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Immediate Pain and Anxiety Responses to Manual Regiosacral Counter-Pressure During Active Labour: An Exploratory Study

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Abstract

Background

Manual approaches are used to support pain management during labour, but variation in anatomical placement, timing, pressure, and exposure limits reproducibility. This study aimed to characterize within-participant changes in labour pain and labour-specific anxiety following focused manual regiosacral counter-pressure and to generate preliminary estimates for a future controlled trial.

Methods

This exploratory one-group pretest–posttest study included 33 women in active labour recruited at a maternity hospital in Semarang, Indonesia, between May and December 2024. Trained providers applied sustained counter-pressure over the sacral region for approximately 35–50 seconds during uterine contractions, adjusting pressure to maternal tolerance. Pain was the primary outcome; anxiety and physiological measures were secondary outcomes. Pre–post changes were summarized using mean differences, 95% confidence intervals, and paired analyses.

Results

Mean pain decreased from 7.70 (SD 1.38) to 5.85 (SD 1.42), a mean reduction of 1.85 points (95% CI 1.67–2.03; P < .001). All 33 participants reported reduced pain, and 26 (78.8%; 95% CI 62.2%–89.3%) experienced a reduction of at least 2 points. Among 31 participants with anxiety data, mean anxiety decreased by 3.52 points (95% CI 2.74–4.30; P < .001). Physiological changes were small and inconsistent, with no intervention-related adverse events.

Conclusions

Focused manual regiosacral counter-pressure was followed by immediate reductions in labour pain and anxiety, while physiological responses were limited and inconsistent. Because the study lacked a concurrent comparator, these findings represent preliminary within-participant responses rather than evidence of treatment effectiveness. Further controlled evaluation with standardized intervention delivery and fidelity monitoring is warranted.

Trial registration

Not prospectively registered.

Introduction

Labour pain is a dynamic sensory and emotional experience produced by uterine contractions, cervical dilatation, pressure on pelvic structures, and distension of the birth canal. Fear, anxiety, expectations, coping resources, previous experience, and the quality of interpersonal support can modify the experience [1–3]. Because labour pain is shaped by both physiological and psychosocial factors, its

management requires an individualized and multidimensional approach [1]. Contemporary pain care during labour therefore includes pharmacological options and supportive non-pharmacological strategies selected in response to the woman's preferences and clinical condition [4].

Tactile and massage-based approaches have shown potential for reducing labour pain, but their effects remain difficult to interpret because the interventions are delivered in markedly different ways [1]. Variations in technique, provider, treatment dose, timing, anatomical target, and comparator contribute to substantial heterogeneity across studies and limit direct comparison of findings [4]. Similar favourable outcomes have been reported with mechanical massage, electric massage chairs, ice massage, and spouse-administered massage, although these approaches differ considerably in how and where the intervention is applied [5]. Recent randomized studies of mechanical massage, electric massage chairs, ice massage, and spouse-administered massage have also reported favourable pain findings, yet the provider, device, dose, timing, anatomical target, and comparator differed materially [6–9]. This variation makes direct comparison across studies difficult and leaves uncertainty about which procedural components are most closely related to the observed pain response.

A further limitation in the current evidence is the lack of procedural detail needed to reproduce manual interventions consistently [10]. Reports of massage and related techniques often provide limited information on hand placement, maternal position, synchronization with uterine contractions, pressure intensity, duration of each application, number of treated contractions, total exposure, provider competency, and intervention fidelity [5]. The effect of these interventions may also extend beyond localized tactile stimulation because their delivery involves direct provider contact, ongoing communication, and adjustment to maternal feedback [11]. These accompanying elements may shape pain perception, coping, and the woman’s sense of control during labour. However, they also make it difficult to determine whether observed changes in pain are attributable specifically to the pressure itself or to provider attention, reassurance, and interpersonal support, particularly when no concurrent comparator is used [3, 12, 13] .

Although previous studies have reported reductions in labour pain with sacral massage, mechanical massage, electric massage chairs, ice massage, and spouse-administered massage, the interventions differ substantially in anatomical target, provider, delivery method, treatment dose, and timing, making their findings difficult to translate into a reproducible manual counter-pressure protocol [6–9]. In addition, the contribution of focused pressure itself remains difficult to distinguish from the effects of provider attention, communication, reassurance, and other concurrent influences when no concurrent comparator is used. This creates a practical gap between favourable pain findings and the development of a clearly defined intervention that can be tested reliably in a controlled trial. Addressing this gap is important because a reproducible protocol is needed before the effectiveness of manual sacral counter-pressure can be evaluated with greater methodological rigor. Therefore, this study aimed to estimate immediate within-participant changes in pain and labour-specific anxiety following a focused, contraction-synchronized manual sacral counter-pressure protocol and to generate preliminary parameters for a future controlled trial.

Methods

Design and Setting

We used an exploratory one-group pretest–posttest design. The study was conducted in a maternity hospital in Semarang, Indonesia, from May to December 2024. The study was reported in accordance with the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) statement, and the intervention description was guided by the Template for Intervention Description and Replication (TIDieR) checklist to improve transparency and reproducibility of the intervention [1, 14]. EQUATOR Network: The design was selected to characterize immediate within-participant response patterns and to document key implementation features of the manual counter-pressure protocol before evaluation in a controlled study. Because no concurrent comparison group was included, the study was intended to generate preliminary estimates and procedural information rather than to establish causal effectiveness.

Participants and Recruitment

Women in active labour were recruited using consecutive sampling, whereby all women presenting during the study period were screened sequentially for eligibility. Eligibility criteria were cervical dilatation of at least 4 cm, singleton pregnancy, cephalic presentation, ability to communicate pain and anxiety responses, no pharmacological analgesia before the study intervention, and written informed consent. Women requiring immediate obstetric intervention, those with a planned caesarean birth, and those with a clinical contraindication to sacral pressure were excluded. Eligible women were approached by the research team, informed about the study procedures, and invited to participate before the intervention was administered. Recruitment continued throughout the prespecified data-collection period. Thirty-three women completed pain and physiological assessments; 31 had complete paired anxiety scores.

Sample Size

No a priori power calculation was performed because this study was designed as an exploratory one-group pretest–posttest evaluation rather than a definitive test of intervention effectiveness. Recruitment was conducted consecutively during the prespecified data-collection period, and the final sample reflected the number of eligible and consenting women enrolled during that period. The sample was therefore used to generate preliminary estimates of within-participant change, variability, responder proportions, and implementation characteristics. These estimates were intended to inform the design, outcome selection, and sample-size calculation of a future controlled trial. Accordingly, the findings were interpreted as hypothesis-generating, with emphasis placed on effect estimates and 95% confidence intervals rather than statistical significance alone.

Manual Regiosacral Counter Pressure

The principal researcher and two trained midwife enumerators delivered the intervention. Before participant recruitment, all intervention providers received standardized preparation on identification of the sacral region, hand placement, synchronization of pressure with uterine contractions, communication during the procedure, assessment of maternal comfort, and criteria for discontinuation. During each uterine contraction, the provider applied firm, continuous pressure with the palm or heel of the hand over the sacral region for approximately 35–50 seconds. Pressure was individualized according to the woman's verbal feedback, comfort, and tolerance rather than delivered at a predetermined force. The procedure was stopped at the woman's request or if discomfort increased. No device, heat source, music, or pharmacological agent formed part of the intervention. The protocol was distinguished from generalized rubbing or whole-back massage by three procedural features: a localized sacral target, sustained rather than stroking pressure, and delivery synchronized with uterine contractions

Outcomes

Pain was the primary outcome and was assessed immediately before and after the intervention using a 0–10 Numeric Rating Scale, where 0 represented no pain and 10 represented the worst imaginable pain. Anxiety was assessed using the nine-item Anxiety Assessment Scale for Pregnant Women in Labor (AASPWL), which yields scores ranging from 9 to 45, with higher scores indicating greater anxiety. The original validation study reported acceptable internal consistency and construct validity [15]. Pain and anxiety were selected because they represent the principal subjective responses expected to change immediately following the intervention.

Secondary physiological outcomes included temperature, pulse, respiratory rate, peripheral oxygen saturation (SpO_2), and systolic and diastolic blood pressure, measured using routine clinical equipment. These variables were included as exploratory physiological indicators and were not treated as primary markers of intervention effectiveness. One implausible pre-intervention SpO_2 value was excluded, leaving 32 valid paired observations. A cortisol value collected as part of the wider project was not analysed as an intervention outcome because no paired pre–post cortisol measurements were available; it was therefore excluded from all effectiveness claims.

Data Collection

Baseline pain, anxiety, and physiological measures were recorded before the counter-pressure intervention. A trained provider then delivered the intervention during uterine contractions, with each application lasting approximately 35–50 seconds. Post-intervention measurements were obtained immediately after completion of the intervention period using the same outcome measures as at baseline. The same sequence of measurement was applied across participants to maintain consistency in data collection. Completed study forms were checked for completeness before data entry, and participant identifiers were removed from the analytical dataset

Statistical Analysis

Continuous variables were summarized using means and standard deviations and, where appropriate, medians and interquartile ranges. Pre–post changes were assessed using paired t tests, with Wilcoxon signed-rank tests used as sensitivity analyses when distributional assumptions were uncertain. Mean changes with 95% confidence intervals were reported. For pain and anxiety, Cohen's d_z was calculated as a standardized within-participant change and was not interpreted as a between-group treatment effect. Pain response was also described as any reduction and a reduction of at least 2 points, with Wilson 95% confidence intervals for responder proportions. Missing pairs were excluded outcome by outcome. Physiological outcomes were treated as exploratory, with no adjustment for multiple comparisons; their P values were interpreted descriptively. Statistical interpretation emphasized effect magnitude, precision, and design limitations rather than statistical significance alone. Analyses were cross-checked using Python 3.13.5 with SciPy 1.17.0

Ethical Considerations

Ethical approval

was obtained from the Health Research Ethics Committee, Faculty of Nursing and Health Sciences, Universitas Muhammadiyah Semarang (No. XXXXX; April 23, 2024), before participant recruitment began. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and applicable national research ethics guidance. All participants received information about the study purpose, procedures, voluntary nature of participation, and their right to withdraw without affecting their clinical care. Written informed consent was obtained before enrolment. Participant confidentiality was maintained by removing direct identifiers from the analytical dataset and restricting access to study data to the research team.

Results

Participant Characteristics

A total of 33 women were included in the analysis. The mean age was 26.88 years (SD 3.11; range 20–34). Twenty-four participants (72.7%) had completed secondary education, seven (21.2%) had a bachelor's degree, and two (6.1%) had postgraduate education. Obstetric history was available for 32 participants because data were missing for one participant; among these, 22 (68.8%) had no previous birth and 10 (31.3%) had one or more previous births. Participant characteristics are presented in Table 1.

Table 1
Participant characteristics

Characteristic	Value
Age, years	26.88 ± 3.11 (range 20–34)
Secondary education	24 (72.7%)
Bachelor’s degree	7 (21.2%)
Postgraduate education	2 (6.1%)
No previous birth, n/N (%)	22/32 (68.8%)
Previous birth(s), n/N (%)	10/32 (31.3%)

Procedural Characteristics of the Manual Regiosacral Counter-Pressure Intervention

To support reproducibility, the manual counter-pressure intervention was specified according to its core procedural components, including anatomical target, mode of hand contact, timing relative to uterine contractions, duration, tailoring to maternal tolerance, and discontinuation criteria. The intervention protocol and its documented limits of standardization are presented in Table 2.

Table 2
Procedural Characteristics of the Manual Regiosacral Counter-Pressure Intervention

Intervention component	Protocol specification
Intervention providers	Principal researcher and two trained midwife enumerators
Provider preparation	Training included identification of the sacral region, hand placement, synchronization with uterine contractions, communication, maternal comfort assessment, and discontinuation criteria
Anatomical target	Localized sacral region
Hand contact	Palm or heel of the hand
Pressure technique	Firm, continuous pressure rather than rubbing or stroking
Timing of application	Applied during uterine contractions
Duration per application	Approximately 35–50 seconds per contraction
Synchronization	Pressure maintained in synchrony with each treated uterine contraction
Individual tailoring	Pressure intensity adjusted according to maternal verbal feedback, comfort, and tolerance
Provider–participant interaction	Ongoing communication used to assess comfort and guide pressure adjustment
Discontinuation criteria	Intervention stopped at the woman's request or when discomfort increased
Additional intervention components	No device, heat source, music, or pharmacological agent was included as part of the protocol
Defining procedural features	Localized sacral pressure, sustained contact, contraction-synchronized delivery, and real-time adjustment to maternal tolerance
Dose/fidelity documentation	Applied pressure force, total number of treated contractions, total intervention exposure, and formal fidelity scores were not recorded quantitatively

Pain and Clinical Response

Pain decreased in all 33 participants. Mean pain decreased from 7.70 (SD 1.38) before the intervention to 5.85 (SD 1.42) after the intervention, corresponding to a mean reduction of 1.85 points (95% CI 1.67–2.03; paired $t = 20.92$; $P < .001$). The paired standardized mean change was large ($dz = 3.64$), although this estimate reflects the low variability of individual change scores and should not be interpreted as a between-group treatment effect. Median pain decreased from 8 (IQR 7–8) to 6 (IQR 5–7), and the Wilcoxon sensitivity analysis yielded a similar direction of change ($P < .001$). Twenty-four women had a 2-point reduction, seven had a 1-point reduction, and two had a 3-point reduction. Overall, 26 of 33

participants (78.8%; Wilson 95% CI 62.2%–89.3%) achieved a reduction of at least 2 points, while all participants showed some reduction in pain.

Anxiety

Among the 31 participants with complete paired AASPWL data, mean anxiety decreased from 26.87 (SD 6.02) to 23.35 (SD 6.74), corresponding to a mean reduction of 3.52 points (95% CI 2.74–4.30; paired t = 9.20; P < .001; dz = 1.65). The reduction was interpreted as an immediate within-participant change, as the absence of a concurrent comparison group precluded attribution of the change specifically to counter-pressure

Physiological Responses and Safety

Physiological changes were generally small (Table 3). Pulse decreased by 2.82 beats/min (95% CI 0.17–5.47; P = .038), while respiratory rate decreased by 0.61 breaths/min and remained significant in the Wilcoxon sensitivity analysis (P = .008). Temperature decreased by 0.06°C (Wilcoxon P = .026), whereas SpO_2 remained unchanged. For systolic blood pressure, the paired t test and Wilcoxon test produced discordant results, while diastolic blood pressure showed no robust evidence of change. No intervention-related adverse events or discontinuations due to discomfort were observed. Given the small magnitude and inconsistent statistical pattern, physiological outcomes were interpreted as exploratory rather than as evidence of haemodynamic stabilization.

Table 3
Physiological Responses and Safety

Outcome	n	Pre-intervention, mean ± SD	Post-intervention, mean ± SD	Mean change (95% CI)	P value	Standardized change
Pain score	33	7.70 ± 1.38	5.85 ± 1.42	1.85 (1.67–2.03)	< .001*	dz = 3.64
AASPWL anxiety score	31	26.87 ± 6.02	23.35 ± 6.74	3.52 (2.74–4.30)	< .001	dz = 1.65
Temperature, °C	33	36.61 ± 0.24	36.54 ± 0.19	0.06 (0.01–0.12)	.026*	—
Pulse, beats/min	33	90.94 ± 10.33	88.12 ± 8.75	2.82 (0.17–5.47)	.038	—
Respiratory rate, breaths/min	33	21.82 ± 1.61	21.21 ± 1.65	0.61 (0.19–1.02)	.008*	—
SpO_2, %	32	98.53 ± 0.51	98.53 ± 0.51	0.00	—	—
Systolic blood pressure, mmHg	33	127.48 ± 12.22	124.39 ± 12.19	3.09 (−0.08 to 6.26)	.056†	—
Diastolic blood pressure, mmHg	33	80.33 ± 10.41	77.12 ± 10.95	3.21 (−0.47 to 6.89)	.190*	—

Note: values are mean ± SD unless stated. *Wilcoxon sensitivity P value. †Paired t P = .056; Wilcoxon P = .021. dz = paired standardized mean change.

ain and anxiety showed the clearest immediate within-participant changes, whereas physiological responses were smaller and less consistent. These findings are considered preliminary and are interpreted in light of the exploratory, uncontrolled study design.

Discussion

This exploratory study examined the immediate response to focused manual regiosacral counter-pressure during active labour. The clearest changes were observed in the subjective outcomes: mean pain decreased by 1.85 points, all participants reported some reduction in pain, and 78.8% experienced a reduction of at least 2 points. Labour-specific anxiety also decreased, while physiological measures showed only small and inconsistent changes. These findings indicate a consistent short-term response pattern following the intervention and provide preliminary information for further protocol development. Because the study used a one-group pretest–posttest design without a concurrent comparator, however,

the observed changes should be interpreted as within-participant responses rather than as evidence of a causal treatment effect. Labour progression, repeated assessment, maternal positioning, expectation, provider attention, and other concurrent influences may also have contributed to the changes observed.

The direction of the pain response is broadly consistent with previous evidence on tactile and massage-based interventions during labour. Sacral massage has been associated with lower pain intensity, although substantial heterogeneity across studies limits direct comparison between protocols [5]. Favourable pain outcomes have also been reported with electric massage chairs, mechanical massage, spouse-administered massage, and ice massage at SP6 [6–9]. These findings support the plausibility of tactile approaches for labour pain management, but the interventions differ considerably in anatomical target, mode of application, provider, timing, treatment dose, and comparator. The present findings should therefore not be interpreted as a direct replication of these studies, but rather as preliminary evidence derived from a more focused manual sacral-pressure procedure.

A key contribution of this study lies in the procedural specification of the intervention. The protocol combined localized pressure over the sacral region, sustained contact during uterine contractions, synchronization with contraction timing, and adjustment of pressure according to maternal feedback. These characteristics distinguish the intervention from generalized back massage or device-assisted techniques and provide a clearer basis for replication in future studies. Nevertheless, standardization was incomplete. The study did not quantitatively record applied force, the total number of treated contractions, total exposure time, maternal position, or formal fidelity scores. The intervention should therefore be considered a structured prototype rather than a fully standardized treatment protocol.

The magnitude of the paired standardized change deserves particular caution. The pain effect estimate was large with a similarly large standardized change for anxiety [6, 14]. In is influenced by the variability of individual change scores; when most participants change in the same direction and by similar amounts, the denominator becomes small and the standardized value may appear unusually large [1]. This estimate is therefore not comparable with a between-group standardized effect from a randomized controlled trial and does not account for natural labour progression, expectancy, provider interaction, or regression to the mean [1]. For this reason, the raw mean change, confidence interval, and participant-level response are more informative for planning a future trial than the standardized effect size alone.

The participant-level response provides additional clinical context. Although all women reported some reduction in pain, 26 of 33 participants experienced a reduction of at least 2 points. This threshold was used descriptively rather than as a validated minimum clinically important difference for labour pain [1]. Meaningful change in acute pain may vary according to baseline intensity and may not be adequately represented by a single fixed threshold [16]. Labour pain is particularly dynamic because pain intensity may change with cervical dilatation, contraction frequency, fetal position, and progression through labour [1]. The 2-point responder estimate should therefore be interpreted as a practical indicator of response distribution rather than evidence of a clinically established treatment benefit.

The concurrent reduction in labour-specific anxiety is also relevant. Pain and anxiety are closely related during labour, and tactile support may influence both through multiple pathways [14, 17]. In the present study, counter-pressure was delivered through direct provider contact, communication, reassurance, and adjustment to maternal tolerance. These accompanying elements may have contributed to the observed reduction in anxiety by improving perceived support, coping, or sense of control. At the same time, the absence of an attention-control condition prevents separation of the specific effect of pressure from the broader relational aspects of care [13]. Future controlled studies should therefore retain person-centred communication as part of routine care while documenting it sufficiently to distinguish specific intervention components from non-specific supportive effects.

Physiological outcomes showed a less consistent pattern than pain and anxiety[18, 19]. Small reductions were observed in pulse, respiratory rate, and temperature, whereas SpO_2 remained unchanged [1]. Blood-pressure findings were also unstable across statistical approaches, particularly for systolic blood pressure [20]. These small changes should not be interpreted as evidence of haemodynamic stabilization or a physiological treatment effect. They may reflect normal measurement variation, maternal position, contraction timing, labour progression, or other clinical influences rather than the intervention itself [14, 18, 21]. The contrast between the clearer subjective response and the limited physiological response suggests that pain and anxiety may be more responsive outcomes for evaluating this intervention in future studies [22]. The unpaired cortisol measurement likewise could not provide evidence of hormonal change and was appropriately excluded from effectiveness claims [23] .

An important consideration is the exceptionally uniform direction of the pain response. All 33 participants reported lower pain after the intervention. Although this may indicate a consistent immediate response, such uniformity should also be interpreted cautiously in an uncontrolled setting. Expectancy, provider interaction, repeated questioning, the timing of assessment relative to uterine contractions, and other contextual influences may have contributed to the pattern. In particular, if pre- and post-intervention pain assessments were not standardized in relation to the contraction cycle, variation in contraction intensity at the time of rating could influence the estimated change. This issue should be addressed prospectively in future trials by specifying when pain is assessed relative to contractions and by recording contraction characteristics at both measurement points.

The findings also highlight the importance of distinguishing immediate response from sustained clinical benefit. The present study assessed outcomes over a short pre–post interval and did not evaluate whether reductions in pain or anxiety persisted as labour progressed. Nor did it assess whether the intervention influenced analgesic use, duration of labour, mode of birth, maternal satisfaction, childbirth experience, or neonatal outcomes. Therefore, the present results are most appropriately interpreted as evidence of short-term response and feasibility rather than evidence of broader obstetric or maternal benefit.

Strengths and Limitations

This study has several strengths. The intervention was anatomically focused and synchronized with uterine contractions, and the protocol included predefined components related to hand placement, duration, maternal feedback, and discontinuation criteria. The study also used a labour-specific anxiety measure, reported participant-level pain response, presented confidence intervals alongside statistical tests, and explicitly distinguished within-participant change from causal treatment effects. These features improve transparency and provide useful information for planning a more rigorous evaluation.

Several limitations should be considered. The absence of a concurrent control group is the principal limitation and prevents separation of intervention-related change from labour progression, regression to the mean, repeated measurement, maternal positioning, expectation, provider attention, and other concurrent care. The sample was small, recruited consecutively from a single hospital, and no a priori power calculation was performed. Participant and provider blinding were not feasible, and outcome assessment was not independent. Intervention dose and fidelity were incompletely characterized because applied pressure force, total number of treated contractions, and total exposure were not quantified. Important obstetric variables, including gestational age, cervical dilatation at repeated measurement, fetal position, induction or augmentation, and contraction characteristics, were unavailable. Two paired anxiety observations were missing, one SpO_2 value was excluded, and the study did not examine sustained pain response, maternal satisfaction, labour duration, mode of birth, subsequent analgesic use, neonatal outcomes, or longer-term maternal experience. These limitations restrict causal interpretation and reinforce the hypothesis-generating nature of the findings.

Implications for Nursing Research and Practice

The present findings are not sufficient to support routine implementation of manual regiosacral counter-pressure as an evidence-based analgesic intervention. They do, however, provide a basis for refining a reproducible nursing protocol and identifying outcomes for a subsequent controlled evaluation. A future trial should use prospective registration, an adequately powered randomized or controlled design, and a clearly defined usual-care or attention-control comparator. Intervention delivery should include standardized anatomical placement, maternal position, pressure force, timing relative to contractions, number of applications, total exposure, provider competency assessment, and formal fidelity monitoring. Pain assessment should also be standardized in relation to uterine contractions, while relevant obstetric factors such as cervical dilatation, contraction frequency, fetal position, and induction or augmentation should be recorded at each measurement point. Broader outcomes should include anxiety, analgesia use, maternal satisfaction, childbirth experience, labour duration, mode of birth, neonatal outcomes, adverse events, and repeated follow-up measurements. Multicentre recruitment would further improve external validity.

Conclusion

Focused manual regiosacral counter-pressure was associated with immediate within-participant reductions in labour pain and labour-specific anxiety, while physiological changes were small and inconsistent. Most participants experienced a pain reduction of at least 2 points, but the uncontrolled

design does not allow these changes to be attributed solely to the intervention. The findings therefore provide preliminary response estimates and support further refinement of the intervention protocol rather than evidence of treatment effectiveness. A prospectively registered, adequately powered, fidelity-monitored controlled trial is needed to evaluate the efficacy and clinical relevance of this intervention more rigorously

Abbreviations

AASPWL
Anxiety Assessment Scale for Pregnant Women in Labor
BP
Blood pressure
CI
Confidence interval
DBP
Diastolic blood pressure
dz
Paired standardized mean change
IQR
Interquartile range
P
P—value
RR
Respiratory rate
SBP
Systolic blood pressure
SD
Standard deviation
SpO_2
Peripheral oxygen saturatio

Declarations

Ethics approval and consent to participate

This study received ethical approval from the Health Ethics Committee of the Faculty of Nursing and Health Sciences, Universitas Muhammadiyah Semarang (No. 212/KE/04/2024), dated April 23, 2024. All participants provided written informed consent before participation.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Authors' information

Not applicable.

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Author Contribution

Sri Rejeki, Anna Kurnia, Machmudah, and Reina contributed to the study and manuscript preparation. All authors read and approved the final manuscript.

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Availability of data and materials

A de-identified dataset generated and analyzed during the current study may be available from the corresponding author on reasonable request, subject to ethics approval and institutional data-governance requirements.

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