

Breathing Techniques Reduce Labor Pain Intensity at Cendana Putih Primary Health Center, North Luwu Regency

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Abstract

This study examined the effect of breathing techniques on labor pain intensity among laboring mothers at Cendana Putih Primary Health Center, North Luwu Regency, in 2024, because primary healthcare facilities need effective, safe, and easily applicable non-pharmacological pain management. A quasi-experimental one-group pretest-posttest design involved 12 women in the active phase of first-stage labor, selected through consecutive sampling during May–June 2024. Pain intensity was measured with the validated Numeric Rating Scale (0–10) before and 60 minutes after approximately 30 minutes of rhythmic breathing (4-second inhalation, 2-second hold, 6-second exhalation), and analyzed using the Wilcoxon Signed Rank Test. The mean pain score decreased from 7.50 to 4.25 ($p = 0.001$; $r = 0.66$, large effect), and all 12 respondents showed a decrease. Breathing techniques thus reduce labor pain in a statistically and clinically meaningful way and merit integration into primary-level midwifery care; larger randomized controlled trials are recommended.

Keywords: *Breathing Techniques, Labor Pain, Non-pharmacological Pain Management*

Introduction

Childbirth is a physiological process marking the culmination of every mother's pregnancy journey, characterized by the expulsion of the fetus and placenta from the uterus through a complex series of mechanisms. Most parturient women face an intense pain experience, originating from rhythmic uterine contractions, stretching of the lower uterine segment, and mechanical pressure on the pelvic and perineal structures. Labor pain is not merely a sensory response, but a multidimensional experience involving physiological, psychological, and social components simultaneously (Rejeki, 2020).

Labor pain is a near-universal and often severe experience during childbirth that remains inadequately managed in many settings worldwide (Smith et al., 2018). Unmanaged or poorly managed labor pain affects labor duration, increases the risk of prolonged labor, and contributes to the rising demand for cesarean section deliveries. Globally, the proportion of births by cesarean section rose from approximately 7% in 1990 to 21% in 2021 and is projected to reach 29% by 2030 (World Health Organization, 2021; Betrán, Ye, Moller, Souza, & Zhang, 2021); the inability of mothers to tolerate labor pain has been identified as one of the driving factors behind this trend (Rana, Mazumder, Khan, Khan, & Rahman, 2024). At the international level, Smith et al. (2018), in the *Cochrane Database of Systematic Reviews*, found that relaxation techniques, including breathing exercises, reduce labor pain intensity and anxiety, although the quality of evidence varies.

At the national level, addressing labor pain has grown increasingly significant given the multifaceted nature of maternal health challenges in Indonesia. The 2020 Long Form Population Census reported Indonesia's maternal mortality ratio (MMR) at 189 per 100,000 live births (Badan Pusat Statistik, 2023), a decline from the 305 per 100,000 live births recorded in the 2015 Intercensal Population Survey and cited in the Indonesian Health Profile (Ministry of Health of the Republic of Indonesia, 2023), yet still considerably above the SDGs 2030 target of below 70 per 100,000 live births. Although MMR is not directly caused by labor pain, unmanaged pain increases the physiological stress response of mothers, which can worsen hemodynamic conditions and prolong labor duration (Indirayani, Meuratana, Aditya, & Rajuddin, 2022). Therefore, effective pain management is an integral part of efforts to reduce maternal morbidity. At the local level, Cendana Putih Primary Health Center in North Luwu Regency recorded 344 deliveries in 2021, 338 in 2022, and 351 in 2023 (Puskesmas Cendana Putih delivery register, 2021–2023). Interviews with midwives in the delivery room indicated that almost all parturient women reported significant labor pain, and the treatment routinely provided has been through breathing techniques as part of midwifery care.

Theoretically, the mechanism through which breathing techniques alleviate labor pain can be elucidated via the Gate Control Theory introduced by Melzack and Wall. This theory posits that pain impulse transmission toward the brain may be modulated by activating large-diameter nerve fibers (A β), which function to close the "gate" within the spinal cord, thereby inhibiting pain signals conducted by A δ and C fibers. Structured and rhythmic breathing techniques stimulate the parasympathetic nervous system, promote endogenous endorphin secretion, and diminish cortisol and epinephrine concentrations in the bloodstream, which collectively and synergistically attenuate pain perception alongside anxiety among parturient women (Darmayanti, Fahriati, Pratiwi, Romlah, & Im, 2024). This approach aligns with the *Stress-Coping Model*, which emphasizes that individuals can develop adaptive coping strategies in facing stressors, including pain, through structured breath-regulation techniques.

Numerous investigations have confirmed the efficacy of breathing relaxation techniques. Sunarsih and Sari (2020) documented a reduction in the mean labor pain score from 6.7 (SD = 0.8) to 4.3 (SD = 0.9) following deep breathing relaxation intervention, with $p < 0.001$. Septiani and Agustia (2022) showed that mothers who applied deep breathing relaxation techniques consistently experienced pain reduction proportional to contraction intensity. Darmayanti et al. (2024) confirmed that third-trimester pregnant women's knowledge of *breath exercises* was positively correlated with their pain management ability during labor. At the international level, Chaillet et al. (2014), in *Birth*, identified breathing relaxation techniques as one of the most applicable non-pharmacological interventions for labor pain management, particularly in resource-limited facilities.

Despite this, a significant research *gap* remains in the literature. First, most previous studies were conducted in advanced health care facilities such as hospitals and private clinics in urban areas, so empirical evidence on the effectiveness of breathing techniques in primary health care facilities, particularly community health centers (*Puskesmas*) in the Eastern Indonesia region with distinctive sociocultural characteristics, remains very limited. Second, the majority of available studies have not systematically measured pain using validated instruments at specific phases of labor, nor have they considered parity as a factor that can moderate pain response (Nainggolan & Harahap, 2024). Third, the reporting of *effect size* and clinical analyses based on the *Minimal Clinically Important Difference* (MCID) is still rarely found in the literature on breathing techniques in Indonesia. Grounded in this identified gap, the current study aimed to determine the change in pain intensity scores among women in the active phase of the first stage of labor after a structured rhythmic breathing intervention in a primary care setting, and to assess whether this change is clinically meaningful. The results are expected to contribute scientific evidence supporting the implementation of breathing techniques as a standard of midwifery care in non-pharmacological pain management in primary health care

facilities, and to serve as a reference for developing more comprehensive and evidence-based maternity service policies.

Method

This study employed a quantitative approach with a quasi-experimental one-group pretest-posttest design, chosen because an insufficient number of parturient women simultaneously met the inclusion criteria at a single primary health care facility, making randomization into a control group unfeasible without delaying care. The study population comprised all parturient women at Cendana Putih Primary Health Center, North Luwu Regency, during May–June 2024 (N = 40). Respondents were recruited using consecutive sampling: every parturient woman presenting during the study period was screened against the inclusion criteria in order of arrival, and eligible, consenting women were enrolled until the study period ended. Of the 40 women screened, 12 met all inclusion criteria and agreed to participate, while 28 were excluded or declined (e.g., not in the first-stage active phase at presentation, prior pharmacological analgesia, labor complications, or non-consent). The inclusion criteria were: (1) first-stage active phase (4–7 cm cervical dilation); (2) willingness to participate through *informed consent*; (3) no pharmacological analgesic administration; and (4) absence of labor complications. Respondents with respiratory disorders precluding the breathing technique, or who declined or withdrew during the intervention, were excluded. This study was approved by the Health Research Ethics Committee (Komisi Etik Penelitian Kesehatan) of TEDC Polytechnic Bandung (Approval No. 034/PKE/210424). As labouring women constitute a vulnerable research population, particular attention was given to voluntary participation, the right to withdraw at any stage without any effect on the care received, and protection of data confidentiality and anonymity; written informed consent was obtained from every respondent prior to enrollment.

Pain intensity was measured using the *Numeric Rating Scale* (NRS, 0–10; 0 = no pain, 1–3 = mild, 4–6 = moderate, 7–9 = severe, 10 = very severe), a validated instrument with high reliability for labor pain measurement (Septiani & Agustia, 2022). Respondents received a brief (± 2 -minute) orientation to the NRS before the *pretest* to ensure uniform understanding. The intervention followed a standard operating procedure for breathing techniques: the mother was positioned comfortably, then guided to inhale through the nose for 4 seconds, hold for 2 seconds, and exhale through the mouth for 6 seconds; this cycle was repeated for approximately 30 minutes under the direct guidance of the researcher, a *trained midwife*. Pain intensity was assessed before the intervention (*pretest*) and 60 minutes afterward (*posttest*). To minimize *confounding* bias from the natural progression of labor, cervical dilation was recorded at both time points, and only respondents who remained in the first-stage active phase at both measurements were retained for analysis.

Data were processed using SPSS version 26. Normality was assessed with the Shapiro-Wilk test, appropriate for a sample size below 50 (Dahlan, 2014); because the data were not normally distributed ($p < 0.05$), the nonparametric Wilcoxon Signed Rank Test was used to compare pretest and posttest pain scores at $\alpha = 0.05$, with the difference computed as pretest minus posttest so that a positive rank denotes a decrease in pain score. Effect size was calculated as $r = |Z|/\sqrt{N}$, where N is the total number of observations (2×12 pairs = 24), and interpreted according to Cohen's (1988) criteria ($r \geq 0.5$ = large effect); the 95% confidence interval for r was obtained via Fisher's z-transformation. Clinical significance was evaluated using the Minimal Clinically Important Difference (MCID) concept for the NRS, defined as a reduction of approximately 2 points or 30% from baseline (Farrar, Young, LaMoreaux, Werth, & Poole, 2001). The 95% confidence interval for the median pretest–posttest difference was estimated using the Hodges–Lehmann estimator for paired nonparametric data.

Results

Respondent Characteristics

Respondent demographic characteristics are depicted in Table 1. The predominant respondents fell within the 26–30 age range (33.3%), were multigravida (58.3%), and possessed senior high school educational background (58.3%).

Table 1. Characteristics of Study Respondents (n = 12)

Characteristic	Frequency (f)	Percentage (%)
Age		
20–25 years	3	25.0
26–30 years	4	33.3
31–35 years	2	16.7
> 35 years	3	25.0
Parity		
Primigravida	5	41.7
Multigravida	7	58.3
Education		
Junior High School	3	25.0
Senior High School	7	58.3
Higher Education	2	16.7
Total	12	100.0

Source: Primary Data, 2024

Distribution of Pain Intensity Before and After Intervention

Pain intensity was assessed utilizing the NRS prior to (pretest) and following (posttest) the breathing techniques intervention. The distribution of pain categories is illustrated in Table 2.

Table 2. Distribution of Labor Pain Intensity Before and After Intervention (n = 12)

Pain Category	Pretest		Posttest	
	f	%	f	%
Mild pain (NRS 1–3)	0	0.0	3	25.0
Moderate pain (NRS 4–6)	2	16.7	9	75.0
Severe pain (NRS 7–9)	10	83.3	0	0.0
Very severe pain (NRS 10)	0	0.0	0	0.0
Total	12	100.0	12	100.0

Source: Primary Data, 2024

Table 2 shows that pain intensity shifted from predominantly severe before the intervention to predominantly moderate afterward, consistent with the reduction in mean and median scores reported in Table 4.

Data Normality Test

Normality assessment was conducted utilizing the Shapiro-Wilk test prior to comparative analysis. The normality test outcomes are depicted in Table 3.

Table 3. Shapiro-Wilk Normality Test Results

Group	n	Significance (p)	Remarks
<i>Pretest</i>	12	0.001	Not normal
<i>Posttest</i>	12	0.019	Not normal

Source: Shapiro-Wilk Test Results, Primary Data 2024

Based on Table 3, the p-value for the *pretest* was 0.001, and for the *posttest* was 0.019. Both values are smaller than $\alpha = 0.05$, so the data are declared not normally distributed. Therefore, the comparative analysis was conducted using the nonparametric *Wilcoxon Signed Rank Test*.

Effect of Breathing Techniques on Labor Pain Intensity

Table 4. Wilcoxon Signed Rank Test Results of the Effect of Breathing Techniques on Labor Pain Intensity

Group	n	Mean $\pm$ SD	Median (IQR)	Z	p-value	Effect Size (r)
<i>Pretest</i>	12	7.50 $\pm$ 1.00	7.50 (7.00–8.00)			
<i>Posttest</i>	12	4.25 $\pm$ 1.22	4.00 (3.75–5.00)	-3.217	0.001	0.66

Source: Wilcoxon Signed Rank Test Results, Primary Data 2024

Note: Difference computed as *pretest* minus *posttest* score; Positive Ranks = 12 (pain score decreased), Negative Ranks = 0 (pain score increased), Ties = 0. Effect size $r = |Z|/\sqrt{N}$, where N is the total number of observations ($2 \times 12 = 24$): $r = 3.217/\sqrt{24} = 0.66$, 95% CI [0.34, 0.84] (Fisher's z-transformation), a large effect per Cohen's (1988) criteria.

The Hodges–Lehmann estimate of the median *pretest*–*posttest* difference (location shift), computed as the median of the Walsh averages of the 12 paired differences, was 3.00. Because the paired differences contained extensive ties (9 of 12 differences equalled 3, and 3 equalled 4), an exact 95% confidence interval was not achievable; the closest achievable exact interval was [3.00, 3.50].

Table 4 reveals that the mean *pretest* pain intensity was 7.50 (SD = 1.00) with a median of 7.50 (IQR 7.00–8.00). Subsequent to the intervention, the mean diminished to 4.25 (SD = 1.22) with a median of 4.00 (IQR 3.75–5.00). The discrepancy of 3.25 points on the NRS scale (43% of the baseline mean) surpassed the MCID threshold (approximately 2 points or 30%), signifying a clinically meaningful transformation. The Wilcoxon Signed Rank Test, computed as the *pretest* score minus the *posttest* score, generated $Z = -3.217$ with $p = 0.001$ ($< \alpha = 0.05$); because the difference was defined in this direction, a positive rank corresponds to a decrease in pain score. Of the 12 respondents, all 12 showed a decrease in pain score (positive ranks = 12), none showed an increase (negative ranks = 0), and none showed no change (ties = 0). The effect size, $r = 0.66$ (95% CI: 0.34–0.84), corresponds to a large effect according to Cohen's (1988) criteria, indicating that the breathing techniques intervention exerts a substantial influence upon alleviating labor pain intensity. Consequently, H_0 was rejected, allowing the conclusion that breathing techniques produced a statistically and clinically significant reduction in labor pain intensity at Cendana Putih Primary Health Center in 2024.

Discussion

The results of this study indicate that breathing techniques contribute significantly to the reduction of labor pain intensity, consistent with the statistically and clinically meaningful change in NRS scores reported in Table 4. Referring to the *Minimal Clinically Important Difference* (MCID) concept on the NRS scale, a reduction of approximately 2 points or 30% is considered clinically important (Farrar et al., 2001), although these thresholds were derived from chronic pain trials. The

magnitude of reduction observed in this study exceeded the MCID threshold, confirming that the breathing techniques intervention provides a real clinical benefit for parturient women.

Theoretically, the mechanism underlying pain attenuation through breathing techniques can be elucidated via the Gate Control Theory introduced by Melzack and Wall. This theory posits that pain impulse transmission from the periphery toward the cerebral cortex may be suppressed through activating large-diameter nerve fibers ($A\beta$) within the spinal cord, which competitively occlude the "gate" of pain transmission conducted by $A\delta$ and C fibers. Regular and rhythmic breathing techniques stimulate $A\beta$ fiber activation, consequently diminishing pain perception received by the brain substantially. Furthermore, controlled breathing patterns engage the parasympathetic nervous system, promote endogenous endorphin secretion as the body's innate analgesic agents, and decrease cortisol alongside epinephrine concentrations within blood circulation (Sanif et al., 2024). This amalgamation of physiological responses synergistically alleviates uterine muscular tension, stabilizes hemodynamic parameters, and attenuates pain perception among parturient women (Darmayanti et al., 2024).

The outcomes of this study are concordant with those of Sunarsih and Sari (2020), who documented a reduction in the mean labor pain score from 6.7 to 4.3 subsequent to deep breathing relaxation among parturient women in Bandar Lampung, with $p < 0.001$. Although the magnitude of reduction in their investigation was considerably greater, this discrepancy may be attributable to: (1) divergent population characteristics; (2) distinct labor phases during measurement; (3) varying intervention durations; and (4) differing breathing protocols, whereby Bandar Lampung employed simple deep breathing relaxation, whereas the present study utilized a more structured 4-2-6-second cycle. The investigation by Septiani and Agustia (2022) further corroborated that parturient women who consistently applied deep breathing relaxation techniques demonstrated pain attenuation proportional to contraction intensity. Additionally, Eniyati, Ayuningtyas, and Yulaikah (2021) documented considerable differences in pain intensity preceding and succeeding belly breathing technique application during the first-stage active phase of labor. Multazam, Eliawati, and Muharni (2023) established a significant influence of deep breathing relaxation techniques upon pain diminution among postoperative patients in Tanjungpinang, reinforcing empirical evidence consistency regarding this intervention across diverse geographical and clinical contexts.

From the perspective of factors influencing pain response, parity has been shown to play an important role in modulating labor pain perception. Nainggolan and Harahap (2024) explained that primigravida mothers tend to experience more intense pain than multigravida mothers because they have no previous childbirth experience, resulting in a relatively lower pain tolerance threshold and higher levels of anxiety. In this study, the proportion of primigravida mothers at 41.7% may have contributed to the distribution of *pretest* pain scores being dominated by the severe pain category. These findings are consistent with Telaumbanua, Hura, and Salim (2023), who emphasized that age and childbirth experience significantly affect the pain intensity felt by mothers, particularly through psychological mechanisms such as anxiety and perception of self-control over pain.

The practical implications of these findings are substantially relevant for advancing midwifery care standards, particularly within primary health care facilities. Breathing techniques represent a non-pharmacological intervention that is economical, non-invasive, readily acquired, and requires no specialized equipment, rendering it highly applicable for routine implementation in community health centers operating with constrained resources. Operationally, midwives may incorporate the 4-2-6-second breathing technique into first-stage active phase management as a first-line intervention preceding pharmacological analgesic consideration. Concise training (1–2 hours) for midwives alongside a straightforward SOP can facilitate consistent and sustainable implementation. These findings corroborate the WHO (2018) recommendation, which advocates non-pharmacological pain management utilization as an integral component of mother-centered normal childbirth care (woman-

centered care). Theoretically, this investigation contributes toward consolidating the evidence base for breathing technique application within the Gate Control Theory framework, whilst expanding empirical evidence regarding intervention effectiveness within primary health care facility contexts throughout the Eastern Indonesia region, an area that has remained considerably underrepresented in existing literature.

Study Limitations. This investigation encompasses several limitations that warrant explicit acknowledgment. First, the one-group pretest-posttest design lacking a control group constitutes a substantial methodological shortcoming, as it cannot comprehensively eliminate confounding factor influences such as natural labor progression, midwife companionship effects (Hawthorne effect), or mothers' spontaneous adaptive responses toward pain. Second, the relatively limited sample size ($n = 12$) elevates the probability of Type II error and constrains the generalizability of findings toward a broader population. Third, although a consecutive sampling approach was applied within the study period, the non-random selection method still diminishes the statistical representativeness of the sample. Fourth, although cervical dilation was documented at pretest and posttest, the 60-minute posttest measurement could not comprehensively regulate the natural dynamics of labor progression, consequently the observed pain score reduction may be partially attributable to non-intervention factors. Fifth, additional confounding variables encompassing pre-labor anxiety levels, social support, and utilization of other complementary interventions were not systematically regulated. Subsequent research employing a randomized controlled trial (RCT) design, larger sample sizes grounded in power analysis, systematic regulation of moderating variables including parity and anxiety levels, alongside a mixed-method approach integrating quantitative measurements with phenomenological exploration of maternal experiences, is strongly advocated to generate more robust and broadly generalizable scientific evidence.

Conclusion and Suggestions

This study shows that breathing techniques contribute significantly to reducing labor pain intensity in parturient women at Cendana Putih Primary Health Center, North Luwu Regency, in 2024. This finding is meaningful both statistically and clinically and supports the integration of breathing techniques into the standard of midwifery care in primary health care facilities as a first-line non-pharmacological pain management intervention. Given the design and sample size limitations, these results need to be confirmed through larger-scale follow-up research with a *randomized controlled trial* design and more systematic control of confounding variables.

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Conflict of Interest

The authors declare no conflict of interest in the preparation and publication of this article.

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