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Effect of eye movement desensitization and reprocessing on intensity of primary dysmenorrhea: a randomized controlled trial

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Abstract

Background A common disorder among women during reproductive age is dysmenorrhea. It has a chronic cyclic nature and a positive association with psychological distress.

Aim The aim of the present study was to determine the effect of desensitization based on eye movement desensitization and reprocessing (EMDR) on dysmenorrhea intensity.

Methods A randomized controlled trial comprising 88 female university students randomly divided in two groups of intervention (EMDR therapy for two 60-min sessions, and control) was conducted based on the balanced blocks randomization method. The main outcome assessed was intensity of dysmenorrhea. Other outcomes were menstrual pain duration, menstrual distress, and the need to take analgesics. All outcomes were assessed at three time points (before intervention, and one and two months after the intervention). Data were evaluated using analysis of variance for repeated measures, Cochran test, and McNemar test (at $p < .05$).

Results Repeated measures ANOVA–ANCOVA analysis indicated that EMDR significantly reduced dysmenorrhea intensity in the intervention group compared to controls at both follow-ups ($p < 0.001$), with a large group-by-time interaction effect ($F = 16.99$, $p < 0.001$). Pain duration also decreased significantly at the second two-month follow-up ($p = 0.003$). Menstrual phase distress showed marked improvements post-intervention ($p < 0.001$). The need to take analgesics was also reduced for participants in EMDR group compared to control group ($p < .001$).

Conclusion These findings suggest EMDR is effective in alleviating key dysmenorrhea symptoms, particularly pain intensity, menstrual phase-specific distress, and the need to take analgesics.

Trial registration Iranian Center of Clinical Trials registration with reference code of IRCT20180823040851N1 in 06-10-2018.

Keywords EMDR, Primary dysmenorrhea, Pain intensity, Menstrual distress

1 Introduction

Primary dysmenorrhea (PD), defined as painful menstruation in the absence of pelvic pathology, is one of the most prevalent gynecological disorders among women of reproductive age [1]. It is characterized by cyclic lower abdominal pain that often radiates to the lower back and thighs, accompanied by systemic symptoms such as nausea, vomiting, fatigue, and headaches [2]. In a recent systematic review and meta-analysis, the prevalence of PD was reported to be 66.1% (95% confidence interval [CI] 63.4%-68.9%) with approximately one-third of women reporting severe pain [3]. The condition not only diminishes quality of life but also leads to significant absenteeism from work or school, reduced productivity, and increased healthcare utilization [4, 5]. Despite its high prevalence and substantial socioeconomic burden, PD remains underdiagnosed and undertreated, often dismissed as a normal part of the menstrual experience [6, 7].

The pathophysiology of PD is primarily attributed to excessive prostaglandin (PG) production, particularly PGF2α, which induces uterine hypercontractility, vasoconstriction, and ischemia [8]. However, emerging evidence suggests that central sensitization, a phenomenon where repeated nociceptive input lowers pain thresholds, plays a critical role in perpetuating and exacerbating menstrual pain [9, 10]. Neuroimaging studies have demonstrated altered pain processing among women with PD, including increased gray matter volume in pain-modulating regions as well as heightened activation of the anterior cingulate cortex during noxious stimuli [11, 12]. These findings underscore the interplay between biological and psychological factors in PD, with stress, anxiety, and depression consistently associated with greater pain severity and poorer treatment outcomes [13].

Current management strategies for PD include nonsteroidal anti-inflammatory drugs (NSAIDs), hormonal contraceptives, and lifestyle modifications (e.g., exercise, heat therapy) [1]. While NSAIDs are effective for 70%-80% of patients, approximately 20%-30% of patients experience inadequate relief or intolerable side effects, such as gastrointestinal bleeding [14, 15]. Similarly, hormonal therapies are contraindicated for some individuals and may not address the psychological dimensions of pain [16]. Given these limitations, there is growing interest in non-pharmacological interventions, particularly those targeting the emotional and cognitive aspects of pain [17].

Eye movement desensitization and reprocessing (EMDR) therapy, originally developed to treat post-traumatic stress disorder (PTSD), has shown promise in managing chronic pain conditions [18, 19]. EMDR employs bilateral stimulation (e.g., eye movements) to facilitate the reprocessing of distressing memories and associated somatic sensations [20]. EMDR is an eight-phase, three-pronged psychotherapy that targets maladaptively stored memories linked to distress. Its efficacy relies on the Adaptive Information Processing (AIP) model, which posits that psychological symptoms arise when traumatic or distressing experiences are inadequately processed in the brain. EMDR facilitates the reprocessing of these memories into adaptive resolutions through structured protocols involving bilateral stimulation (BLS) (e.g., eye movements, taps, or tones) [21]. Recent meta-analyses have reported moderate to large effect sizes for EMDR in reducing pain intensity in conditions such as fibromyalgia, phantom limb pain, and migraines [22–24]. However, its application to PD remains underexplored.

The bidirectional relationship between PD and psychological distress provides a strong rationale for evaluating EMDR. Women with PD exhibit higher rates of anxiety

and depression compared to asymptomatic peers, and these symptoms often worsen premenstrually [25]. Conversely, pre-existing mood disorders predict greater PD severity, likely due to amplified central sensitization [26]. EMDR's three-pronged protocol, addressing past traumatic experiences, current triggers, and future adaptive responses, uniquely disrupt this cycle by attenuating the emotional valence of pain memories [21]. For instance, a woman with PD might associate menstruation with past experiences of helplessness or invalidation, exacerbating her pain perception [27]. EMDR could help reprocess these memories while fostering self-efficacy, thereby reducing both affective and sensory pain components [28].

Despite these theoretical advantages, critical gaps persist in the literature. First, existing studies on EMDR for pain have focused predominantly on chronic conditions with clear traumatic etiologies (e.g., accident-related pain) [23, 29, 30], leaving its utility for cyclic, non-traumatic pain such as PD uncertain. Second, prior PD trials of psychological interventions (e.g., cognitive-behavioral therapy) have yielded mixed results, possibly due to insufficient targeting of implicit emotional memories [31]. EMDR's direct engagement with somatic and affective pain representations may offer a more precise mechanism [32]. Third, no study has yet evaluated whether EMDR's benefits for PD extend beyond pain intensity to functional outcomes such as analgesic use or menstrual distress, which are key determinants of quality of life.

1.1 Aim of present study

The aim of the present study was to determine the effectiveness of the desensitization method based on eye movement and reprocessing (EMDR) on intensity of primary dysmenorrhea (the primary outcome measure). The duration of menstrual pain, menstrual-related physical and psychological distress, and need for analgesics to relieve menstrual pain as well as participants' state-trait anxiety were assessed as secondary outcomes. It was hypothesized that EMDR would significantly reduce pain intensity compared to a no-intervention control, with concomitant improvements in secondary outcomes.

2 Methods

2.1 Design

The present study was a randomized controlled trial conducted from April 2019 to February 2020. The study protocol has already been published [33].

2.2 Participants and setting

The participants comprised 88 single female university students. The inclusion criteria were females with dysmenorrhea (scores greater than four on the ten-point Visual Analogue Scale) and willingness to voluntarily participate in the study. The exclusion criteria were self-reported presence of diagnosed secondary dysmenorrhea and its underlying factors, history of known mental illness, abdominal or pelvic surgery, seizures, strabismus, vision problems, and cardiorespiratory disease. Those who were graduating during the study were also excluded because they would no longer on campus and follow-up would not be possible.

2.3 Sample size calculation

Considering the effect size of 0.25 for EMDR [34], α error of 0.05, study power of 0.80, and 10% probable estimation of participants dropout, using *G*Power* software it was found that 88 participants were needed.

2.4 Recruitment

For recruiting potentially eligible individuals, convenience sampling from female university dormitories and different university faculties was used. One of the research team visited the students during the breaks between classes in different faculties (known as 'colleges' in Iran). In addition, in dormitories and faculties, information leaflets and invitations to participate in the study were distributed. Using this recruitment procedure, 625 individuals were consulted, and 88 individuals were finally recruited to participate.

2.5 Randomization

Eligible individuals were divided into study groups using the balanced blocks randomizing method with a block size of four. The random allocation sequence was written using the online random allocation generator program (randomizer.org). Details are explained elsewhere [33, 35]. The allocated study group was written on a piece of paper based on the allocation sequence, and placed in opaque sealed envelopes (88 sealed envelopes). Therefore, the allocation sequence was concealed.

2.6 Variables and measures

2.6.1 Demographic and menstrual characteristics

Demographic data were collected including age, education, study field, and relationship status. Menstrual characteristic data were collected including menarche age, duration of dysmenorrhea, whether they took analgesics for dysmenorrhea, and the amount taken if they did.

2.6.2 Dysmenorrhea intensity

The Visual Analogue Scale (VAS) was used to assess dysmenorrhea intensity with 0–10 point rating scale [36]. Its validity and reliability for evaluating dysmenorrhea pain have been confirmed in many studies [37]. The VAS is a 10 cm line, where feeling no pain is rated as 0, and the experience of severe pain is rated as 10 [36]. The pain intensity was rated in both groups at three time points: before intervention (mean of two consecutive months before intervention), and one and two months after the intervention.

2.6.3 Menstrual distress

The 19-item short-form of Moos Menstrual Distress Questionnaire was used to assess the physical and psychological symptoms that an individual experiences during menstruation. Items are rated on a four-point Likert scale (experiencing no symptoms is rated 1, and the most severe and debilitating symptoms is rated 4). With summation of all the items, a total score is calculated. Higher scores indicate experiencing greater menstrual distress [38]. Good psychometric properties of Persian version have been reported [39]. Menstrual distress was assessed in both groups at the three aforementioned time points.

2.6.4 Anxiety

Anxiety levels in participants were assessed using the Spielberger State-Trait Anxiety Inventory (STAI). This instrument evaluates both state and trait anxiety, with 20 items for each subscale rated on a four-point Likert scale, where higher scores reflect greater anxiety. The original [40] and Persian [41] versions of the STAI have demonstrated strong psychometric properties. Participants completed the STAI at two time points: before the intervention and during the menstrual cycle when the interventions had finished.

2.6.5 EMDR outcomes

Two EMDR-related procedural outcome variables were used. The Validity of Cognitions (VOC), a self-report eight-point rating scale, was used to assess belief in a positive cognition. More specifically, the participants were asked to express their cognition regarding the subject matter, at each stage of EMDR. In the present study, a positive cognition was desired. Consequently, a lack of belief was scored as 0 and complete belief was scored as 7 [42]. The other procedural outcome was Subjective Units of Distress (SUD), a self-report scale assessing individuals' subjective distress. No distress is rated as 0 and maximum distress is rated as 10. Based on the SUD, participants were assessed and reported the degree of distress (e.g., intensity of dysmenorrhea pain the present study) at each stage of intervention [42]. These outcomes were assessed at the beginning and the end of each intervention session.

2.7 EMDR therapy

The protocol used in present study is explained elsewhere [33, 35], but in brief, the EMDR therapy was conducted in eight phases: (i) taking a participant's history (to determine individual's discomfort, decide the proper treatment protocol, and identify treatment goal after interviewing participants about their source of discomfort and their unpleasant experience regarding dysmenorrhea); (ii) preparation of participant by giving information about EMDR therapy, how it is done, its effects and safety to participants, and answering their concerns and questions; (iii) evaluation with identifying the components of the therapeutic goal including asking participants to set a negative cognition and the image regarding the best memory state to be replaced with the negative cognition; (iv) desensitization with focus on reprocessing and reconstruction of impaired cognition and disturbing feelings and emotions; (v) installation of positive cognition to be replaced with negative cognition; (vi) body scan to evaluate the participant's physical stress levels and reinforce positive cognition. Afterwards, they were asked if they still experienced any bodily discomfort; (vii) end of treatment session to assess the participant at the end of the session. Participants should reach a state of emotional balance; and (viii) reevaluation of treatment effect to check that all related events are processed [42].

These eight essential phases of EMDR were performed with a focus on participants' disturbed feelings and cognitions regarding dysmenorrhea. All eight phases were performed in one treatment session which lasted approximately one hour. Within one week, the next session was held to achieve the maximum effect of the intervention. In EMDR intervention, the number of treatment sessions are decided based on participants' response to intervention (assessed by SUD and VOC scales). The first author was the person responsible for conducting the interventions. She learned how to conduct EMDR

sessions under the supervision of an expert qualified in EMDR The first five interventions were conducted by first author under supervision and in the presence of the expert. After ensuring her competence to perform the therapy, she performed EMDR sessions independently. A suitable place was set aside for carrying out intervention in the dormitory or faculty based on participants' preferences.

The research team did not provide special care for control group. They were asked to use their own dysmenorrheal pain-controlling methods but report the details. After completion of the study, they were offered to try EMDR based on their willingness.

2.8 Ethics

The ethics committee affiliated to Qazvin University of Medical Sciences approved the protocol (decree code IR.QUMS.REC.1397.100) and it was pre-registered in the Iranian Clinical Trial Registration Center under decree code of IRCT20180823040851N1. The trial was designed with two main outcomes. These were PD pain intensity (the present study) and anxiety related to dysmenorrhea (published elsewhere; see [35] for details of recruitment, study CONSORT flowchart, and results). Each outcome was registered and reported separately. Written informed consent was acquired. Participants were not inhibited from using their own pain relief method during study. They were only asked to report use of these methods before and during the intervention.

2.9 Statistical analysis

The Statistical Package for the Social Sciences (SPSS-Version 27) was used for all statistical analysis. Categorical variables were reported by frequencies and percentages, and quantitative variables were summarized using means and standard deviations (SDs). Balanced distribution of continuous variables between study groups were confirmed based on having a standardized mean difference (SMD) less than 0.25. Balanced distributions of categorical variables were confirmed if the difference index was less than 10% [43]. To choose appropriate statistical tests, the normal distribution of data was checked. Normal distribution of data was confirmed for pain intensity, pain duration, and menstrual distress. Consequently, analysis of variance–covariance for repeated measurements with Bonferroni correction for multiple comparison were used.

For each outcome, baseline scores were controlled as covariates in analysis of variance–covariance. EMDR measure of effect was assessed based on SMD which is interpreted as small (value of 0.2–0.5), medium (value of 0.5–0.8), or large (value > 0.8) [44]. The clinical significance of intervention was assessed based on the mean difference based on Minimum Clinically Important Difference (MCID) for dysmenorrhea pain. MCID in dysmenorrhea pain was reported by Woo et al. [45], to be 15 mm on the 100 mm VAS or 1.5 cm on the 10 cm VAS. Due to abnormal distribution, the Cochran test and McNemar post hoc test were used to assess the need to use menstrual pain relief methods, and a Wilcoxon non-parametric test was used to assess mental anxiety scores and validity of the cognitions. All tests were considered significant at $p < 0.05$.

3 Results

Eighty-eight individuals with PD were assigned randomly into study groups. Five individuals from each group dropped out of the study due to the intervention coinciding with their semester's final exams timetable. The distribution of baseline characteristics

was balanced in the study groups (Table 1), except for age (controlled as covariate in the subsequent analysis).

Table 2 presents the results of a repeated measures analysis of variance and covariance (RM ANOVA–ANCOVA) examining the effects of EMDR on dysmenorrhea-related outcomes and anxiety measures. The study compared an intervention group (n = 39) with a control group (n = 39) across multiple time points: pretreatment, one-month follow-up, and two-month follow-up. Covariates including age, baseline pain scores, and baseline scores for each outcome scale were adjusted in the model. For dysmenorrhea intensity (measured using the VAS), the intervention group showed significant reductions at both follow-up assessments compared to the control group. At one-month follow-up, the mean difference was – 1.59 (95% CI: – 2.31 to – 0.87), with a standardized difference of – 1.02 (95% CI: – 1.49 to – 0.55), and these improvements were maintained at two-month follow-up.

The group-by-time interaction was significant (F = 16.99, $p < 0.001$), indicating that EMDR had a sustained effect on pain intensity. Similarly, for duration of pain, the intervention group exhibited a significant reduction at two-month follow-up (mean difference: – 0.53 days, 95% CI: – 0.86 to – 0.19), although the group-by-time interaction was

Table 1 Summarized demographic and menstrual characteristics of participants by study groups

Variable	Intervention group (39 individuals) frequency (%)	Comparison group (39 individuals) frequency (%)
Father's education		
High school	10 (25.6)	10 (25.6)
Diploma	18 (46.2)	15 (38.5)
University	11 (28.2)	14 (35.9)
Mother's education		
High school	12 (30.8)	11 (28.2)
Diploma	19 (48.7)	18 (46.2)
University	8 (20.5)	10 (25.6)
Father's job		
Employed	9 (23.1)	4 (10.3)
Retired	30 (76.9)	35 (89.7)
Mother's job		
Housewife	29 (74.4)	31 (79.5)
Employed	8 (20.5)	10 (25.6)
Economic status of the family		
Good	12 (30.8)	15 (38.5)
Moderate	24 (61.5)	27 (69.2)
Menstrual pain relief method		
Do not use	0 (0)	1 (2.6)
Pharmaceutical method	14 (35.7)	17 (43.6)
Non-pharmacological method	5 (12.8)	3 (7.7)
Both	20 (51.5)	18 (46.2)
	Mean (standard deviation)	**Mean (standard deviation)**
Age (years)	21.49 (1.72)	22.26 (2.99)
Menarche age (years)	12.9 (1.73)	12.85 (1.53)
Educational term	4.44 (2.9)	4.97 (3.22)
Menstrual cycle length	28.5 (2.1)	29.0 (1.8)
Bleeding duration	5.2 (1.3)	5.0 (1.1)

Table 2 Results of analysis of variance–covariance for repeated measures (RM ANOVA-ANCOVA) assessing the effect of EMDR on of variables of interest

Outcome	Measurement time points	Group		Between group comparison t(p)	Mean difference (95% CI)	Standardized mean difference (95% CI)	Repeated measure analysis of variances results		
		Intervention (n = 39)	Control (N = 39)				Effect	F (*p*)	Partial η2
Dysmenorrhea intensity (VAS 0–10 cm)	Pretreatment	6.52 (1.30)	6.04 (1.34)	1.59 (0.12)	0.47 (−0.12; 1.07)	0.36 (−0.09; 0.81)	Time	0.62 (0.53)	0.008
	Follow-up 1	4.44 (1.56)	6.03 (1.56)	19.52 (< 0.001)	−1.59 (−2.31; −0.87)	−1.02 (−1.49; −0.55)	Group	5.06 (0.03)	0.063
	Follow-up 2	4.29 (1.84)	6.18 (1.84)	19.99 (< 0.001)	−1.89 (−2.74; −1.05)	−1.03 (−1.50; −0.56)	Group*Time	16.99 (< 0.001)	0.185
Duration of pain (days)	Pretreatment	2.23 (0.90)	2.36 (0.98)	−0.60 (0.55)	−0.13 (−0.55; 0.30)	−0.14 (−0.58; 0.31)	Time	0.53 (0.58)	0.007
	Follow-up 1	2.10 (1.10)	2.36 (1.10)	1 (0.32)	−0.26 (−0.76; 0.25)	−0.24 (−0.68; 0.21)	Group	3.37 (0.07)	0.043
	Follow-up 2	1.60 (0.74)	2.13 (0.74)	9.64 (0.003)	−0.53 (−0.86; −0.19)	−0.72 (−1.17; −0.26)	Group*Time	2.23 (0.12)	0.029
Menstrual distress									
Follicular phase	Pretreatment	19.37 (6.08)	19.19 (3.44)	0.16 (0.87)	0.18 (−2.05; 2.41)	0.04 (−0.41; 0.48)	Time	1.57 (0.22)	0.020
	Follow-up 1	18.96 (2.85)	19.91 (2.85)	2.13 (0.15)	−0.96 (−2.26; 0.35)	−0.33 (−0.78; 0.11)	Group	0.37 (0.54)	0.005
	Follow-up 2	19.38 (4.09)	19.90 (4.09)	0.30 (0.58)	−0.52 (−2.39; 1.36)	−0.13 (−0.57; 0.32)	Group*Time	0.66 (0.50)	0.009
Premenstrual phase	Pretreatment	25.13 (7.29)	24.85 (6.21)	0.18 (0.86)	0.28 (−2.77; 3.34)	0.04 (−0.40; 0.49)	Time	0.16 (0.85)	0.002
	Follow-up 1	24.11 (11.19)	25.86 (11.19)	0.96 (0.33)	−1.75 (−5.33; 1.82)	−0.16 (−0.60; 0.29)	Group	0.89 (0.35)	0.012
	Follow-up 2	23.37 (8.12)	26.01 (8.12)	2.01 (0.16)	−2.64 (−6.36; 1.07)	−0.33 (−0.77; 0.12)	Group*Time	1.24 (0.29)	0.016
Menstrual phase	Pretreatment	33.21 (8.04)	32.51 (8.50)	0.37 (0.71)	0.69 (−3.04; 4.42)	0.08 (−0.36; 0.53)	Time	0.88 (0.41)	0.012
	Follow-up 1	29.48 (6.26)	33.88 (6.26)	9.35 (< 0.001)	−4.40 (7.27; −1.53)	−0.70 (−1.16; −0.25)	Group	1.92 (0.17)	0.025
	Follow-up 2	28.14 (6.58)	33.52 (6.58)	12.65 (< 0.001)	−5.38 (−8.39; −2.37)	−0.82 (−1.28; −0.36)	Group*Time	8.8 (< 0.001)	0.105
State anxiety									
	Pre- intervention	46 (12.34)	43.56 (13.24)	0.84 (0.40)	2.44 (−3.34; 8.21)	−0.19 (−0.64; −0.25)			
	Post-intervention	44.64 (8.97)	45.71 (8.97)	0.18 (0.67)	−1.07 (−5.18; 3.04)	−0.12 (−0.33; −0.56)			0.002
Trait anxiety									
	Pre- intervention	44.61 (11.07)	43.87 (11.78)	0.29 (0.78)	0.74 (−4.41; 5.9)	−0.07 (−0.51; −0.38)			
	Post-intervention	43.56 (7.87)	44.34 (7.87)	0.18 (0.67)	−0.77 (−4.37; 2.83)	−0.10 (−0.54; 0.35)			0.003

N.B. Covariates adjusted in model were age, and baseline pain scores and baseline scores of each scale

Please note that the results regarding the effect of EMDR on state and trait anxiety is reported and discussed elsewhere [35]. The results are added to this table based on peer review request

not significant ($p = 0.12$). In contrast, menstrual distress scores did not show significant differences between groups at most time points, except for the menstrual phase at one-month and two-month follow-ups, where the intervention group reported lower menstrual distress during the menstruation phase (two-month follow-up mean difference: – 5.38, 95% CI: – 5.39 to – 2.37). The group-by-time interaction for the menstrual distress in menstruation phase was significant ($F = 8.8$, $p < 0.001$), suggesting EMDR's specific efficacy in this domain.

For state and trait anxiety, no significant differences were observed between groups at pre- or post-intervention (reported and discussed elsewhere; see [35]). Overall, EMDR demonstrated notable efficacy in reducing dysmenorrhea intensity and menstrual phase distress, with less consistent effects on pain duration and minimal impact on broader menstrual distress or anxiety measures. The findings highlight EMDR's potential as a targeted intervention for specific dysmenorrhea-related symptoms.

The results of Cochran test and McNemar post hoc test showed that using analgesics for menstrual pain was significantly lower two months after the intervention in comparison to previous time points ($p = 0.04$) (Table 3). The means of SUD and VOC were significantly different after the intervention ($p < 0.001$). Performing EMDR intervention in one session was effective in reducing SUD and improving cognition of individuals with dysmenorrhea in 90% of cases. In approximately 8% of cases, three sessions were required.

Side effects: During the intervention and follow-up process, none of the participants reported any side effects (such as headache) after the intervention.

4 Discussion

The present randomized controlled trial demonstrated that EMDR therapy significantly reduced the intensity of primary dysmenorrhea (PD) pain, menstrual phase-specific distress, and the need for analgesics compared to a no-intervention control group. These findings align with emerging evidence supporting EMDR's efficacy for chronic pain conditions [29, 46, 47] and extend its potential applications to cyclic, non-traumatic pain. Below, the findings are contextualized within three key themes of mechanisms: EMDR in pain modulation, comparative effectiveness with other interventions, and clinical and research implications.

4.1 EMDR and pain modulation: targeting central sensitization

The large reduction in pain intensity (SMD = – 1.03 at two-month follow-up) and menstrual distress suggests that EMDR may disrupt central sensitization which is a hallmark of PD pathophysiology [9, 10]. By reprocessing distressing memories associated with past menstrual cycles (e.g., invalidation, helplessness), EMDR likely attenuates the emotional salience of pain, thereby reducing hyperexcitability in nociceptive pathways [20, 21]. This was supported by significant improvements in Subjective Units of Distress (SUD) scores and Validity of Cognition (VOC) scores post-intervention, reflecting decreased affective pain components. Neuroimaging studies among PD patients have shown altered activity in the anterior cingulate cortex and insula during pain processing [12]. EMDR's bilateral stimulation may normalize these aberrant patterns by enhancing cortical integration of sensory and emotional pain signals [20]. Notably, the delayed effect on pain duration and analgesic use (significant only at the two-month follow-up) suggests that EMDR's impact on behavioral outcomes requires longer-term neuroplastic changes, consistent

Table 3 Distribution of absolute and relative frequency of number of participants who needed to use analgesics during menstruation in two groups of intervention and comparison

Variable	Group	Before intervention		After intervention	
		First month	Second month	First month	Second month
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
Need to use the analgesia	Intervention	32 (832.1)	33 (84.6)	28 (78.8)	26 (66.7)
	Comparison	34 (87.2)	35 (89.7)	32 (82.1)	33 (84.6)
Cochran test statistics	Intervention	p-value = 0.02	Cochran's Q = 9.59		
	Comparison	p-value = 0.54	Cochran's Q = 2.14		

with findings for chronic back pain [48]. Future studies should include biomarkers (e.g., prostaglandin levels, functional MRI) to elucidate these mechanisms.

4.2 Comparative effectiveness and advantages of EMDR

The present study's results contrast with mixed outcomes from cognitive-behavioral therapy (CBT) trials for PD [31], possibly due to EMDR's direct targeting of implicit emotional memories through its three-pronged protocol (past-present-future) [49]. Unlike CBT, EMDR does not require homework or cognitive restructuring, which may improve adherence among populations with high academic/workload stress [50]. The brevity of the present study's intervention (two sessions) aligns with evidence that EMDR achieves rapid effects is a critical advantage given PD's cyclic nature and the 20%–30% failure rate of NSAIDs [14]. However, EMDR did not significantly reduce trait anxiety or non-menstrual phase distress, underscoring its specificity for pain-related emotional processing. This mirrors findings for fibromyalgia, where EMDR improved pain but not generalized anxiety [23]. Integrative approaches combining EMDR with mindfulness or pelvic floor therapy may address broader symptoms [17].

4.3 Clinical implications

For individuals with PD who are unresponsive to NSAIDs or hormonal treatments—particularly those with associated psychological distress—EMDR serves as a non-pharmacological alternative [13]. The lack of reported side effects and low session burden (1–2 h) make EMDR feasible for primary care or school health settings. Consequently, the implications of the study findings are twofold. Clinically, EMDR could offer a rapid, non-pharmacological option for PD patients who are unresponsive to or intolerant of conventional treatments. The intervention's brevity (typically 2–6 sessions) and lack of homework requirements may enhance adherence compared to other psychotherapies [50]. At a mechanistic level, demonstrating EMDR's efficacy for PD would bolster the 'central sensitization' model of dysmenorrhea and highlight the importance of addressing emotional pain representations in treatment [9–11]. Given the global prevalence of PD and its substantial personal/societal costs, expanding the therapeutic options for this condition is an urgent priority.

4.4 Limitations

The present study investigated the effect of using EMDR therapy on the dysmenorrhea intensity using a randomized controlled trial design. However, in interpreting the findings of the present study, it is necessary to consider following limitations. First, the

study participants with PD were selected based on self-reported symptoms, and there was no medical examination to exclude potential undiagnosed secondary dysmenorrhea (i.e., underlying organic conditions). Therefore, future studies should incorporate clinical screening to ensure diagnostic accuracy. Second, the study outcomes including pain intensity, duration of pain, need for analgesics, and menstrual distress were all assessed using self-report. Third, despite randomization, there was a notable baseline difference in age between the groups, which was statistically controlled for in the analysis. However, other covariates that may influence dysmenorrhea (e.g., BMI, physical activity, nutritional status) were not measured or adjusted for. This could affect the generalizability of the findings. Future trials should stratify randomization based on these factors or include them as covariates in the analysis. Fourth, the short follow-up period (two months' post-intervention) limited the ability to assess the long-term durability of EMDR's effects. Given that EMDR is hypothesized to have sustained benefits for chronic conditions, future research should incorporate longer follow-up assessments to evaluate whether pain reduction and psychological improvements are maintained over time (e.g., at 6 and 12 months). Fifth, the pain assessment strategy, while validated, did not capture temporal patterns of dysmenorrhea pain across the menstrual cycle. The use of single timepoint VAS measurements rather than daily menstrual diaries limits the understanding of whether EMDR modifies the trajectory of pain development/relief during menstruation. Future studies should implement more granular pain tracking methods, such as daily symptom diaries throughout the cycle or real-time pain monitoring via mobile apps. This would enable analysis of whether EMDR affects the temporal dynamics of pain. Another limitation of the present study is the potential influence of a placebo effect, because the control group did not receive an active intervention (e.g., sham therapy or alternative non-pharmacological treatment). The absence of an active control makes it difficult to determine whether the observed improvements in dysmenorrhea intensity, menstrual distress, and analgesic use were specifically due to EMDR or non-specific factors such as participant expectations, therapist attention, or the therapeutic ritual. Future studies should incorporate an active control condition to isolate the unique effects of EMDR and better account for placebo-related influences.

5 Conclusion

The present study indicated that EMDR led to a significant reduction in the intensity of menstrual pain and distress, as well as a reduction in the need for medication (with a significant effect size). Moreover, EMDR can be used in the treatment of primary dysmenorrhea due to (i) its availability, (ii) lack of side effects, (iii) clinically and statistically acceptable effect, (iv) the small number of sessions compared to other non-pharmacological methods, and (v) lack of 'homework' assignments outside the therapy session.

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Author contributions
S.V., Z.A. & M.M.B. contributed to the conception and design of the study, S.V. and V.C. contributed to intervention and data collection in supervision of M.M.B., Z.A. and M.R. contributed in data analyzing and interpretation of data. Z.A. and S.V. drafted the manuscript. V.C., M.R. and M.M.B. provided contributions to the literature review and discussion. M.D.G. critically reviewed and copy-edited the manuscript. All authors revised the manuscript, agreed to be fully accountable for ensuring the integrity and accuracy of the study, and read and approved the final version of the manuscript to be published. All the authors met the criteria for authorship, and they are listed as co-authors on the title page.

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Data availability
Data will be available via email to corresponding author.

Declarations

Ethical approval
The study was performed in accordance with the Declaration of Helsinki. The ethics committee affiliated to Qazvin University of Medical Sciences approved the protocol (decree code IR.QUMS.REC.1397.100) and it was pre-registered in the Iranian Clinical Trial Registration Center under decree code of IRCT20180823040851N1.

Consent to participate
After obtaining the necessary permits, the individuals were invited to participate in the research, and informed consent was obtained from all participants.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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