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The Effectiveness of Combine Endophin Massage and The Aman Mobile Health Application in Reducing Maternal Anxiety and Labor Pain During The Active Phase of Labor at Tempat Praktik Bidan Mandiri in Tanjungpinang, Indonesia

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Abstract: Labor anxiety and pain in the active phase remain prevalent challenges in Indonesian midwifery care, yet integrated non-pharmacological interventions are underexplored. To evaluate the effectiveness of combined endorphin massage (EM) and the AMAN (*Aplikasi Mobile Android Nyeri*) mobile health application for reducing maternal anxiety and labor pain during the active phase of labor. A qualitative action-research design was employed with 32 purposively selected women in spontaneous labor at two independent midwifery practices in Tanjungpinang. The intervention comprised standardized endorphin massage delivered by trained midwives and simultaneous use of the AMAN application. Quantitative data were collected using the Hamilton Anxiety Rating Scale (HARS) and Visual Analog Scale (VAS); qualitative data were obtained through in-depth interviews, participant observation, and field notes. Results: HARS scores decreased from 30.9 ± 5.2 (moderate-severe anxiety) to 14.1 ± 4.8 (mild anxiety) after the intervention ($p<0.001$). VAS pain scores declined from 7.8 ± 1.3 to 4.6 ± 1.7 ($p<0.001$). Four core qualitative themes emerged: (1) tangibility of pain relief, (2) amplified self-efficacy, (3) emotional anchoring through the digital companion, and (4) preservation of human-centered care. The combined EM-AMAN intervention effectively reduced anxiety and pain, fostered maternal empowerment, and was highly acceptable. This integrative, technology-assisted, non-pharmacological strategy offers a scalable model for Indonesian midwifery practice.

Keywords: endorphin massage, AMAN application, mobile health, maternal anxiety, labor pain, active phase of labor, midwifery

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1. Introduction

The active phase of labor represents one of the most physiologically and psychologically demanding periods in a woman's life. As uterine contractions become more frequent, prolonged, and intense, the parturient commonly experiences escalating pain and anxiety that can profoundly influence the trajectory of labor and birth outcomes. In Indonesia, the incidence of complications during labor reaches 71%, with anxiety due to severe labor pain reported in 53% of cases and prolonged labor in 41%. These figures underscore an urgent public health imperative to optimize non-pharmacological pain and anxiety management strategies within the Indonesian maternity care system. Despite a growing international evidence base supporting integrative therapies, the combination of manual tactile interventions and mobile health technology for laboring women remains critically underexamined in low-resource and midwifery-led settings [1].

Labor pain is a complex, multidimensional phenomenon that encompasses sensory, affective, cognitive, and cultural dimensions. During the active phase, cervical dilation accelerates from approximately 4 cm to complete dilation, and the frequency, duration,

and intensity of contractions increase substantially. The neurophysiological pathways involved in nociception during this phase are well established: visceral pain signals generated by uterine contractions and cervical distension are transmitted via afferent fibers that accompany sympathetic nerves, entering the spinal cord at the T10–L1 levels before ascending to the thalamus and somatosensory cortex. Concurrently, the emotional–affective component of pain is processed through the limbic system, particularly the amygdala and anterior cingulate cortex, which are also intimately involved in the neurobiology of anxiety. This anatomical and functional overlap explains why pain and anxiety are often mutually reinforcing during labor heightened anxiety lowers pain tolerance, while escalating pain amplifies fear and distress [2].

Anxiety during labor is not merely an emotional epiphenomenon but a clinically significant variable that can adversely affect maternal and neonatal outcomes. Elevated anxiety activates the sympathetic nervous system, leading to increased circulating catecholamines epinephrine and norepinephrine—which can diminish uterine contractility, prolong the first and second stages of labor, and increase the likelihood of instrumental delivery and cesarean section. Furthermore, maternal anxiety has been associated with abnormal fetal heart rate patterns, reduced uterine blood flow, and lower Apgar scores, underscoring the systemic consequences of unmanaged psychological distress. A literature review examining anxiety levels in primigravida and multigravida women confirmed that primigravida women consistently demonstrate higher anxiety levels during the active phase, partly attributable to unfamiliarity with the birthing process and fear of the unknown. In the Indonesian context, cultural factors such as limited birth preparedness, inadequate prenatal education, and reliance on family members rather than professional support further compound maternal anxiety [3].

Pharmacological analgesia, particularly epidural anesthesia, is widely regarded as the gold standard for labor pain relief in high-income countries. However, epidural services remain inaccessible to the vast majority of Indonesian women, especially those delivering at independent midwifery practices (*Tempat Mandiri Praktik Bidan*) in regional cities such as Tanjungpinang. Epidural analgesia requires specialized anesthesiology personnel, continuous maternal and fetal monitoring, and substantial financial resources—conditions rarely met in primary midwifery settings. Systemic opioids, while more accessible, carry risks of maternal sedation, respiratory depression, nausea, and neonatal neurobehavioral effects. Consequently, non-pharmacological interventions have garnered considerable attention as safe, low-cost, and culturally acceptable alternatives that can be administered by midwives without advanced medical infrastructure [4].

Endorphin massage represents one such non-pharmacological modality with growing empirical support. Endorphin massage is a light-pressure, rhythmic massage technique that stimulates the release of endogenous opioid peptides—primarily β-endorphin, enkephalins, and dynorphins which bind to mu, delta, and kappa opioid receptors in the central and peripheral nervous systems. By activating the body's intrinsic analgesic system, endorphin massage not only attenuates nociceptive transmission but also promotes relaxation, reduces muscle tension, and induces a state of calmness. A recent study demonstrated that the combination of endorphin massage and nutmeg aromatherapy significantly reduced labor-related pain and anxiety, with authors recommending this method as a supportive non-pharmacological intervention for midwives. A systematic review further confirmed that endorphin massage and counter-pressure techniques are effective non-pharmacological strategies for overcoming labor pain and anxiety through the release of endorphin hormones. Importantly, endorphin massage has also been found to increase oxytocin release, which may facilitate uterine contractility and promote labor progress while simultaneously enhancing maternal–infant bonding [5].

Parallel to the resurgence of manual therapies, the rapid expansion of mobile health (mHealth) technologies over the past decade has created unprecedented opportunities to extend health education, self-management support, and real-time guidance to pregnant

women. Mobile applications designed for obstetric populations have demonstrated efficacy in improving antenatal care attendance, enhancing knowledge of pregnancy danger signs, and promoting healthy behaviors. In Indonesia, smartphone penetration has increased dramatically, reaching over 80% of the adult population in urban and semi-urban areas such as Tanjungpinang, making mHealth interventions increasingly feasible. The AMAN application an acronym for *Aplikasi Mobile Android Nyeri persalinan* was specifically developed to provide pregnant women with accessible, evidence-based information on non-pharmacological labor pain management techniques. The application features guided breathing exercises, visualization modules, progress-tracking tools, and educational content on pain physiology, positioning, and relaxation strategies. The development study for AMAN employed the ADDIE (Analysis, Design, Development, Implementation, Evaluation) instructional design model, with user testing yielding positive perceptions across six dimensions: stimulation (mean 2.18), attractiveness (1.41), efficiency (1.09), perspicuity (1.96), dependability (1.64), and novelty (1.45). The stimulation aspect achieved the highest benchmark rating of "Excellent," indicating strong user engagement and motivational appeal [6].

Despite the individual merits of endorphin massage and mHealth applications, no study to date has investigated their synergistic combination. This gap in the literature is significant because laboring women require multidimensional support that addresses somatic pain through physical touch while simultaneously addressing cognitive–emotional distress through psychoeducation and guided self-regulation. The convergence of tactile and digital modalities may produce additive or synergistic effects by targeting distinct yet complementary pathways: endorphin massage directly modulates nociceptive processing and induces parasympathetic activation, while the AMAN application provides cognitive distraction, self-efficacy enhancement, and emotional reassurance. Furthermore, the integration of a mobile application into the labor support repertoire may extend the reach and consistency of interventions beyond the intermittent presence of the midwife, ensuring that women receive continuous guidance during the entire active phase [7].

Tanjungpinang, the capital of the Riau Islands Province, represents a compelling setting for this investigation. As a rapidly urbanizing regional center with a mixed Malay, Chinese, and Javanese population, Tanjungpinang offers a microcosm of Indonesia's sociocultural diversity. The city's health system is characterized by a pluralistic mix of public hospitals, community health centers (Puskesmas), and independent midwifery practices (Tempat Mandiri Praktik Bidan), with the latter serving as the primary point of care for a substantial proportion of low-risk pregnant women. Independent midwifery practices in Tanjungpinang, such as *Praktek Mandiri Bidan Rini Famaya Dewi* and *Praktek Mandiri Bidan Nova Yanti Manurung*, operate with limited resources and rarely have access to pharmacological analgesia. Thus, these settings are ideal for implementing and evaluating low-cost, non-invasive interventions that can be integrated into routine midwifery care without requiring additional infrastructure.

The theoretical framework underpinning this study integrates three interrelated models. First, the Gate Control Theory of Pain posits that non-noxious sensory input, such as light massage, can "close the gate" to painful stimuli at the substantia gelatinosa of the dorsal horn, thereby reducing the transmission of pain signals to the brain. Second, the Self-Efficacy Theory (Bandura, 1977) suggests that individuals' beliefs in their capacity to execute behaviors necessary for managing prospective situations are critical determinants of coping. The AMAN application, by providing mastery experiences and verbal persuasion through guided modules, may enhance women's self-efficacy for labor. Third, the Biobehavioral Model of Labor Pain recognizes that pain during childbirth is not purely nociceptive but is shaped by cognitive appraisal, emotional arousal, social support, and cultural meaning all factors that the combined intervention is designed to modulate [8].

In light of the high burden of unmanaged labor pain and anxiety, the limited access to pharmacological analgesia, the individual evidence supporting endorphin massage and mHealth technologies, and the critical gap in knowledge regarding their combined

effectiveness, this study aims to evaluate the effectiveness of combined endorphin massage and the AMAN mobile health application in reducing maternal anxiety and labor pain during the active phase of labor at *Tempat Mandiri Praktik Bidan* in Tanjungpinang, Indonesia. The study further seeks to explore women's subjective experiences and perceptions of the combined intervention, thereby providing a comprehensive, methodologically triangulated understanding of its impact.

2. Method

This study employed a qualitative action-research design with embedded quantitative measures. Action research was chosen because the intervention was introduced into ongoing clinical practice, and the research process itself was designed to generate actionable knowledge for improving midwifery care. The qualitative component was guided by a phenomenological approach, as the study sought to understand the lived experiences of women receiving the combined intervention during the active phase of labor. The quantitative component comprised pre- and post-intervention assessments of anxiety and pain using validated instruments, providing complementary outcome data for methodological triangulation [9].

The study was conducted at two *Tempat Mandiri Praktik Bidan* (independent midwifery practices) in Tanjungpinang, Riau Islands Province, Indonesia: *Praktek Mandiri Bidan* Rini Famaya Dewi and *Praktek Mandiri Bidan* Nova Yanti Manurung. These sites were purposively selected because they serve a diverse low-risk obstetric population, provide continuous labor support by qualified midwives, and lacked access to pharmacological analgesia. Data were collected over a period of 18 weeks, from July to November 2025.

The source population comprised all women presenting in spontaneous labor at the two study sites during the data collection period. Inclusion criteria were: (1) term pregnancy (37–42 weeks of gestation), (2) singleton fetus in cephalic presentation, (3) spontaneous onset of labor in the active phase (cervical dilation $\geqslant$4 cm), (4) absence of obstetric complications or medical comorbidities requiring pharmacological analgesia or operative delivery, (5) ownership of an Android-compatible smartphone, (6) willingness to use the AMAN application and receive endorphin massage, and (7) ability to communicate in Bahasa Indonesia. Exclusion criteria were: (1) epidural or systemic opioid analgesia requested or required, (2) labor augmentation with oxytocin, (3) fetal distress or meconium-stained amniotic fluid, (4) history of psychiatric illness, and (5) maternal pyrexia or signs of infection.

A purposive sampling strategy was employed to ensure maximum variation in parity (primipara vs. multipara), age, education, and occupation. The target sample size for the qualitative component was determined by the anticipated point of data saturation. Based on phenomenological research guidelines, an initial sample of 30–35 participants was planned. The final sample comprised 32 women who completed all study procedures.

Intervention

The intervention consisted of two integrated components delivered simultaneously:

Component 1: Endorphin Massage. A trained research midwife provided standardized endorphin massage to participants during the active phase of labor. The massage was administered with the participant in a lateral or semi-recumbent position. The technique consisted of light-pressure effleurage strokes applied to the back, shoulders, lower abdomen, and sacral region, following a standardized protocol of 20 minutes per session, repeated every 2 hours until delivery. The massage protocol was adapted from the Indonesian Ministry of Health guidelines and previous research studies. The training for research midwives comprised a 3-day workshop covering the physiological basis of endorphin massage, demonstration of the standardized technique, supervised practice with feedback, and competency assessment.

Component 2: AMAN Application. Participants were introduced to the AMAN application during the third-trimester antenatal visit (⩾36 weeks). They were guided to download the application from the Google Play Store onto their personal Android smartphones and were oriented to its features, including guided breathing exercises, visualization modules, educational content on labor pain physiology, progress-tracking tools, and positive affirmation messages. During the active phase of labor, participants were encouraged to use the application continuously, with particular emphasis on the guided breathing module synchronized with contraction patterns and the visualization module during contraction intervals. The research midwife assisted participants in navigating the application as needed.

Data were collected using four complementary methods:

Hamilton Anxiety Rating Scale (HARS). The HARS, a 14-item clinician-administered instrument, was used to assess anxiety severity. Items are rated on a 0–4 scale (total score range 0–56), with scores <17 indicating mild anxiety, 18–24 mild-moderate, 25–30 moderate-severe, and >30 severe anxiety. The HARS was administered upon admission during the active phase (pre-intervention) and again immediately after delivery (post-intervention).

Visual Analog Scale (VAS) for Pain. The VAS, a 10-cm horizontal line anchored by "no pain" (0) and "worst imaginable pain" (10), was used to assess labor pain intensity. Pain scores were recorded at admission (pre-intervention), at 30 minutes post-intervention initiation, and at 60 minutes post-intervention initiation.

In-Depth Interviews. Semi-structured interviews were conducted within 6–12 hours postpartum in a private room at the midwifery practice. An interview guide covering five domains was used: (a) overall experience of the intervention, (b) perceived effects on pain and anxiety, (c) experience with the endorphin massage component, (d) experience with the AMAN application component, and (e) perceptions of the combined intervention's acceptability and suggestions for improvement. Interviews lasted 30–60 minutes, were audio-recorded with consent, and were transcribed verbatim.

Participant Observation and Field Notes. The research midwife maintained detailed field notes documenting observations of participants' behavioral responses during the intervention, verbal and non-verbal expressions of pain and anxiety, interactions with the application, and contextual factors.

Quantitative data were analyzed using SPSS version 26.0. Descriptive statistics were computed for demographic variables and outcome measures. Paired-sample t-tests were used to compare pre- and post-intervention HARS and VAS scores, with statistical significance set at $p<0.05$. Effect sizes were calculated using Cohen's d.

Qualitative data were analyzed using thematic analysis following the six-phase framework of Braun and Clarke: (1) familiarization with data through repeated reading of transcripts and field notes, (2) generation of initial codes, (3) searching for themes by collating codes, (4) reviewing themes against coded extracts and the entire dataset, (5) defining and naming themes, and (6) producing the analytic report. Coding was conducted by two independent researchers, with discrepancies resolved through discussion. Data management was facilitated by NVivo 14 software.

Trustworthiness was ensured through the following strategies: (a) credibility prolonged engagement in the field, persistent observation, triangulation of data sources and methods, and member checking; (b) transferability provision of thick description of the study context, participants, and intervention to enable readers to assess applicability to other settings; (c) dependability maintenance of a comprehensive audit trail documenting all research activities, decisions, and analytical processes; and (d) confirmability reflexive journaling by the research midwife and co-coding by independent researchers.

Ethical approval was obtained from the Health Research Ethics Committee of Politeknik Kesehatan Kemenkes Tanjungpinang (No. 456/HREC-PTK/2025). All participants provided written informed consent prior to enrollment. Participants were informed that they could withdraw from the study at any time without consequences for their care. Confidentiality was ensured by assigning unique participant codes and storing all data on password-protected devices.

3. Result & Discussion

A total of 32 women completed the study. Table 1 summarizes the demographic and obstetric characteristics of participants. The mean age was 27.4 ± 4.9 years (range 19–37). The majority were married (100%), Muslim (81.3%), and had completed secondary education (43.8%) or higher education (31.3%). Primiparas constituted 53.1% of the sample. Mean gestational age was 39.2 ± 1.1 weeks, and mean cervical dilation at admission was 5.3 ± 1.4 cm.

Table 1. Demographic and Obstetric Characteristics of Participants (N = 32)

Variable	Category	n	%
Age Group	19–25 years	12	37.5
	26–30 years	13	40.6
	31–37 years	7	21.9
Education	Primary	8	25.0
	Secondary	14	43.8
	Tertiary	10	31.3
Occupation	Employed	14	43.8
	Homemaker	18	56.3
Parity	Primipara	17	53.1
	Multipara	15	46.9
Religion	Islam	26	81.3
	Christian	5	15.6
	Buddhist	1	3.1
Antenatal Care Visits	<4 visits	2	6.3
	≥4 visits	30	93.8
Previous Smartphone App Use for Health	Yes	22	68.8
	No	10	31.3

Mean (±SD): Age = 27.4 ± 4.9 years; Gestational Age = 39.2 ± 1.1 weeks; Cervical Dilation at Admission = 5.3 ± 1.4 cm.

The sample reflects the demographic profile of women seeking midwifery-led care in Tanjungpinang. The high proportion with at least four antenatal care visits (93.8%) indicates good engagement with the health system, while the substantial majority with prior health app experience (68.8%) suggests digital literacy and receptivity to mHealth interventions.

Pre-intervention HARS scores indicated that participants experienced moderate to severe anxiety at the onset of the active phase. The mean pre-intervention HARS score was 30.9 ± 5.2 (range 21–42), with 37.5% of participants scoring in the severe range (>30) and 50.0% in the moderate-severe range (25–30). Following the combined intervention, the mean post-intervention HARS score decreased significantly to 14.1 ± 4.8 (range 6–25), with 75.0% of participants now classified as having mild anxiety (<17) and 25.0% as mild-moderate (18–24) (Table 2). The mean reduction was 16.8 points (95% CI: 14.9–18.7, p<0.001), representing a 54.4% decrease. The effect size was very large (Cohen's d = 3.36).

Table 2. Comparison of Hamilton Anxiety Rating Scale (HARS) Scores Before and After the Combined EM-AMAN Intervention (N = 32)

HARS Measure	Pre-Intervention	Post-Intervention	Mean Difference (95% CI)	t	p
Total Score (Mean ± SD)	30.9 ± 5.2	14.1 ± 4.8	16.8 (14.9–18.7)	18.7	<0.001
Anxiety Severity*					
Mild (<17)	0 (0%)	24 (75.0%)	—	—	—
Mild-Moderate (18–24)	4 (12.5%)	8 (25.0%)	—	—	—
Moderate-Severe (25–30)	16 (50.0%)	0 (0%)	—	—	—
Severe (>30)	12 (37.5%)	0 (0%)	—	—	—

Data presented as n (%). Paired-sample t-test used for continuous variables.

The substantial reduction in anxiety was consistent across all participant subgroups. Primiparas exhibited a mean reduction of 18.1 ± 5.4 points compared to 15.5 ± 4.9 points among multiparas, a difference that did not reach statistical significance (p=0.16) but may reflect greater baseline anxiety among primiparas.

VAS pain scores demonstrated a statistically and clinically significant reduction following the combined intervention (Table 3). Mean VAS at admission (pre-intervention) was 7.8 ± 1.3. At 30 minutes post-intervention, the mean VAS decreased to 6.1 ± 1.5 (p<0.001 vs. baseline). At 60 minutes, the mean VAS further decreased to 4.6 ± 1.7 (p<0.001 vs. baseline), representing a 41.0% reduction from baseline. The effect size for the 60-minute comparison was large (Cohen's d = 2.11).

Table 3. Comparison of Visual Analog Scale (VAS) Pain Scores at Admission, 30 Minutes, and 60 Minutes Post-Intervention (N = 32)

VAS Measure	Admission (Pre)	30 Minutes Post	60 Minutes Post
Mean ± SD	7.8 ± 1.3	6.1 ± 1.5*	4.6 ± 1.7**
Median (Range)	8.0 (5–10)	6.0 (3–9)	4.5 (2–8)

Mean Reduction from Baseline	—	1.7 (21.8%)	3.2 (41.0%)
Cohen's d (vs. Baseline)	—	1.21	2.11

Thematic analysis of interview transcripts, field notes, and observational data revealed four overarching themes, each encompassing several sub-themes.

Theme 1: Tangibility of Pain Relief "The Pain Did Not Disappear, But It Became Less Threatening"

The most consistently articulated experience across all 32 participants was that the combined intervention did not eliminate labor pain but transformed its character. Women described a shift from a threatening, overwhelming pain that provoked fear to a manageable sensation that could be tolerated and even worked with. The endorphin massage was frequently described using metaphors of warmth, gentleness, and comfort that "penetrated through the pain." The AMAN application's visualizations and breathing guidance provided a cognitive framework for interpreting pain as purposeful each contraction bringing the baby closer rather than as a signal of danger. Representative quotes include:

"The massage was like a shield… the pain was still there, but it was outside the shield, not inside me." (P07, 26 years, primipara)

"The application told me to breathe in rhythm with the contractions. It made me feel that I was in control, not the pain." (P14, 31 years, multipara)

Theme 2: Amplified Self-Efficacy "I Felt I Could Do This"

Participants consistently reported a transformation in their perceived ability to cope with labor. The combination of hands-on support and digital guidance created a sense of being equipped with multiple tools. Women described moving from a passive stance enduring labor as something that happened to them to an active stance of participation and agency. The self-efficacy enhancements were attributed to three sources: (a) the tangible experience of successfully using breathing techniques to "ride" contractions, (b) the continuous feedback from the application validating their efforts (e.g., "You are doing great"), and (c) the midwife's physical presence reinforcing their competence.

"At first, I was so scared I wanted to give up. But after the massage and using the application, I thought, 'I can handle this. One contraction at a time.'" (P21, 19 years, primipara)

"It was not just the midwife telling me I could do it; the phone was also telling me. And I believed it." (P09, 28 years, multipara)

Theme 3: Emotional Anchoring Through the Digital Companion "Something Familiar in a Foreign Experience"

For many participants, particularly primiparas, the active phase of labor represented an unprecedented and disorienting experience. The AMAN application emerged as an "emotional anchor" a familiar technological interface in an unfamiliar physiological terrain. The application provided predictability and structure: women knew which breathing exercise would come next, they recognized the visualization images from their antenatal practice, and they trusted the app as a source of reliable information. This familiarity reduced the cognitive load associated with navigating the labor experience and allowed women to focus their psychological resources on coping.

"When the contractions became very strong, I just looked at the screen and followed the breathing circle. In… out… in… out. It was like I was not alone; the application was there with me." (P03, 24 years, primipara)

"I used the application during pregnancy, so it was like having a friend with me during labor. A friend who knew exactly what to do." (P18, 29 years, primipara)

Theme 4: Preservation of Human-Centered Care—"The Technology Did Not Replace the Midwife"

A crucial finding was that participants did not perceive the AMAN application as a replacement for the midwife's care; rather, they experienced the massage and the application as complementary components of a holistic support system. The human touch and presence of the midwife were described as irreplaceable, providing warmth, reassurance, and individualized attention that technology could not replicate. However, the application was valued for extending and reinforcing the midwife's guidance, particularly during moments when the midwife was occupied with documentation or attending to other women. This theme provides strong reassurance that introducing mHealth technology into intimate labor care does not risk depersonalization, provided it is positioned as an adjunct to, rather than a substitute for, human contact.

"The massage was from the midwife's hands; the application was from my phone. They were different but both helped me." (P25, 33 years, multipara)

"I liked that the application was mine to use. The midwife was there, but when she stepped away for a moment, I was not left alone. The application was in my hands." (P11, 22 years, primipara)

Analysis of qualitative data by parity revealed notable patterns. Primiparas more frequently emphasized the emotional anchoring function of the AMAN application (Theme 3) and the need for continuous reassurance, whereas multiparas more frequently discussed the tangibility of pain relief (Theme 1) and drew explicit comparisons to previous birth experiences. One multiparous participant stated:

"With my first baby, I had nothing. No massage, no phone. I remember screaming. This time, I was calm. My husband said he could not believe it was the same woman." (P16, 30 years, multipara)

Observational field notes corroborated the interview data. The research midwife documented that participants' facial expressions transitioned from tense, grimacing, and fearful at admission to more relaxed, focused, and occasionally smiling during the intervention. Fifteen participants spontaneously verbalized appreciation for the application during labor, and 12 participants voluntarily extended the use of the AMAN application beyond the structured observation period.

4. Discussion

The 54.4% reduction in anxiety scores (Cohen's d = 3.36) represents a clinically meaningful improvement that exceeds effect sizes typically reported for single-modality non-pharmacological interventions. For comparison, a recent meta-analysis of relaxation techniques for labor anxiety reported effect sizes ranging from d = 0.8 to 1.5, suggesting that the combined EM-AMAN intervention may produce synergistic effects beyond the sum of individual components. The anxiety reduction is particularly important given the well-documented adverse consequences of unmanaged maternal anxiety, including prolonged labor, increased analgesic requirements, reduced maternal satisfaction, and impaired maternal–infant bonding. The finding that all participants who were classified as having severe or moderate-severe anxiety pre-intervention improved to mild-moderate or mild levels post-intervention is striking and suggests that the intervention may be particularly beneficial for women with high baseline distress [10].

The 41.0% reduction in VAS pain scores at 60 minutes represents a substantial analgesic effect, especially when considering that labor pain typically escalates in intensity as the active phase progresses. The fact that pain scores decreased rather than merely stabilized is noteworthy and suggests that the combined intervention actively counteracted the progressive increase in nociceptive input. The trajectory of pain reduction (Figure 2)—with 21.8% reduction at 30 minutes and further decrease to 41.0% at 60 minutes—indicates a cumulative effect consistent with the temporal dynamics of endogenous opioid release, which reaches peak plasma concentrations approximately 20–40 minutes after continuous massage stimulation. This temporal pattern has practical implications for clinical implementation, suggesting that the intervention should be initiated early in the active phase and maintained continuously to achieve optimal analgesic benefit [11].

The qualitative findings illuminate the mechanisms through which the combined intervention operates. Theme 1 tangibility of pain relief aligns with the Gate Control Theory's proposition that non-noxious sensory input (massage) can modulate pain signal transmission at the spinal level. However, participants' descriptions also suggest that the intervention altered the cognitive appraisal of pain (sense of threat) and the emotional response to pain (fear), effects that extend beyond spinal gating and implicate supraspinal mechanisms. This finding is consistent with the Cognitive-Affective Model of Pain, which emphasizes the interaction between sensory, affective, and cognitive dimensions in shaping the pain experience.

Theme 2 amplified self-efficacy provides empirical support for the integration of Bandura's Self-Efficacy Theory into the conceptual framework of the intervention. Women's descriptions of moving from passive endurance to active coping are consistent with the four sources of self-efficacy proposed by Bandura: mastery experiences (successfully using breathing techniques), vicarious experiences (observing the midwife's calm demeanor), verbal persuasion (affirmations from both the midwife and the application), and physiological feedback (feeling relaxation in response to massage). The AMAN application's built-in affirmations and progress-tracking features appear to have systematically provided verbal persuasion and performance feedback, creating a continuous loop of self-efficacy reinforcement. For primiparas in particular, this self-efficacy enhancement may have long-term implications for postpartum psychological adjustment, future birth experiences, and breastfeeding self-efficacy [12].

Theme 3 emotional anchoring through the digital companion represents a novel finding not previously described in the labor support literature. The concept of a technological device serving as an emotional anchor in an unfamiliar and potentially frightening experience has been explored in other contexts, such as pediatric hospitalization and chronic pain management, but has not been documented in the context of labor. This finding has important implications for mHealth design: applications intended for use during labor should prioritize familiarity, predictability, and simplicity, with interfaces that require minimal cognitive effort to navigate. The AMAN application's breathing circle visualization a simple, rhythmic, and predictable stimulus likely contributed to its anchoring function by providing a focal point for attention that was both neutral and task-oriented. This insight suggests that future iterations of labor-support applications should avoid complex navigation structures and instead provide a clean, stripped-down interface optimized for use during states of high physiological and psychological arousal.

Theme 4 preservation of human-centered care addresses a critical concern regarding the integration of technology into intimate healthcare encounters. The finding that participants valued the application as a complement to, rather than a substitute for, the midwife's touch provides reassurance that mHealth interventions need not threaten the therapeutic relationship. Rather than depersonalizing care, the application appeared to extend the reach of the midwife's support, ensuring that women felt continuously supported

even during brief periods when the midwife was not in direct physical contact. This finding has potential workforce implications: in settings where midwife-to-patient ratios are high, a well-designed mHealth application could function as a "force multiplier," enabling a single midwife to provide high-quality, continuous support to multiple laboring women simultaneously.

The subgroup analysis by parity revealed that primiparas derived particular benefit from the emotional anchoring and self-efficacy functions of the intervention, while multiparas valued the direct analgesic effects and drew on explicit comparisons to previous births. These findings suggest that the combined intervention may be universally beneficial but may serve different primary functions depending on parity. For primiparas, the intervention appears to function primarily as an anxiety management and empowerment tool, addressing the fear of the unknown and building confidence. For multiparas, the intervention may function primarily as an analgesic tool, providing comfort that may have been absent in previous birth experiences. This differential pattern has implications for intervention tailoring: primiparas might benefit from a greater emphasis on the AMAN application's educational and self-efficacy modules, while multiparas might benefit from early initiation of endorphin massage and more intensive tactile support [13].

The integration of quantitative and qualitative findings through methodological triangulation strengthens the credibility of the study's conclusions. The large, statistically significant reductions in both anxiety and pain scores are consistent with the overwhelmingly positive qualitative accounts of the intervention's effects. The qualitative data provide explanatory depth, revealing the mechanisms (enhanced self-efficacy, emotional anchoring, cognitive reframing) that likely mediate the quantitative outcomes. This concordance between quantitative and qualitative findings increases confidence that the results reflect genuine intervention effects rather than measurement artifacts.

The findings of this study are consistent with and extend the existing literature on endorphin massage and mHealth interventions for labor pain. The 41.0% pain reduction observed at 60 minutes compares favorably with the pain reductions reported in previous endorphin massage studies, which have typically found reductions of 20–35% in VAS scores among laboring women. The addition of the AMAN application may have contributed to the larger effect size observed in this study. The anxiety reduction of 54.4% is also larger than that typically reported for single-modality endorphin massage, which in previous studies reduced preoperative anxiety in cesarean section patients by approximately 35–45%. The enhanced anxiety reduction may be attributable to the AMAN application's cognitive-behavioral components, which have established efficacy for anxiety disorders through mechanisms such as cognitive restructuring, exposure, and self-monitoring [14].

Previous studies of smartphone-based interventions for labor pain have yielded mixed results. The 2018 study of a music-based smartphone intervention found significant pain reduction in the latent phase but not in the active phase. The authors speculated that the intensity of active-phase pain may overwhelm the analgesic capacity of music alone. The present study's findings support this hypothesis and suggest that multimodal interventions incorporating both tactile and digital components may be necessary to achieve meaningful analgesia in the active phase. The results also align with a 2024 randomized controlled trial demonstrating the efficacy of shiatsu massage for labor pain and anxiety in low-risk pregnancies, extending these findings to a combined tactile–digital intervention.

The findings of this study have several implications for midwifery practice and health policy in Indonesia and similar settings. First, the combined EM-AMAN intervention represents a low-cost, scalable, and culturally acceptable strategy for improving the quality of labor care in independent midwifery practices where pharmacological analgesia is unavailable. The estimated cost per woman is minimal, comprising approximately IDR 50,000 (USD 3.20) for the massage component (midwife time and materials) and the freely downloadable AMAN application. This cost profile compares favorably with the

cost of even the most basic pharmacological analgesia and positions the intervention as a highly cost-effective alternative [15].

Second, the findings support the integration of endorphin massage training into midwifery education curricula and continuing professional development programs. The 3-day training workshop model used in this study could be replicated across Indonesian midwifery academies and professional organizations. Third, the positive reception of the AMAN application suggests that the Indonesian Ministry of Health should consider endorsing and promoting evidence-based mHealth applications as part of standard antenatal and intrapartum care packages. Fourth, the preservation-of-human-centered-care theme provides a framework for the responsible integration of technology into midwifery practice, emphasizing that digital tools should be positioned as adjuncts that extend and reinforce rather than replace the therapeutic relationship between midwife and woman.

This study has several limitations. First, the single-group pre-post design limits the ability to control for the natural history of pain and anxiety progression during labor. A randomized controlled trial design, ideally with a three-arm structure (EM alone, AMAN alone, combined EM-AMAN), would permit stronger causal inferences and isolate the contribution of each component. Second, the sample was drawn from two independent midwifery practices in Tanjungpinang, and results may not generalize to other settings or populations. Third, the absence of blinding, which is inherently challenging in non-pharmacological intervention research, may have introduced expectancy effects. Fourth, the relatively small sample size limits the statistical power for subgroup analyses. Fifth, the study did not measure biochemical markers of endogenous opioid release (e.g., plasma β-endorphin, salivary oxytocin), which would have provided objective validation of the proposed mechanisms. Future research should address these limitations through multi-site randomized controlled trials with biochemical outcome measures and longer-term follow-up.

5. Conclusion

This study demonstrates that the combined intervention of endorphin massage and the AMAN mobile health application is highly effective in reducing maternal anxiety and labor pain during the active phase of labor in independent midwifery practices in Tanjungpinang, Indonesia. The 54.4% reduction in anxiety scores and the 41.0% reduction in pain scores represent clinically meaningful and statistically significant effects that exceed those typically reported for single-modality interventions. Qualitative findings reveal that the intervention achieves its effects through four mechanisms: transforming the experience of pain, amplifying maternal self-efficacy, providing emotional anchoring through a familiar digital interface, and preserving human-centered care. The combined EM-AMAN intervention represents a scalable, culturally appropriate, and low-cost model for improving the quality of labor care in low-resource midwifery settings. It offers a practical solution to the pressing challenge of unmanaged labor pain and anxiety in Indonesia and similar contexts, with potential benefits for maternal satisfaction, birth outcomes, and postpartum psychological well-being. Integration into midwifery education, clinical practice guidelines, and national maternal health policies is recommended.

6. Patents

This paper does not have a patent yet.

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Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. Fatimah do it all research.

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Appendix A

Not appendix A

Appendix B

Not appendix B

References.

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