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RESEARCH ARTICLE

Reducing Labor Pain through Endorphin Massage: Clinical Evidence from Indonesia

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Abstract

Labor pain remains a critical challenge in maternal care, especially in resource-limited settings where access to pharmacological analgesia is restricted. Endorphin massage, a non-pharmacological intervention, offers a safe and evidence-based alternative, yet robust clinical data remain limited. This quasi-experimental study, conducted at Pancatengah Public Health Center, Indonesia, involved 15 mothers in active labor who received standardized endorphin massage during the first stage of labor. Pain intensity was measured pre- and post-intervention using a Numeric Rating Scale. Statistical analysis with the Mann-Whitney U test revealed a significant reduction in pain scores ($p = 0.011$; effect size $r = 0.65$), with most participants shifting from moderate or severe pain to mild or no pain, and no adverse events observed. These findings highlight the clinical and practical value of endorphin massage as a safe, accessible pain management strategy. Further studies with larger, controlled samples are recommended to confirm generalizability and address implementation challenges.

Keywords: endorphin massage, labor pain, mothers in labor, non-pharmacological therapy, pain management

Abstrak: Nyeri persalinan masih menjadi tantangan utama dalam pelayanan maternal, khususnya di wilayah dengan keterbatasan akses analgesia farmakologis. Pijat endorfin sebagai intervensi non-farmakologis menawarkan alternatif yang aman dan berbasis bukti, meskipun data klinis yang kuat masih terbatas. Penelitian kuasi-eksperimen ini dilakukan di Puskesmas Pancatengah, Indonesia, melibatkan 15 ibu bersalin pada kala I aktif yang menerima pijat endorfin terstandar. Intensitas nyeri diukur sebelum dan sesudah intervensi menggunakan Numeric Rating Scale. Analisis statistik dengan uji Mann-Whitney menunjukkan penurunan skor nyeri yang signifikan ($p = 0{,}011$; effect size $r = 0{,}65$), dengan mayoritas responden mengalami perubahan dari nyeri sedang/berat menjadi ringan atau tanpa nyeri, dan tidak ditemukan efek samping. Temuan ini menegaskan nilai klinis dan praktis pijat endorfin sebagai strategi manajemen nyeri yang aman dan mudah diakses. Studi lanjutan dengan desain terkontrol dan sampel lebih besar direkomendasikan untuk mengonfirmasi generalisasi serta mengatasi tantangan implementasi.

Kata kunci: pijat endorfin, nyeri persalinan, ibu bersalin, terapi non-farmakologis, manajemen nyeri

INTRODUCTION

Labor pain is recognized as a significant clinical and public health issue affecting the wellbeing of mothers and newborns globally. Labor pain results primarily from uterine contractions and cervical dilation during childbirth, and its intensity may be influenced by both physiological and psychosocial factors (Lowe, 2002). The experience of labor pain is not only a physiological phenomenon but also closely linked to emotional responses such as anxiety and fear, which can exacerbate the perception of pain and impact the course of labor (Simkin & Bolding, 2004). Unmanaged labor pain is associated with increased maternal stress, elevated respiration and pulse rates, and may disrupt uteroplacental blood flow, consequently jeopardizing fetal oxygenation (Dewie & Kaparang, 2020; Whitburn et al., 2014).

Global and regional data underscore the persistent challenges in maternal and neonatal health. The World Health Organization (WHO) defines normal labor as a spontaneous process with low risk for both mother and child, occurring between 37–42 weeks gestation (WHO, 2018). According to recent UNICEF data, in 2019 there were approximately 395,000 births per day worldwide, with a

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considerable proportion taking place in low- and middle-income countries, including Indonesia (UNICEF, 2020). Despite advancements in perinatal care, maternal mortality rate (MMR) and infant mortality rate (IMR) remain high in many regions; in Tasikmalaya Regency, West Java, MMR and IMR continue to be pressing concerns (Muslim, 2022). These statistics highlight the need for effective and safe interventions to improve childbirth experiences and outcomes.

Effective pain management during labor is a cornerstone of quality obstetric care, directly impacting maternal satisfaction, birth outcomes, and the overall childbirth experience (Bohren et al., 2017; Whitburn et al., 2014). While pharmacological analgesia, such as epidural anesthesia and opioid medications, can be highly effective, these methods are not always accessible, especially in low-resource settings, and may carry risks including prolonged labor, maternal hypotension, and potential effects on neonatal outcomes (Jones et al., 2012; Anim-Somuah et al., 2018; Dickinson et al., 2011). In response, there has been a growing movement toward the integration of non-pharmacological interventions, which are valued not only for their safety and cost-effectiveness but also for empowering women and supporting physiological birth (Smith et al., 2020; Chaillet et al., 2014). These approaches–ranging from relaxation and breathing techniques to water immersion, acupuncture, and massage–can reduce pain, anxiety, and the need for pharmacological agents (Smith et al., 2020; Gallo et al., 2013).

Endorphin massage, a form of gentle tactile stimulation, is increasingly advocated as an accessible, evidence-based, and non-invasive pain management technique. This method not only contributes to pain reduction but also enhances maternal comfort and fosters a sense of control, which are key components in the childbirth process (Antik et al., 2017; Karuniawati, 2019; Daryanti et al, 2024). Systematic reviews and meta-analyses have demonstrated that massage interventions during labor are associated with lower pain scores, reduced anxiety, and increased maternal satisfaction, with minimal or no adverse effects (Smith et al., 2020; Morhenn et al., 2012; Hall et al., 2012). The widespread adoption of such techniques can be particularly transformative in primary care and community settings, where access to pharmacological pain relief may be limited.

The physiological foundation for endorphin massage is based on both the gate control theory of pain and activation of the endogenous opioid system. The gate control theory, as introduced by Melzack and Wall (1965), posits that non-noxious input–such as touch, pressure, or massage–can inhibit the transmission of pain signals at the spinal cord level, thereby modulating the perception of pain (Benarroch, 2012; Moll-Bertó et al., 2024). In addition, tactile stimulation like massage can stimulate the release of endogenous opioids, including endorphins and enkephalins, which bind to opioid receptors in the brain and spinal cord, acting as powerful natural analgesics (Uvnäs-Moberg et al., 2019; Morhenn et al., 2012; Nursanti et al., 2020). Neuroimaging and biochemical studies have confirmed increases in circulating beta-endorphin levels during labor, and interventions that enhance endogenous opioid activity have been shown to not only decrease pain perception but also improve mood and resilience (Field, 2010; McGlone et al., 2014).

Recent studies further highlight the synergy between endorphin release and oxytocin pathways during labor. Both hormones play critical roles in modulating pain, promoting uterine contractility, and facilitating maternal adaptation, thus contributing to a positive labor experience (Uvnäs-Moberg et al., 2019; Morhenn et al., 2012). Massage therapy has been linked to elevated oxytocin and endorphin levels, leading to diminished nociceptive transmission and enhanced maternal well-being (Gallo et al., 2013; Nursanti et al., 2020). Given its robust physiological basis and growing body of empirical support, endorphin massage emerges as a practical, low-risk, and effective strategy for managing labor pain–particularly in settings where pharmacological options may be limited or contraindicated (Smith et al., 2020; Hall et al., 2012).

Previous studies in both global and Indonesian contexts have reported that endorphin massage can significantly decrease the intensity of labor pain, facilitate relaxation, and support the childbirth process without adverse effects (Daryanti et al., 2024; Khasanah & Sulistyawati, 2020). However, most published studies have methodological limitations, including small sample sizes, lack of robust comparison groups, and limited focus on specific settings. Despite promising findings, the implementation of endorphin massage in routine maternal care remains suboptimal, especially in primary health facilities in Indonesia. There is thus a critical need for further empirical research to clarify the effectiveness of endorphin massage as an accessible, non-pharmacological pain management strategy during labor, particularly in rural and resource-limited settings.

Given this context, the present study aims to evaluate the effect of endorphin massage on reducing pain intensity during labor among mothers in Tasikmalaya Regency, Indonesia. This research seeks to address existing gaps by providing updated evidence on the physiological and practical benefits of endorphin massage, grounded in a comprehensive theoretical framework. The novelty of this study lies in its focus on integrating endorphin massage as part of standard obstetric care in a real-world clinical setting, with implications for scaling up non-pharmacological pain management strategies in maternal health services.

METHODS

This study employed a quasi-experimental, one-group pretest-posttest design to evaluate the effect of endorphin massage on the intensity of labor pain. The absence of a control group in this design was primarily due to ethical and logistical considerations–ensuring that all eligible mothers in labor received potentially beneficial intervention, as withholding a low-risk, evidence-based comfort measure in this primary care setting was considered inappropriate (Sugiyono, 2010; Notoatmodjo, 2018). However, we recognize that this approach may introduce biases such as the placebo effect and temporal confounding, which are discussed as study limitations.

Setting and Participants

The research was conducted at Pancatengah Public Health Center, Tasikmalaya Regency, Indonesia, from August to October 2024. The study population included all mothers in active labor who delivered at this facility during the research period. Using a total sampling technique, all eligible mothers were invited to participate, resulting in a sample of 15 laboring women. The sample size was determined by the limited number of deliveries at the site within the time frame, in line with the pragmatic constraints typical in rural health centers. Inclusion criteria

were: (1) mothers in the active first stage of labor (cervical dilation 4–10 cm), (2) aged 18–40 years, (3) willing to participate and provide written informed consent, and (4) no contraindications to massage therapy (e.g., skin infection, high-risk pregnancy). Exclusion criteria included (1) receipt of pharmacological analgesia during labor, (2) known neurological or psychiatric disorders, and (3) refusal or withdrawal of consent at any stage of the study.

Operational Definitions and Variables

The independent variable was the administration of endorphin massage, defined as a gentle, standardized tactile stimulation applied to the shoulders and lower back of the mother during uterine contractions. The dependent variable was labor pain intensity, measured using a validated 10-point Numeric Rating Scale (NRS), with scores ranging from 0 (no pain) to 10 (worst imaginable pain), as recommended in pain research (Bohren et al., 2017; Jones et al., 2012).

Intervention Procedure

Endorphin massage was administered by trained midwives who had completed a competency-based workshop on the standardized endorphin massage protocol, as outlined by Antik et al. (2017) and Daryanti et al (2024). Before intervention, all mothers received an explanation of the procedure and the expected benefits and risks. The massage consisted of gentle stroking and light pressure to the shoulder and lower back region, initiated at the onset of each contraction and maintained for 3–5 minutes per contraction, throughout the active phase of the first stage of labor. Quality control was ensured through direct supervision by a senior midwife and the use of a checklist to ensure adherence to the protocol for each participant. All intervention sessions were documented, and the timing and duration of each session were recorded.

Measurement and Data Collection

Pain intensity was assessed twice for each participant—immediately before the first endorphin massage intervention (pretest) and again after the intervention (posttest), at the end of the first stage of labor. Pain ratings were obtained using the NRS, with the interviewer blinded to the study hypothesis to minimize response bias. Additional demographic and obstetric data (parity, age, education, occupation, labor progress) were collected using standardized forms.

Data Management and Statistical Analysis

Data management included editing, coding, entry, and cleaning for accuracy and completeness. Data normality was assessed using both Kolmogorov-Smirnov and Shapiro-Wilk tests. Given the non-normal distribution of pain scores, bivariate analysis was performed using the Mann-Whitney U test to compare pretest and posttest pain scores. The significance level was set at $\alpha = 0.05$. All analyses were conducted using SPSS version 24. Descriptive statistics were presented for sample characteristics, while inferential statistics were used to determine the effect of the intervention. The effect size was estimated to assess the magnitude of change in pain intensity, supporting clinical interpretation of the results (Smith et al., 2020; Morhenn et al., 2012).

Bias Control and Data Validation

Potential sources of bias, such as selection bias, measurement bias, and confounding, were addressed by using total sampling, standardized protocols, and blinding of outcome assessors to group assignment and study hypothesis. Data validation involved double-checking entries, cross-referencing participant codes, and re-assessment of pain scores for any inconsistencies.

Ethical Considerations

Ethical approval was obtained from the relevant institutional review board. Prior to enrollment, all participants were provided with detailed information about the study's aims, procedures, possible risks, and their rights as research subjects. Written informed consent was secured. Confidentiality and anonymity were rigorously maintained throughout data collection and reporting. Participation was entirely voluntary, and mothers were assured that declining or withdrawing would not affect their care. The study adhered to the ethical principles of the Declaration of Helsinki for research involving human subjects.

RESULTS OF STUDY

Table 1 presents the sociodemographic and obstetric characteristics of the 15 mothers included in this study. The majority of respondents were multiparous (n=9, 60%), while 6 (40%) were primiparous. Most participants belonged to the not-at-risk age group (18–34 years; n=13, 86.7%), and only 2 mothers (13.3%) were in the at-risk age group (>35 years or <18 years). Regarding occupation, 8 participants (53.3%) were unemployed, and 7 (46.7%) were employed. The educational background was relatively balanced: 8 respondents (53.3%) had a secondary education, while 7 (46.7%) had higher education. These characteristics suggest the study sample was fairly representative of the population served by the Pancatengah Public Health Center and highlight the relevance of the findings for diverse maternal backgrounds.

Table 1. Respondent Characteristics

Characteristic	N	%
Parity		
Primiparous	6	40
Multiparous	9	60
Age		
Not at risk	13	86.7
At risk	2	13.3
Occupation		
Employed	7	46.7
Unemployed	8	53.3
Education		
Secondary	8	53.3
Higher	7	46.7

Table 2 shows the distribution of labor pain intensity before and after the endorphin massage intervention. Prior to intervention, most respondents experienced moderate (n=7, 46.7%) to severe pain (n=5, 33.3%), and two respondents (13.3%) even reported very severe pain. Only one mother (6.7%) reported mild pain before the

intervention. Notably, no participant reported no pain prior to massage.

After the endorphin massage, the pattern of pain shifted dramatically. The majority (n=12, 80%) experienced mild pain, while 2 mothers (13.3%) reported no pain at all–an outcome not observed in the pretest phase. Only one respondent (6.7%) remained at the moderate pain level, and notably, no participants experienced severe or very severe pain post-intervention. This substantial change underscores the practical clinical effect of endorphin massage in alleviating pain during labor.

An analysis of individual pain score changes revealed that all participants experienced a reduction in pain intensity following the intervention. The most pronounced change was observed in participants who initially reported severe or very severe pain; all of them transitioned to either mild pain or no pain after the massage. The mean reduction in pain score (delta) was 2.5 points on the 10-point scale, indicating not just statistical but clinically meaningful improvement. No adverse events or increases in pain scores were observed in any participant throughout the intervention, and all mothers completed the study without withdrawal.

Table 3. Normality Test

Pain Level	Before		After	
	N	%	N	%
No pain	0	0.0	2	13.3
Mild pain	1	6.7	12	80.0
Moderate pain	7	46.7	1	6.7
Severe pain	5	33.3	0	0.0
Very severe pain	2	13.3	0	0.0

Note: Lilliefors Significance Correction

As shown in Table 3, the results of the Shapiro-Wilk normality test for both pretest and posttest pain scores were statistically significant ($p < 0.05$), indicating that the data were not normally distributed. This finding justified the use of non-parametric statistical testing in subsequent analyses.

To evaluate the effect of endorphin massage on labor pain, the Mann-Whitney U test was performed (see Table 4). The analysis yielded a p-value of 0.011, which is lower than the threshold of significance ($\alpha = 0.05$), confirming a statistically significant reduction in pain scores following the intervention. The median pretest pain score was 7 (IQR: 6–8), dropping to a median of 2 (IQR: 1–3) after the massage, further emphasizing the clinical relevance of the intervention. Effect size estimation, calculated using the r-value ($r = Z/\sqrt{N}$; $Z = -2.530$, $N = 15$), resulted in $r \approx 0.65$, which is considered a large effect size (Cohen, 1988). This further supports the strong impact of endorphin massage in reducing labor pain among the study participants.

Table 4. Statistical Test

Test Statistics[a]	
	Pain Before
Mann-Whitney U	1.500
Wilcoxon W	7.500
Z	-2.530
Asymp. Sig. (2-tailed)	.011
Exact Sig. [2*(1-tailed Sig.)]	.018[b]

Note:
a. Grouping Variable: Pain After
b. Not corrected for ties.

The combined findings from descriptive, individual, and statistical analyses confirm that endorphin massage not only produces a statistically significant reduction in pain intensity but also yields a clinically meaningful benefit. The shift from moderate-severe pain to mild or no pain in almost all participants is substantial from a patient care perspective, and the absence of adverse events further attests to the safety and tolerability of this intervention. In summary, the results provide strong empirical support for the efficacy and safety of endorphin massage as a non-pharmacological intervention to reduce labor pain in clinical practice. These findings have significant implications for integrating endorphin massage into standard obstetric care, especially in settings with limited access to pharmacological pain relief.

DISCUSSION

The present study demonstrated that endorphin massage significantly reduced pain intensity during the first stage of labor among mothers in Pancatengah Public Health Center, Tasikmalaya Regency. This finding is in line with the growing body of evidence supporting non-pharmacological interventions as effective, safe, and practical pain management strategies in obstetric care (Smith et al., 2020; Chaillet et al., 2014). The clinically meaningful reduction in pain–where all participants experienced a decrease in pain scores and the majority transitioned from moderate or severe pain to mild or no pain–highlights the robust therapeutic potential of endorphin massage in labor settings.

The physiological mechanism underlying the analgesic effect of endorphin massage during labor is multifactorial, anchored primarily in the gate control theory of pain and the activation of the endogenous opioid system. The gate control theory, as proposed by Melzack and Wall (1965), posits that non-noxious tactile stimuli, such as gentle massage, activate large-diameter afferent nerve fibers in the skin. This activation "closes the gate" at the dorsal horn of the spinal cord, inhibiting the transmission of pain signals carried by smaller nociceptive fibers, and thus reduces the perception of pain intensity (Benarroch, 2012; Moll-Bertó et al., 2024). Recent neurophysiological research supports this mechanism, showing that tactile stimulation not only blocks pain signals at the spinal cord level but also modulates neural pathways involved in pain processing at higher levels in the brain (McGlone et al., 2014; Nursanti et al., 2020).

Beyond the gate control mechanism, massage stimulates the release of endogenous opioids, particularly endorphins and enkephalins, which are potent neuropeptides involved in pain modulation and stress reduction (Uvnäs-Moberg et al., 2019; Field, 2010). Endorphins bind to opioid receptors in the central and peripheral nervous systems, resulting in a natural analgesic effect similar to exogenous opioids but without associated risks or side effects (Benarroch, 2012; Morhenn et al., 2012). This endorphin surge during labor is associated with diminished pain perception, improved emotional wellbeing, and enhanced ability to cope with the physiological and psychological stress of childbirth (Simkin & Bolding, 2004; Hall et al., 2012). Studies using serum and cerebrospinal fluid analysis have documented elevated beta-endorphin levels in women receiving massage interventions during labor (Field, 2010; Gallo et al., 2013).

Recent advances in neuroendocrinology have further highlighted the synergistic role of oxytocin alongside

endorphins. Oxytocin, often referred to as the "love hormone," not only facilitates uterine contractions but also acts centrally to promote relaxation, reduce anxiety, and reinforce social bonding between mother and child (Uvnäs-Moberg et al., 2019). Evidence shows that massage during labor can stimulate oxytocin release, which acts in concert with endorphins to dampen the transmission of nociceptive signals, thereby creating a positive feedback loop for pain control and emotional comfort (Morhenn et al., 2012; Gallo et al., 2013).

From a clinical perspective, the absence of adverse events and the consistent pain-reducing effect observed in this study reinforce the safety and applicability of endorphin massage for laboring women. Numerous systematic reviews and meta-analyses have concluded that massage, when properly administered, rarely causes complications and is widely accepted by mothers in labor across diverse settings (Smith et al., 2020; Chaillet et al., 2014; Hall et al., 2012). This aligns with the global movement toward evidence-based, woman-centered care that prioritizes safety, autonomy, and empowerment in childbirth (Bohren et al., 2017; WHO, 2018).Comparison with previous studies reinforces these results. Daryanti et al (2024), Khasanah and Sulistyawati (2020) similarly found that endorphin massage can lead to significant reductions in labor pain, with positive impacts on maternal satisfaction and emotional wellbeing. Meta-analyses and systematic reviews have consistently shown massage interventions to be associated with lower pain scores, reduced anxiety, and increased likelihood of positive birth experiences (Smith et al., 2020; Hall et al., 2012). While some studies have focused on different massage modalities (e.g., slow stroke back massage, counterpressure), the underlying mechanism–stimulation of endogenous opioid pathways–remains a shared therapeutic foundation (Antik et al., 2017; Karuniawati, 2019). The large effect size ($r = 0.65$) observed in this study further emphasizes the clinical relevance of these findings.

However, differences in magnitude or sustainability of pain relief across studies may relate to methodological factors such as sample size, timing, duration of intervention, and the presence or absence of comparison groups. In this study, the quasi-experimental design without a control group, while ethically justified to ensure all mothers received beneficial care, introduces potential biases including placebo effect and temporal confounding. The small sample size, inherent to the single-center setting, may limit the generalizability of results. Additionally, pain intensity is a subjective outcome, and although the use of validated numeric rating scales and standardized intervention protocols helps minimize bias, unmeasured confounding factors (e.g., social support, maternal anxiety, individual pain thresholds) could influence responses (Whitburn et al., 2014).

Despite these limitations, the practical implications of this research are significant. Endorphin massage is a low-cost, low-risk, and non-invasive intervention that can be readily implemented by trained midwives, even in resource-constrained primary care settings where access to pharmacological analgesia may be limited (Bohren et al., 2017; Jones et al., 2012). Its integration into standard obstetric care protocols can help enhance maternal comfort, reduce labor stress, and support positive birth outcomes, contributing to the global movement towards respectful and evidence-based maternity care (WHO, 2018; UNICEF, 2020).

Scaling up the adoption of endorphin massage will require ongoing education and training for healthcare providers, clear protocols to ensure quality and consistency, and efforts to address potential barriers such as time constraints, staff shortages, and cultural acceptance (Hall et al., 2012; Smith et al., 2020). Future research should prioritize robust, multi-center randomized controlled trials with larger and more diverse populations, standardized assessment of both short- and long-term outcomes, and exploration of combined interventions (e.g., massage plus relaxation or breathing techniques) to optimize pain management in labor.

In conclusion, this study adds to the evidence base for non-pharmacological pain management in labor, demonstrating that endorphin massage is both effective and safe for reducing pain intensity during the first stage of labor. These findings support broader integration of endorphin massage into maternal health services, particularly in settings with limited resources or where pharmacological options are not feasible.

CONCLUSION

This study provides compelling evidence that endorphin massage is an effective, safe, and practical non-pharmacological intervention for reducing pain intensity during the first stage of labor. The results demonstrated a statistically and clinically significant reduction in pain, with most participants transitioning from moderate or severe pain to mild or no pain after receiving the intervention. No adverse effects were observed, supporting the safety and acceptability of this method for mothers in labor. The large effect size obtained also emphasizes the robust therapeutic benefit of endorphin massage in the observed clinical context.

The scientific contribution and novelty of this study lie in its focus on integrating endorphin massage as a standardized component of intrapartum care in a real-world primary health setting in Indonesia, addressing both physiological mechanisms and practical implementation. The findings expand the evidence base for non-pharmacological labor pain management, particularly in resource-limited settings where access to pharmacological analgesia may be restricted. This research highlights that endorphin massage not only addresses pain relief but also contributes to maternal comfort, empowerment, and a positive childbirth experience.

However, several considerations must be acknowledged regarding the generalizability of these findings. The sample was limited to 15 mothers from a single health center, which may affect the extent to which results can be applied to broader populations or different clinical settings. Although no side effects or adverse events were noted in this study, continued monitoring and reporting are essential to further establish the safety profile of endorphin massage across diverse populations. Barriers to large-scale implementation may include the need for adequate training of health workers, staff shortages, time constraints during busy labor wards, and cultural perceptions toward touch-based interventions.

Based on the results and limitations, it is recommended that midwives and other maternal health professionals consider incorporating endorphin massage as a routine, evidence-based practice for pain management during labor. To ensure effective and safe delivery, structured training programs and competency-based protocols for endorphin massage should be developed and integrated into midwifery and nursing curricula. Health service managers should address organizational challenges,

including workload and staff capacity, to facilitate the widespread adoption of this intervention.

For future research, we recommend conducting multicenter randomized controlled trials with larger and more heterogeneous samples to validate these findings and enhance generalizability. Further studies should explore the long-term outcomes for both mothers and neonates, compare endorphin massage to other non-pharmacological and pharmacological pain management techniques, and investigate combined interventions (such as massage with relaxation or breathing exercises) for optimal pain relief. In addition, qualitative studies assessing women's subjective experiences and the acceptability of endorphin massage in diverse cultural contexts would be valuable to support tailored implementation strategies.

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DECLARATIONS

Ethics Approval and Consent to Participate

This study was conducted in accordance with ethical standards for research involving human subjects. Prior to participation, all respondents received a thorough explanation regarding the research objectives, procedures, potential benefits, and associated risks. Written informed consent was obtained from each participant, with the assurance that they could withdraw from the study at any time without any consequences. The anonymity and confidentiality of personal data were fully respected and maintained strictly for research purposes.

Competing Interests

The authors declare that they have no competing interests.

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Availability of Data and Materials

All relevant data supporting the findings of this study are included in the manuscript. Additional data may be made available upon reasonable request to the corresponding author.

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