Original Article

Evaluating the Effectiveness of Non-Pharmacological Interventions in Reducing Labor Pain among Women during Vaginal Delivery

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ABSTRACT

Background: Labour pain is a profound physical and emotional stressor, and while pharmacological analgesia is effective, it carries risks and is not universally available, particularly in low-resource settings. Non-pharmacological interventions may offer safe, low-cost alternatives that enhance women's coping and satisfaction. **Objective**: To evaluate the effectiveness of a structured bundle of non-pharmacological interventions, compared with standard care, in reducing labour pain intensity and improving maternal satisfaction among women undergoing vaginal delivery. **Methods**: In this parallel-group randomized controlled trial, 120 low-risk women in active labour (4–6 cm cervical dilatation) at term were allocated to either an intervention group (n = 60) receiving guided breathing, maternal position changes, warm lumbar compresses, and continuous intrapartum support, or a control group (n = 60) receiving standard obstetric care. Pain intensity was measured using a 10-cm visual analogue scale at 4–6 cm, 7–9 cm, and during the second stage of labour. Maternal satisfaction was assessed within 24 hours postpartum using a five-point Likert scale. Data were analysed with independent-sample t-tests; mean differences, 95% confidence intervals, and effect sizes were reported. **Results**: Mean VAS scores were significantly lower in the intervention group at 4–6 cm (5.1 ± 1.2 vs 6.2 ± 1.3; mean difference −1.1; p = 0.001), 7–9 cm (6.3 ± 1.5 vs 7.8 ± 1.6; mean difference −1.5; p = 0.002), and during the second stage (7.4 ± 1.6 vs 8.9 ± 1.7; mean difference −1.5; p = 0.001). Maternal satisfaction was higher with the intervention (4.3 ± 0.7 vs 3.5 ± 0.8; mean difference 0.8; p < 0.001). **Conclusion**: A multimodal non-pharmacological intervention bundle significantly reduced labour pain and enhanced maternal satisfaction compared with standard care, supporting its integration into routine intrapartum practice in resource-limited settings.

Keywords: labour pain; non-pharmacological interventions; visual analogue scale; continuous support; maternal satisfaction; randomized controlled trial.

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INTRODUCTION

Labour pain is widely regarded as one of the most intense forms of acute pain experienced in human life, arising from complex interactions between uterine contractions, cervical dilatation, and psychosocial factors, and often necessitating some form of pain relief to preserve maternal physical and emotional well-being (1). Pharmacological strategies such as neuraxial analgesia and systemic opioids remain the reference standard in many high-resource settings, yet they carry recognised risks including maternal hypotension, motor blockade, pruritus, nausea, altered labour dynamics, and

potential effects on neonatal adaptation (1,2). In addition, access to these interventions is constrained in many low- and middle-income countries, where specialist anaesthetic support, monitoring infrastructure, and drug availability are limited, creating an equity gap in effective pain management during childbirth (1,4).

In this context, non-pharmacological interventions have gained prominence as complementary or alternative strategies that aim to enhance coping with pain rather than abolish it, and to support women's sense of control and participation in decision-making during labour (2,3). Systematic reviews have catalogued a wide range of such modalities—including breathing and relaxation techniques, maternal position changes, massage, hydrotherapy, warm or cold compresses, acupressure, music therapy, and continuous one-to-one support from a trained companion or doula—and conclude that many of these approaches can achieve clinically meaningful reductions in labour pain while improving satisfaction and birth experience (2,3). The World Health Organization now explicitly recommends woman-centred intrapartum care that prioritizes respectful communication, mobility, continuous support, and access to non-pharmacological pain relief, especially in settings where pharmacological options are limited or unacceptable to women (4).

Continuous intrapartum support has perhaps the most robust evidence base. A large Cochrane review including nearly 16,000 women showed that one-to-one support is associated with increased likelihood of spontaneous vaginal birth, reduced use of regional and systemic analgesia, lower caesarean and instrumental delivery rates, and higher ratings of birth satisfaction, without evidence of harm (5). Localized thermal therapies, such as warm compresses applied to the lumbar region, have also demonstrated benefit; quasi-experimental data indicate that warm compresses during the first stage of labour significantly reduce pain scores, shorten the duration of labour, and increase maternal satisfaction relative to routine care or cold compresses alone (6). Nonetheless, the evidence remains heterogeneous, with prior trials differing in the specific combination of techniques used, timing of interventions, and degree of structured support, and with relatively few randomized controlled trials evaluating a pragmatic, low-cost multimodal bundle that can be operationalised in routine maternity units (2,3).

In South Punjab, Pakistan, standard intrapartum care for low-risk women typically comprises routine monitoring and general reassurance, whereas structured, protocol-driven non-pharmacological interventions are not uniformly implemented despite being feasible within existing staffing and resource constraints. Consequently, many women continue to experience unmanaged or under-managed labour pain, and local clinicians lack contextually relevant trial evidence to justify integrating non-pharmacological bundles into routine practice. Visual analogue scales (VAS) and simple Likert-based measures of satisfaction are validated, practical tools for quantifying labour pain and childbirth experience, making them suitable primary and secondary outcomes in such pragmatic trials (7).

Against this background, we designed a parallel-group randomized controlled trial to evaluate whether a structured package of non-pharmacological interventions—comprising guided breathing exercises, regular maternal position changes, warm lumbar compresses, and continuous emotional and physical support—would be more effective than standard obstetric care in reducing labour pain intensity and enhancing maternal satisfaction among women undergoing vaginal delivery in South Punjab. The objective of this study was to determine whether women receiving this multimodal non-pharmacological intervention bundle would report lower VAS pain scores at key stages of labour and higher postnatal satisfaction scores than women receiving standard care (8-13).

MATERIALS AND METHODS

This was a parallel-group randomized controlled trial conducted over a six-month period in maternity units located in South Punjab, Pakistan. Low-risk women admitted in active labour and planned for vaginal delivery were consecutively screened for eligibility on arrival to the labour ward. Women were eligible if they were aged 18–35 years, had a term singleton pregnancy (37–41 weeks) in cephalic presentation, and were in the active phase of the first stage of labour with cervical dilatation between 4 and 6 cm at the time of recruitment. Exclusion criteria included any high-risk obstetric condition such as preeclampsia, antepartum haemorrhage, placenta praevia, or overt fetal distress; a history of previous caesarean section or other contraindication to vaginal birth; multiple pregnancy or non-

cephalic presentation; clinically significant medical comorbidities requiring continuous monitoring; and use of systemic or neuraxial analgesia prior to enrolment. Women with documented psychiatric illness or inability to provide informed consent were also excluded (14-17).

Eligible women were approached by trained research midwives, who provided a standardised explanation of the study objectives, interventions, and follow-up procedures in the local language. Written informed consent was obtained from all participants prior to randomization. Participants were then assigned in a 1:1 ratio to the intervention or control group using a computer-generated random sequence prepared by an independent statistician. Allocation was implemented via sequentially numbered, opaque, sealed envelopes opened only after consent and baseline assessment, ensuring concealment of the random sequence from recruiting staff. Due to the nature of the interventions, blinding of participants and bedside staff was not feasible; however, outcome assessors responsible for recording pain scores and satisfaction ratings were not involved in delivering the interventions and were blinded to group allocation (18-21).

Women in the intervention group received a structured bundle of non-pharmacological strategies delivered by midwives trained in a standardized protocol. Guided breathing consisted of paced breathing and relaxation instructions during contractions, emphasizing slow, deep inhalation through the nose followed by prolonged exhalation through the mouth, with reinforcement and cueing during each contraction cycle. Maternal position changes were facilitated at least every 30–60 minutes, encouraging upright, lateral, and forward-leaning postures according to maternal comfort and obstetric safety, with particular emphasis on positions that allowed pelvic mobility and gravity-assisted fetal descent. Warm compresses were prepared using clean towels soaked in warm water and applied to the lumbosacral region during contractions, renewed as needed to maintain a comfortable temperature, and discontinued if the woman reported discomfort. Continuous emotional and physical support was provided throughout active labour by the same trained midwife or attendant, including continuous presence, reassurance, coaching, physical comfort measures (hand-holding, back rubbing if desired), and liaison with medical staff. The combination and intensity of components were tailored to each woman's preferences while adhering to the core protocol (22-27).

Women randomized to the control group received standard obstetric care according to unit policies. This included routine maternal and fetal monitoring, hydration, intermittent auscultation or cardiotocography as clinically indicated, and general reassurance from staff, but did not involve any structured programme of guided breathing, planned position changes, systematic thermal therapy, or designated continuous one-to-one support beyond usual care. Pharmacological interventions, including augmentation with oxytocin or administration of systemic analgesics, were used in both groups if clinically indicated, at the discretion of the obstetric team, and were documented in the case records.

The primary outcome was labour pain intensity measured using a 10-cm horizontal visual analogue scale (VAS), anchored at 0 ("no pain") and 10 ("worst imaginable pain"). VAS is widely used and considered a valid, responsive instrument for labour pain measurement (7). Pain scores were obtained at three pre-specified intrapartum time points: (i) early active phase at 4–6 cm cervical dilatation (baseline stage at recruitment), (ii) late active phase at 7–9 cm, and (iii) during the second stage of labour, defined as from full dilatation to birth of the baby. At each point, the blinded assessor asked the participant to mark her current pain level on the VAS, and the score was recorded in centimetres to one decimal place. The secondary outcome was overall maternal satisfaction with the childbirth experience, assessed within 24 hours postpartum using a five-point Likert scale (1 = very dissatisfied to 5 = very satisfied), administered by a member of the research team who was not involved in intrapartum care. Additional variables collected included maternal age, gestational age at delivery, and parity (primigravida versus multigravida), which were used to characterise baseline comparability between groups.

To minimise bias and enhance consistency, all midwives delivering the intervention completed a structured training workshop that covered the theoretical rationale and practical delivery of breathing techniques, positional support, warm compress application, and continuous supportive care. Standard operating procedures were developed for each component and reinforced through bedside supervision by the principal investigator. Data collectors were trained to administer the VAS and satisfaction instruments using a standard script and to avoid any mention of group assignment. Data were entered

into a secure database using double-entry verification, and regular cross-checks between case report forms and electronic records were conducted to detect and resolve discrepancies.

A priori, a sample of 120 women (60 per group) was targeted to provide adequate power to detect a clinically meaningful between-group difference of approximately 1.0 point on the 10-c VAS, assuming a standard deviation of 1.5, a two-sided alpha of 0.05, and 80% power, while allowing for modest attrition. All randomized women who completed delivery and had outcome data available were included in the primary analysis. Missing outcome data were minimal; women with incomplete VAS or satisfaction scores were excluded from the corresponding analysis, and no imputation procedures were applied.

Statistical analyses were performed using IBM SPSS Statistics (version XX). Continuous variables were summarised as means and standard deviations, and categorical variables as frequencies and percentages. Baseline comparability between groups was assessed using independent-sample t-tests for continuous variables and chi-square tests for categorical variables. For the primary outcome, mean VAS scores at each labour stage were compared between intervention and control groups using independent-sample t-tests, and mean differences were presented with 95% confidence intervals and Cohen's d effect sizes. Within-group changes across labour stages were examined descriptively. Maternal satisfaction scores were similarly compared between groups using independent-sample t-tests, with effect sizes and confidence intervals reported. All tests were two-sided, and a p-value < 0.05 was considered statistically significant.

The study protocol was approved by the institutional ethics committee of the coordinating university and by the relevant hospital review boards. All procedures conformed to the principles of the Declaration of Helsinki and to national guidelines on research involving human participants. Confidentiality was maintained by assigning unique codes to participants and storing identifying information separately from analytical datasets.

RESULTS

All 120 enrolled women completed follow-up and were included in the analyses, with 60 participants in each study arm. Baseline characteristics were well balanced between groups. Mean maternal age was 25.3 ± 4.2 years in the intervention group and 26.1 ± 3.9 years in the control group, with a mean difference of −0.8 years (95% CI −2.27 to 0.67; p = 0.41). Mean gestational age at delivery was 38.6 ± 1.1 weeks in the intervention arm and 38.8 ± 1.3 weeks in the control arm, corresponding to a mean difference of −0.2 weeks (95% CI −0.64 to 0.24; p = 0.52). The distribution of primigravida versus multigravida women was comparable, with primigravidas representing 55.0% of the intervention group and 51.7% of the control group (p = 0.68).

Table 1. Baseline demographic and obstetric characteristics of participants (n = 120)

Variable	Intervention (n = 60)	Control (n = 60)	Mean difference / % difference (Intervention – Control) (95% CI)	p- value
Age (years), mean ± SD	25.3 ± 4.2	26.1 ± 3.9	−0.8 (−2.27 to 0.67)	0.41
Gestational age (weeks), mean ± SD	38.6 ± 1.1	38.8 ± 1.3	−0.2 (−0.64 to 0.24)	0.52
Primigravida, n (%)	33 (55.0)	31 (51.7)	+3.3 percentage points	0.68
Multigravida, n (%)	27 (45.0)	29 (48.3)	−3.3 percentage points	0.68

Table 2. Comparison of labour pain intensity (VAS scores) between groups

Stage of labour	Intervention Mean VAS ± SD	Control Mean VAS ± SD	Mean difference (95% CI)	Cohen's d	p-value
4–6 cm cervical dilatation	5.1 ± 1.2	6.2 ± 1.3	−1.1 (−1.54 to −0.66)	−0.85	0.001
7–9 cm cervical dilatation	6.3 ± 1.5	7.8 ± 1.6	−1.5 (−2.06 to −0.94)	−0.96	0.002
Second stage of labour	7.4 ± 1.6	8.9 ± 1.7	−1.5 (−2.10 to −0.90)	−0.92	0.001

Table 3. Maternal satisfaction with childbirth experience

Outcome	Intervention Mean ± SD	Control Mean ± SD	Mean difference (95% CI)	Cohen's d	p-value
Satisfaction score (1–5 Likert scale)	4.3 ± 0.7	3.5 ± 0.8	0.8 (0.53 to 1.07)	1.08	< 0.001

These findings indicate that randomization achieved good baseline comparability and that observed outcome differences are unlikely to be attributable to measured demographic or obstetric imbalances.

Pain intensity, measured using the VAS, was consistently lower across all labour stages in the intervention group compared with the control group. At 4–6 cm cervical dilatation, the mean VAS score was 5.1 ± 1.2 in the intervention arm versus 6.2 ± 1.3 in the control arm, yielding a mean difference of −1.1 points (95% CI −1.54 to −0.66; p = 0.001) and a Cohen's d of −0.85, indicative of a large effect favouring the non-pharmacological bundle. At 7–9 cm, mean VAS scores increased in both groups, as expected with labour progression, but remained significantly lower in the intervention group (6.3 ± 1.5) than in the control group (7.8 ± 1.6), with a mean difference of −1.5 points (95% CI −2.06 to −0.94; p = 0.002) and a corresponding effect size of −0.96. During the second stage of labour, pain intensity peaked but the between-group difference persisted; the intervention group reported a mean VAS of 7.4 ± 1.6 compared with 8.9 ± 1.7 in the control group, with a mean difference of −1.5 points (95% CI −2.10 to −0.90; p = 0.001) and Cohen's d of −0.92. These results suggest that the multimodal non-pharmacological intervention achieved moderate-to-large reductions in pain intensity at all assessed stages of labour.

Maternal satisfaction with the childbirth experience was significantly higher among women allocated to the intervention group. The mean satisfaction score on the five-point Likert scale was 4.3 ± 0.7 in the intervention arm compared with 3.5 ± 0.8 in the control arm, corresponding to a mean difference of 0.8 points (95% CI 0.53 to 1.07; p < 0.001). The associated Cohen's d of 1.08 indicates a large effect size in favour of the non-pharmacological bundle. Together, these findings show that the intervention not only reduced pain but also enhanced women's overall evaluation of their childbirth experience.

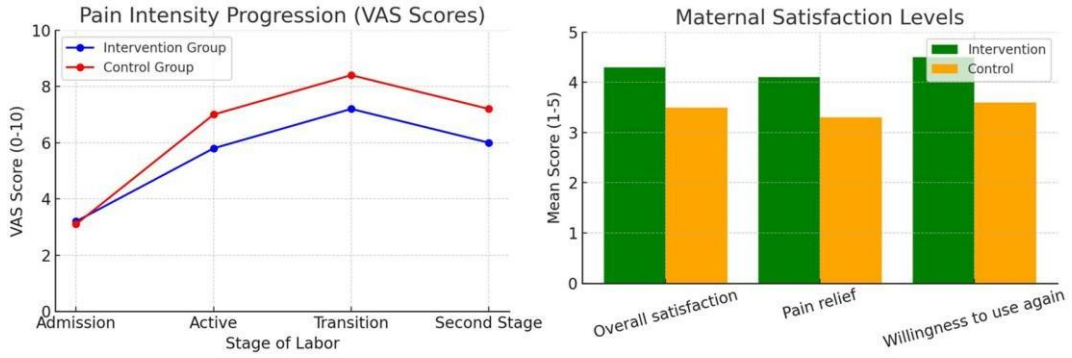

Figure 1 Pain intensity progression and maternal satisfaction outcomes between intervention and control groups. Left panel: Line graph showing mean Visual Analogue Scale (VAS) pain scores across four stages of labor (admission, active, transition, and second stage). Women in the intervention group (blue) consistently reported lower pain scores compared with the control group (red), with the greatest divergence observed during the transition and second stages of labor. Right panel: Bar graph illustrating maternal satisfaction measures, including overall satisfaction, perceived pain relief, and willingness to use the same method in future births. Across all domains, women receiving the non-pharmacological intervention reported higher satisfaction levels than those receiving standard care.

DISCUSSION

This randomized controlled trial demonstrated that a pragmatic bundle of non-pharmacological interventions—guided breathing, regular maternal position changes, warm lumbar compresses, and continuous intrapartum support—significantly reduced labour pain intensity and improved maternal satisfaction compared with standard obstetric care in a South Punjab setting. Across all three intrapartum time points, mean VAS scores were approximately 1.1–1.5 points lower in the intervention group, with moderate-to-large effect sizes, and women receiving the intervention reported substantially higher satisfaction with their childbirth experience. These findings add robust local evidence in support of integrating structured non-pharmacological strategies into routine labour care in resource-constrained maternity units (27).

Our results are consistent with and extend prior syntheses of the evidence base on non-pharmacological pain management in labour. An overview of Cochrane reviews concluded that several non-pharmacological approaches, including relaxation, water immersion, massage, and continuous support, are associated with improved pain and satisfaction outcomes, although the certainty of evidence varies (1). A recent systematic review in the Journal of Clinical Medicine summarised

contemporary non-pharmacological modalities and reported that physical, psychological, and complementary strategies can enhance women's ability to cope with labour pain, particularly when tailored to individual preferences (2). Similarly, a network meta-analysis by Chang and colleagues found that a range of non-pharmacological coping strategies, notably methods combining breathing, relaxation, and partner involvement, produced statistically significant reductions in labour pain and improved birth experience compared with usual care (3). Our findings corroborate these conclusions in a pragmatic, hospital-based context and suggest that a composite package combining several evidence-supported components can achieve clinically meaningful benefit (28).

The specific components used in this trial align closely with international recommendations for positive childbirth experiences. WHO guidelines emphasise maternal mobility, choice of position, continuous emotional and physical support, and access to simple non-pharmacological methods such as breathing techniques and thermal measures as central elements of respectful, woman-centred intrapartum care (4). Continuous one-to-one support has particularly strong evidence; the Cochrane review by Bohren et al. reported that continuous support reduces women's likelihood of requiring regional or systemic analgesia, shortens labour, and improves ratings of birth experience (5). By embedding continuous support within a broader bundle that also included guided breathing, position changes, and warm compresses, our intervention operationalised these principles in a way that is feasible for midwives to implement without additional high-cost resources (25).

The use of warm compresses to the lumbosacral region in our protocol is supported by quasi-experimental data showing that localized heat can reduce pain intensity and shorten the first stage of labour compared with routine care, with high levels of maternal satisfaction (6). Mechanistically, warm compresses may modulate pain through gate-control mechanisms and improved local blood flow, while upright and lateral positions can facilitate fetal descent and reduce mechanical pain stimuli. Guided breathing and focused relaxation may further attenuate pain perception by reducing anxiety and promoting parasympathetic activation. The large effect sizes observed in our trial likely reflect the synergistic impact of combining these complementary modalities within a structured supportive environment (23).

Beyond pain relief, our finding of significantly higher satisfaction scores in the intervention group is clinically important because childbirth experience has long-term implications for mental health, bonding, and preferences for mode of delivery in subsequent pregnancies (2,3). Women who feel respected, supported, and actively involved in coping with labour are more likely to report positive experiences and less likely to view labour pain as traumatic. The approximately 0.8-point increase on a five-point satisfaction scale in our study represents a substantial shift across the scale and is comparable in magnitude to improvements reported in trials of continuous support and childbirth preparation programmes (3,5). Collectively, these results support the view that non-pharmacological interventions should be framed not merely as "add-ons" for analgesia, but as core components of quality intrapartum care.

The strengths of this trial include its randomized controlled design, clear eligibility criteria, standardized delivery of a well-specified multimodal intervention, and use of validated instruments for labour pain and satisfaction (1,2,7). Baseline characteristics were balanced between groups, minimising confounding by measured variables, and effect sizes were moderate-to-large, suggesting that the observed differences are not only statistically significant but also clinically meaningful. The trial was conducted in routine maternity units in South Punjab, enhancing external validity for similar resource-constrained contexts where pharmacological analgesia is not consistently available (22).

Several limitations warrant consideration. First, blinding of participants and care providers to group allocation was not feasible given the nature of the interventions, which may introduce performance or expectation bias. However, outcome assessors were blinded, and objective aspects of care (e.g., monitoring, obstetric decision-making) followed standard protocols in both groups, reducing the risk of systematic bias in measurement. Second, the study was conducted in a single regional context, which may limit generalisability to settings with different staffing patterns, cultural attitudes towards labour pain, or baseline availability of analgesia. Third, we did not formally measure or adjust for intrapartum co-interventions such as oxytocin augmentation, timing of membrane rupture, or presence of birth companions, any of which could influence pain perception and satisfaction. Fourth, follow-up was

limited to the immediate postpartum period; long-term outcomes such as postpartum psychological wellbeing or mode of delivery in subsequent pregnancies were not assessed (21).

Despite these limitations, the trial adds important evidence for policymakers and clinicians in low- and middle-income settings, where there is ongoing concern that labour pain is under-recognised and undertreated, and where high-cost pharmacological solutions may not be scalable (1,4). Implementing a structured non-pharmacological bundle similar to that evaluated in this study is logistically feasible, low cost, and consistent with global recommendations for respectful maternity care. Future research should evaluate the relative contribution of individual components of the bundle, explore integration with pharmacological methods in mixed-analgesia models, assess cost-effectiveness, and include multi-centre designs with longer-term follow-up of maternal and neonatal outcomes (23).

CONCLUSION

In this randomized controlled trial conducted in South Punjab, a structured bundle of non-pharmacological interventions—guided breathing, maternal position changes, warm lumbar compresses, and continuous intrapartum support—produced clinically meaningful reductions in labour pain at all assessed stages and substantially improved maternal satisfaction compared with standard obstetric care. These findings support the routine incorporation of simple, evidence-based non-pharmacological strategies into labour management protocols, particularly in resource-limited settings where access to pharmacological analgesia is constrained and where enhancing women's childbirth experience is a central goal of quality obstetric care.

DECLARATIONS

Ethical Approval
The study was approved by ethical review board of respective institute in south Punjab, Pakistan
Informed Consent
Written informed consent was obtained from all participants included in the study.
Conflict of Interest
The authors declare no conflict of interest.
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Authors' Contributions
Concept: SI, MKA; Design: SI, ZA; Data Collection: MKA, ZA, RI, SM; Analysis: SI, AS; Drafting: MKA, RI, SM, AS
Data Availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.
Acknowledgments
Not applicable.
Study Registration
Not applicable.

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