existing literature supports the considerable burden of this issue on public health.

The management approaches for primary dysmenorrhea can be pharmacological, non-pharmacological, or surgical. Pharmacological management by non-steroidal anti-inflammatory drugs is the most common treatment for menstrual pain; however, the research continues in alternative medicine to alleviate this excruciating pain (Dawood, 2006). In a study conducted to assess the management of primary dysmenorrhea, a small proportion of girls reported having sought medical advice. The majority of them were using self-selected medicine without a doctor’s consultation. The practice of staying in bed, having a hot water bath, use of special food or drink to reduce pain and distraction by watching TV, reading etc., are the measures to relieve pain (Omidvar et al., 2016). Findings of a study conducted by Karanth et al. showed that taking medications, heat application, and lying down were the strategies adopted by a group of adolescent nursing students to overcome the dysmenorrhea symptoms (Karanth & Liya, 2018). Adolescent girls relied more on readily available over-the-counter medications to alleviate the symptoms reported in many research studies. The pharmacological measures may give only temporary relief from pain and certainly will have ill effects on the human body.

Yoga is one of the promising fields in alternative systems of medicine. Yoga typically combines physical poses, breathing techniques and meditation or relaxation to improve physical fitness and relieve stress (Yang & Kim, 2016). A growing body of evidence to supports that yoga and meditation could improve physical and mental health via down-regulation of the hypothalamo-pituitary-adrenal axis and the sympathetic nervous system. Yoga also plays a vital role in reducing

Worldwide, during the 21st century, yoga serves as one of the interventions to improve general health, stress, flexibility, muscle strength and alleviate specific physical symptoms such as chronic pain. Yoga can reduce the severity of menstrual pain and improve physical fitness and quality of life, thus suggesting yoga as a possible complementary treatment for primary dysmenorrhea (Yonglithipagon et al., 2017). The effects of three yoga poses in women with primary dysmenorrhea showed a significant reduction in the pain intensity and duration. The findings suggest that yoga poses are a safe and simple treatment for primary dysmenorrhea (Rakhshaee, 2011). Some special breathing and meditation techniques also positively influence the central nervous system to control pain and pain tolerance, thereby reducing school absenteeism (Nag & Kodali, 2013). However, only a few studies were conducted to assess the effectiveness of yoga on primary dysmenorrhea (Nag & Kodali, 2013). A systematic review of randomized controlled trials (RCTs) on effects of yoga on dysmenorrhea identified only two potential trials for review from CINAHL, the Cochrane Library, Embase, PsycINFO, PubMed, and KoreaMed electronic databases. The evidence from these two RCTs showed good effectiveness of yoga for dysmenorrhea. However, the review also concluded that further high-quality RCTs were needed to investigate the hypothesis that yoga alleviates menstrual pain since the number of RCTs was small and with quality limitations (Ko, Le, & Kim, 2016).

1.1 Gaps in the existing literature
Across the globe, the burden of dysmenorrhea is well studied. However, there is a dearth of evidence on the impact of dysmenorrhea among adolescent girls’ academic concentration and self-efficacy. Self-efficacy is an essential element that enhances adolescents’ general health and wellbeing, a psychological mediator for health and academic accomplishment and academic success. A high levels of self-efficacy is also necessary for motivation in educational activities (Armum & Chellappan, 2016). Thus, there is a need to explore the impact of these variables in the context of dysmenorrhea. Prostaglandins play a significant role in the pathomechanism of dysmenorrhea (Grzybowska & Barcikowska, 2020) and performing aerobic exercises can improve dysmenorrhea (Dehnavi, Jafarnejad, & Kamali, 2018). However, there is not ample evidence from published literature on the effect of yoga and pelvic stretching exercises in prostaglandin synthesis among adolescent girls with primary dysmenorrhea. There is also a need for educating adolescent girls on effective and appropriate management of dysmenorrhea to cope with menstrual pain, as it is associated with many other symptoms. Interventions such as meditation can mediate happiness, the experience of reward and develop positive motivation (Babu et al., 2020). Hence, a paradigm shift is essential for practicing the potentially non-harmful and generally effective method. Thus, practicing comprehensive interventions such as yoga and meditation may change the lifestyle to improve wellbeing during painful menstruation and the adolescents’ health.

1.2 Conceptual framework
The conceptual framework for the proposed project is developed based on Betty Neuman’s system’s model (Chandran & Kumar, 2017), which indicates that the stressors from various sources cause a reaction within the system. Stressors are classified as intra-, inter- and extra-personal by Betty Neuman. Intrapersonal stressors are the ones that originate within the system and the intrapersonal stressors identified in the study are age, prostaglandin, estrogen and progesterone levels, body mass index and other menstruation-related problems. Interpersonal stress occurs within one or more individual systems in the immediate environment. In this study, the interpersonal factors identified are economic status, birth order and level of study. Extra personal stress occurs to the forces outside that system’s control or influence. The extra personal stressors identified in the proposed research are stressful and unpleasant situations such as examinations and food items that influence dysmenorrhea.

A “flexible line of defense” against stressors that reflect the current wellness status of the system and a “normal line of defense” which reflects a state of wellness that has developed over some time, will be reflected with an estimation of the prevalence of dysmenorrhea and associated symptoms. Neuman identifies three levels of prevention, i.e. primary, secondary, and tertiary prevention to strengthen the individual’s different systems. In this study, the purpose of meditation and yoga in primary prevention is to strengthen the healthy lifestyle, whereas its practice as secondary prevention aims at reducing the stressors causing dysmenorrhea.

2. Methods
2.1 Aims and research objectives
The overall aims of the study are to estimate the prevalence of dysmenorrhea and evaluate the effectiveness of Meditation and Yoga intervention on dysmenorrhea among adolescent girls.
Objectives developed for achieving the aims are:

1. Estimate prevalence of dysmenorrhea among adolescent girls of Udupi District using the Dysmenorrhea Questionnaire (DYSQ)

2. Evaluate the effectiveness of meditation and yoga intervention on dysmenorrhea outcomes such as pain intensity, stress, academic performance, self-efficacy and biomarker level (Hb, Progesterone, Estrogen, Prostaglandins F2α and E2).

2.2 Hypotheses

The trial is designed to test all the hypotheses at a 0.05 level of significance. The hypotheses formulated are as follows:

**H1:** There will be a significant difference in the mean post-test scores on the outcomes such as pain intensity, stress, academic performance, self-efficacy and biomarker level between the intervention and control arms.

**H2:** There will be a significant difference in the mean pre-test and post-test scores on the outcomes such as pain intensity, stress, academic performance, self-efficacy and biomarker level within the intervention arm.

2.3 Design and setting

This research proposes a prospective, school-based study and will be conducted in two phases to meet the objectives (Figure 1). The proposed trial will be conducted at high schools and pre-university colleges across Udupi district, Karnataka, Southern India, Asia. There are 108 Pre-university colleges and 304 high schools spread across six taluks in the Udupi district. The study’s target population consists of adolescent girls between the age group of 13 and 18 years. Adolescent girls who attained menarche willing to participate and can read/understand Kannada (the local language of the state where the study will be conducted) or the English language will be included.

Phase I: An exploratory survey will be conducted to estimate the prevalence of dysmenorrhea among adolescent girls. Data will be collected from all high schools and pre-university colleges (both government & private) of two randomly selected taluks (district subdivisions) of the Udupi district in Karnataka (out of six taluks).

Phase II: The proposed second phase of the trial will be a cluster randomized controlled trial to evaluate the impact of meditation and yoga on dysmenorrhea. From the first phase, those adolescent girls with high pain intensity (numerical pain rating scale ≥4) from each school will be selected for the second phase. Schools will be the clusters and the cluster size will be determined based on phase I findings. Clusters will be randomly allocated to either the intervention arm or control arm. The intervention arm will receive the proposed meditation and yoga intervention for 12 weeks and the

*Figure 1. Schematic representation of study approach.*
control arm will continue with standard routine care. The outcomes will be re-assessed among study participants after 12 weeks of intervention.

2.4 Sample size and sampling technique
Two taluks out of six will be randomly selected for the exploratory survey in phase I. High-schools and pre-university schools will be then chosen randomly to conduct the study.

For phase I, the sample size is calculated based on the estimation of proportion. With a 50% prevalence of dysmenorrhea, 2% absolute error, considering the design effect (Cluster effect, the calculated sample size is ≈5000.

In phase II, a comparison of two means formulae is used to calculate the sample size. At a 5% level of significance, with 80% power, 0.5 (moderate) Δ-effect size, the sample required in each arm is 63. The sample size has to be increased by 20% as the primary outcome, 'pain' is an ordinal outcome that must be analyzed by a non-parametric test. Accounting for an attrition rate of 20%, the calculated sample size is 200 in each group, and approximately 20 schools will be selected for phase II. However, the number of schools chosen will be finalized based on phase I findings.

The schools will be the unit of randomization and will be allocated to either an intervention or control arm through simple randomization. The random allocation sequence is generated from https://www.sealedenvelope.com. The sequence will be generated by preparing sequentially numbered, opaque sealed envelopes (SNOSE) by the person not part of the study for the allocation concealment. There is no blinding in this study.

2.5 Outcome measures
The proposed study aims to estimate the prevalence of dysmenorrhea and evaluate the effectiveness of meditation and yoga intervention on dysmenorrhea among adolescent girls. In Phase 1, by estimating the prevalence of dysmenorrhea among adolescent girls, the research team will implement Meditation and Yoga intervention for adolescent girls with dysmenorrhea in Phase II. Pain intensity, stress, academic performance, self-efficacy and biomarker levels (Hb, progesterone, estrogen, prostaglandins F2α and E2) will be assessed at baseline and 12 weeks after the intervention.

2.6 Variables and measurements
2.6.1 Socio-demographic proforma of adolescent girls
Socio-demographic proforma consists of eight items to collect the socio-demographic details of the participants and this tool will be used in Phase I of the study.

2.6.2 Dysmenorrhea questionnaire (DYSQ)
The dysmenorrhea questionnaire has 14 items to collect menstrual history and dysmenorrhea information. This tool consists of items related to age at menarche, details of family members having dysmenorrhea, regularity of menstruation, details of dysmenorrhea with associated symptoms, use of medications and other strategies, and effects of dysmenorrhea on other activities. The DYSQ will be used in phase I of the study.

2.6.3 Numerical pain rating scale
This is a numerical rating scale to assess the pain experienced by participants during menstruation. The scale has a 0 to 10 rating and participants will indicate their pain by encircling one number on the scale. The scale will be used in phase I and Phase II of the study.

2.6.4 Stress scale (SSc)
The tool is a Likert scale consisting of 55 items to assess stress among adolescent girls. The score ranges from 55 to 220. Participants scoring below 110 are considered to have mild stress, between 110 and 142 are considered to have moderate stress and score above 142 as having severe stress. The scale will be used in Phase II of the study.

2.6.5 Academic performance (absenteeism and concentration)
This tool will have two sections. Researchers will use section A to assess the school absenteeism and the data will be collected from school attendance records with the reason for school absenteeism. Academic performance will be assessed
through the scores obtained by the adolescent girls in the previous academic assessments. Section B consists of a Likert scale with six items to assess concentration in studies among adolescent girls during menstruation. The possible scores range from 0 to 18 and the higher the score, the concentration. The scale will be used in Phase II of the study.

2.6.6 Generalized self-efficacy scale (GSE)

It is a 10-item standardized scale used to measure the participants’ self-efficacy. For the GSE, the total score ranges between 10 and 40, with a higher score indicating more self-efficacy (Schwarzer & Jerusalem 1995). The scale also will be used in Phase II of the study.

2.6.7 Estimation of bio-markers (Hb, progesterone, estrogen, prostaglandins F2α and E2)

Estimation of hemoglobin will be done by using a Sahlis Hemoglobinometer. Assessment of the levels of progesterone, estrogen, and prostaglandins in the blood will be done by a competitive ELISA kit. Biomarkers will be assessed in Phase II of the study.

Study status: Phase I data collection is ongoing, and completed nearly 2000 adolescent girls.

2.7 Validity and reliability

2.7.1 Study protocol

The study protocol has been reviewed by the Institutional research committee of Manipal College of Nursing, Manipal and approved by the expert panel of the Institutional Ethics Committee of Kasturba Medical College & Kasturba Hospital Manipal (IEC: 414/2021). The protocol is presented in the scientist’s forum of the Department of Science and Technology of Yoga and Meditation (DST SATYAM) and approved. The protocol is registered prospectively in the Clinical Trials Registry of India with the ID number (CTRI/2021/11/037703).

2.7.2 Study instruments

The numerical rating scale and the general self-efficacy scale are developed and validated internationally (Luszczynska, Scholz, & Schwarzer, 2005). This instrument has been translated and validated for the Indian population. Other tools used in the study were developed by researchers and reviewed five experts. The experts from nursing, mental health, pediatric, and education were included in the panel. The content validity of the instruments was established. The study instruments were then finalized after making necessary modifications as suggested by the panel. The questionnaires were translated to the local language and did the back translation to ensure the language validity of the instruments. The reliability of the study instruments will be calculated for internal consistency by administering it to 50 adolescent girls.

2.7.3 Meditation and yoga program

The experts from the division of yoga prepared the meditation and yoga protocol. The protocol was refined, validated, and approved by Morarji Desai National Institute of Yoga (MDNIY), an autonomous organization under the Ministry of AYUSH, Government of India.

2.8 Data collection procedure

2.8.1 Phase I: Exploratory survey

Administrative permission from the Deputy Director of Public Instruction (DDPI) of Udupi district has been obtained to conduct the research study. Permission from headteachers and principals of respective high schools and pre-university colleges will be obtained. Written informed consent forms will be sent to the parents along with the participant information sheet and written assent will be taken from adolescent girls. Upon approval, the data will be collected by distributing the socio-demographic proforma, DYSQ and numerical pain scale among the study participants by the researchers. Phase I data collection will take six months to reach the estimated sample size.

2.8.2 Phase II: Cluster randomized controlled trial

Adolescent girls with high pain intensity (numerical pain rating scale ≥4) in Phase I will be selected for Phase II. The school will be the clusters and the cluster size will be determined based on phase I findings. After obtaining the consent
from parents and assent from adolescent girls, data on the numerical pain rating scale, stress, academic performance, perceived self-efficacy and bio-markers (Hb, prostaglandins, estrogen and progesterone) will be assessed on the first day of the menstrual cycle. A trained phlebotomist will collect the required amount of blood in the vacutainers. The session on meditation and yoga will be conducted for 12 weeks. It includes Aumkar meditation, relaxation, loosening exercises, yogasanas and pranayamas. These yogasanas and meditation will be introduced gradually, and adolescent girls will be performing the intervention for 45 minutes under the supervision of the investigator every day, five days a week for 12 weeks, except the days of menstruation. After 12 weeks of intervention, the data will be collected using the same tools as the pretest. After the posttest assessment, the meditation and yoga intervention will be taught to the control group participants. The collected blood will be used only for the said analysis and the remaining blood won’t be stored for any purposes, and it will be discarded as per the institutional protocol.

2.9 Statistical analysis
In phase I, descriptive statistics such as frequency and percentage will describe socio-demographic characteristics, estimate of the prevalence of dysmenorrhea and related factors among adolescent girls. In Phase II, Chi-squared (\( \chi^2 \)) and the independent sample t-test will be used to compare the baseline variables of the intervention and the control arms. An intention-to-treat analysis (ITT) will be adopted to manage the missing data. An independent group ‘t’ test will be used to analyze the outcome variables. Data will be analyzed using Statistical Package for Social Sciences (SPSS version 16) (RRID: SCR_002865).

2.10 Ethical considerations
Administrative permission from the Deputy Director for Public Instructions (DDPI) of the Udupi district is obtained. Administrative permission from headteachers and Principals will be obtained from all the high schools and pre-university colleges before the process of data collection. After obtaining administrative permissions, consent will be sent to the parents and a participant information sheet consisting of a complete explanation of the research project. They have the right to consent voluntarily or decline to participate and the right to withdraw their participation at any time in-between. Assent will be obtained from adolescent girls after obtaining consent from parents. Participants’ privacy, anonymity, and confidentiality will be secured and maintained throughout and after the conduct of the study.

2.11 Expected outcome
In phase I of the proposed study, the prevalence of dysmenorrhea and related factors will be estimated from adolescent girls. Upon estimating the prevalence, in the second phase of the study the research team will focus on meditation and yoga intervention’s impact on adolescent girls with dysmenorrhea. The expected outcomes of meditation and yoga intervention in phase II of the trial are a reduction in dysmenorrhea and its associated symptoms. This would further help reduce stress, decrease school absenteeism, and improve concentration, self-efficacy and academic performance of adolescent girls. Thus, the simple, non-harmful and comprehensive intervention of meditation and yoga would change the lifestyle, improve the adolescents’ health and quality of life and reduce the public health burden. Yoga and meditation generally do not cause any adverse effects if performed as instructed. Appropriate referrals will be given if any adverse effects are identified.

3. Discussion
Yoga could be an effective non-pharmacological option for adolescent girls with primary dysmenorrhea. Pain can be diagramed as a spiral in medical theory: pain/tension/fear/pain. Yoga is thought to aid the brain’s pain center regulation by the spinal cord’s gate controlling mechanism and the body’s natural painkiller release. Meditation and yoga also have much awareness and control of one’s breathing. Relaxation and stress reduction can be aided by exhaling. Breathing awareness allows for calmer, slower breathing, which aids in relaxation and pain control (Rakhshaee, 2011). Research conducted with yoga interventions showed significant improvement in trunk flexibility and leg muscle strength within the intervention group. Improvement in body movement and breathing is linked with activating ‘relaxation response’ in the neuroendocrine system improving holistic health (Yonglitthipagon et al., 2017). Yoga’s popularity and medical benefits have grown with the growing interest in alternative and complementary medicine (Rakhshaee, 2011). However, a study conducted by Yang et al. with yoga as an intervention for primary dysmenorrhea recommends conducting RCTs with larger sample size and assessing of objective outcomes such as prostaglandins (Yang & Kim, 2016; Yonglitthipagon et al., 2017). Though the current studies lay a strong foundation for future research and propose that yoga could be a safe and cost-effective treatment for dysmenorrhea’s growing public health issue, there is currently insufficient evidence to support the use of yoga to treat dysmenorrhea symptoms (Ko et al., 2016). Hence, this unique study attempts to establish the evidence on the effectiveness of meditation and yoga in primary dysmenorrhea symptoms among adolescent girls.

There was closure of the schools as the second wave of coronavirus disease 2019 (COVID-19) pandemic evolved around the proposed time of initial recruitment. Our team was challenged to recruit the participants due to the restrictions of
ethical committee and school management. However, the recruitment for phase I has started on November 2021 with the school reopening. Schools approached for data collection to date are 25 and four have declined to participate. A total of 868 adolescents are screened and 335 (38.59%) are having numeric pain score (N>4). As the schools started functioning with offline classes and vaccinations and guidelines for the vaccinations for the age group has been implemented which would reduce COVID-19 related challenges.

4. Limitation
The study will be conducted among adolescent girls between the ages of 13 and 18, and no blinding will limit the study’s generalization. The intervention will be performed for 12 weeks under direct supervision. As there is no further follow-up, the sustainability of the study findings purely relies on adolescent girls’ self-motivation.

5. Conclusion
A simple and comprehensive intervention like meditation and yoga among young adolescents would be beneficial for reducing dysmenorrhea-related symptoms from an early age and thereby improving the quality of life. The researchers recommend regular yoga training as a school program to improve adolescent health based on the expected outcome.

Data availability
Underlying data
No data are associated with this article.

Extended data

Reporting guidelines

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

References
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