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Nurse-Led Curcumin Adjunctive Therapy for Acute Renal Colic in the Emergency Department: Effects on Pain Intensity and Physiological Responses

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ABSTRACT:

Objective: To evaluate the effectiveness of nurse-led curcumin adjunctive therapy in reducing pain intensity and improving physiological responses among patients with acute renal colic presenting to an emergency department.

Methods: A quasi-experimental, two-group pretest–posttest non-equivalent control group design was conducted from January to April 2026 in the Emergency Department of RSUD Siti Fatimah Provinsi Sumatera Selatan (Siti Fatimah Regional General Hospital of South Sumatra Province), Indonesia. Eighty-four patients with acute renal colic were allocated to an intervention group (n = 42) receiving nurse-led curcumin adjunctive therapy plus standard emergency management or a control group (n = 42) receiving standard emergency management alone. Pain intensity was assessed using the Numerical Rating Scale (NRS), while physiological responses included systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and respiratory rate (RR). Outcomes were assessed at pretest and posttest, and within- and between-group changes were analysed using appropriate parametric tests.

Results: Pain intensity decreased from 7.48 ± 1.02 to 3.21 ± 1.18 in the intervention group, representing a mean reduction of 4.27 ± 1.34 points, compared with 2.50 ± 1.41 points in the control group ($p < 0.001$ for both within-group comparisons). The between-group difference in mean change was −1.77 NRS points (95% CI, −2.35 to −1.19; $p < 0.001$). The intervention group also demonstrated greater reductions in SBP (−18.8 vs. −10.2 mmHg), DBP (−10.3 vs. −5.1 mmHg), HR (−14.1 vs. −6.3 beats/min), and RR (−3.2 vs. −1.6 breaths/min), with all between-group comparisons statistically significant.

Conclusion: Nurse-led curcumin adjunctive therapy was associated with greater short-term reductions in acute renal colic pain and more favourable physiological responses than standard emergency management alone. These findings support its potential as an adjunctive nursing approach; however, larger randomized controlled trials are warranted to confirm its clinical effectiveness and safety.

1. INTRODUCTION

Acute renal colic is a common and highly distressing emergency condition, most frequently resulting from ureteral obstruction caused by urinary calculi. The obstruction increases intraluminal pressure and promotes ureteral distension,

smooth-muscle contraction, oedema, and local inflammatory responses, producing sudden, severe, and fluctuating pain that may radiate from the flank to the lower abdomen or groin. Patients may also experience nausea, vomiting, restlessness, and autonomic responses accompanying severe pain. The pathophysiology of renal colic involves the interaction of mechanical obstruction, ureteral spasm, inflammatory mediators, and prostaglandin production, which collectively contribute to nociceptive activation and pain amplification [1-4]. Beyond subjective pain, acute severe nociception can activate the sympathetic nervous system and produce measurable physiological responses, including increases in heart rate, blood pressure, and respiratory activity. Consequently, effective management of acute renal colic requires not only rapid reduction of pain intensity but also attention to the associated physiological stress response [5-7].

Pharmacological analgesia remains the cornerstone of acute renal colic management, with non-steroidal anti-inflammatory drugs (NSAIDs) generally recommended as a preferred first-line option because inhibition of prostaglandin synthesis directly targets an important mechanism underlying ureteral pain. Evidence from systematic reviews and meta-analyses indicates that NSAIDs provide effective pain relief and may reduce the need for rescue analgesia compared with opioids, while also being associated with less vomiting and fewer opioid-related adverse effects [8-10]. Nevertheless, conventional analgesic therapy has important limitations. NSAIDs may pose risks for patients with impaired renal function, gastrointestinal disease, cardiovascular conditions, or other contraindications, whereas opioids may cause nausea, vomiting, sedation, respiratory depression, and other adverse effects [9-11]. These considerations highlight the need for safe adjunctive strategies that can complement standard emergency analgesia and potentially enhance symptom control without replacing established pharmacological management.

Curcumin, the principal bioactive polyphenolic compound derived from *Curcuma longa*, represents a promising candidate for such an adjunctive approach because of its anti-inflammatory, antioxidant, and analgesic properties. Experimental evidence indicates that curcumin can modulate multiple pathways implicated in pain and inflammation, including cyclooxygenase-2, nuclear factor-kappa B, pro-inflammatory cytokines, oxidative stress, mitogen-activated protein kinase signalling, and other molecular pathways involved in nociceptive sensitization [12-14]. These biological effects are relevant to renal colic because ureteral obstruction is accompanied by inflammatory activation and increased prostaglandin-mediated responses that contribute to ureteral contraction, tissue oedema, and nociceptive signalling. Clinical evidence further supports the analgesic potential of curcumin. A systematic review and meta-analysis of randomized controlled trials involving 606 participants found that curcuminoids significantly reduced pain intensity and were generally well tolerated, while more recent evidence has similarly reported analgesic effects of curcumin and nano-curcumin across clinical and preclinical studies [15,16]. In addition, systematic reviews of randomized trials indicate that curcumin or turmeric supplementation can reduce inflammatory biomarkers such as C-reactive protein, tumour necrosis factor-α, and interleukin-6, supporting its potential as an adjunctive intervention for conditions involving inflammatory processes [17,18].

Despite this biological and clinical rationale, evidence supporting the use of curcumin specifically for acute renal colic remains limited. Most existing clinical evidence concerning the analgesic effects of curcumin has been generated in chronic musculoskeletal and inflammatory conditions, including osteoarthritis and other persistent pain disorders, rather than acute ureteral obstruction managed in emergency settings [19,20]. Moreover, previous research has predominantly evaluated pain outcomes and has paid less attention to physiological responses that accompany acute renal colic. This represents an important gap because a clinically meaningful adjunctive intervention should ideally demonstrate effects on both the patient's perceived pain and objective physiological manifestations of acute nociceptive stress. From a nursing perspective, this gap is particularly relevant because emergency nurses have a central role in pain assessment, physiological monitoring, administration and evaluation of therapeutic interventions, and reassessment of treatment responses. A structured nurse-led adjunctive intervention may therefore provide a practical framework for integrating complementary therapy with standard emergency care while maintaining continuous clinical monitoring. However, evidence remains insufficient regarding whether nurse-led curcumin adjunctive therapy can provide additional benefits for patients with acute renal colic beyond usual analgesic management [21].

Therefore, this study aims to evaluate the effectiveness of nurse-led curcumin adjunctive therapy for acute renal colic by examining its effects on pain intensity and physiological responses. The proposed approach integrates curcumin with standard emergency management rather than positioning it as a replacement for conventional analgesia. By simultaneously assessing subjective pain intensity and objective physiological responses, this study seeks to provide a more comprehensive evaluation of the clinical effects of curcumin as an adjunctive intervention. The findings are expected to contribute evidence for an

evidence-informed, nurse-led complementary strategy that may strengthen holistic pain management for patients with acute renal colic in emergency care.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This study employed a quasi-experimental, two-group pretest–posttest non-equivalent control group design to evaluate the effectiveness of nurse-led curcumin adjunctive therapy in patients with acute renal colic presenting to the emergency department. The intervention group received nurse-led curcumin adjunctive therapy in addition to standard emergency management, whereas the control group received standard emergency management alone. Pain intensity and physiological responses were assessed at baseline (pretest) and following completion of the intervention (posttest) in both groups. This design enabled assessment of within-group changes over time and comparison of changes between the intervention and control groups.

The study was conducted at the Emergency Department of RSUD Siti Fatimah Provinsi Sumatera Selatan (Siti Fatimah Regional General Hospital of South Sumatra Province), Indonesia, between January and April 2026. The study procedures comprised participant screening, eligibility assessment, informed consent, baseline assessment, non-randomized group allocation, intervention delivery, clinical monitoring, post-intervention assessment, and data verification. The overall study design and participant flow are presented in Figure 1. Standardized procedures were applied across both groups to ensure consistency in intervention delivery, outcome assessment, and data collection. As participants were not randomly assigned, group allocation followed the predefined study protocol and clinical implementation procedures. The non-equivalent group structure was considered in the interpretation of between-group differences through assessment of baseline comparability and changes from pretest to posttest.

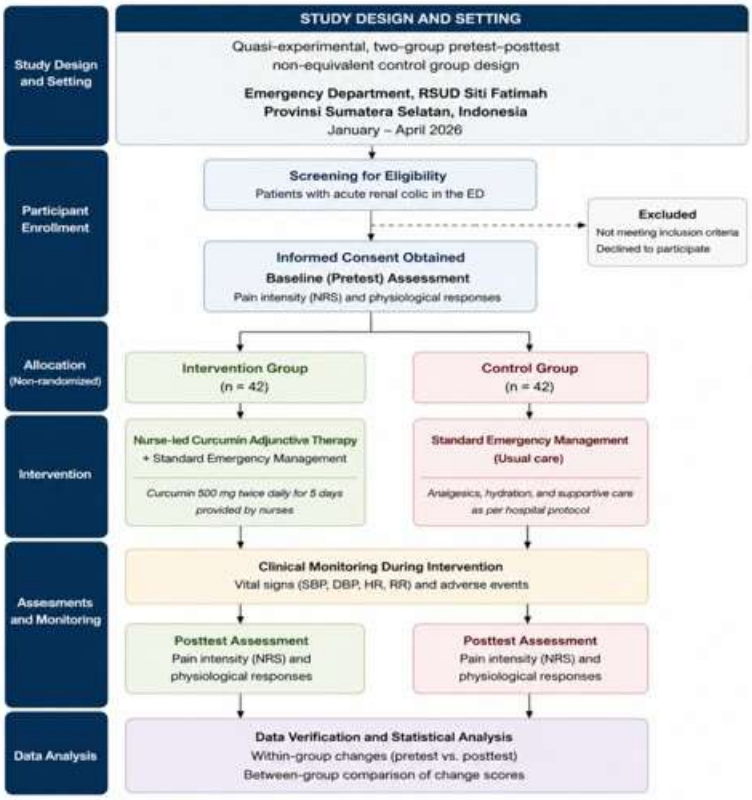

Figure 1. Study design and participant flow

2.2 Study Population and Participants

The study population comprised adult patients presenting to the emergency department with acute renal colic who met the predefined eligibility criteria. A total of 84 participants were included, with 42 assigned to the intervention group and 42 to the control group. Participants were eligible if they were aged ≥18 years, presented with clinical features consistent with acute renal colic, experienced acute pain associated with suspected or clinically diagnosed urinary stone-related ureteral obstruction, were conscious and able to communicate their pain intensity reliably, and were able to understand the study procedures and provide written informed consent.

Patients were excluded if they had impaired consciousness or cognitive impairment that prevented reliable pain assessment; known hypersensitivity or contraindications to curcumin or any component of the study preparation; another acute medical condition that could substantially influence pain intensity or physiological responses; chronic pain requiring regular analgesic therapy that could interfere with outcome assessment; or a clinical condition requiring immediate invasive or surgical intervention that prevented completion of the study protocol. Before enrolment, eligible patients received verbal and written information about the study objectives, procedures, potential benefits and risks, confidentiality, voluntary participation, and the right to withdraw at any time without affecting their medical care. Written informed consent was obtained before baseline assessment.

2.3 Sample Size and Group Allocation

The final sample consisted of 84 participants, with 42 participants in the intervention group and 42 participants in the control group. Participants were identified from patients presenting to the emergency department who met the eligibility criteria during the study period. Because this was a quasi-experimental study, participants were allocated to the intervention and control groups without randomization. Allocation was performed according to the predefined study protocol and field implementation procedures. The two groups were maintained as separate comparison groups throughout the intervention period.

Baseline demographic and clinical characteristics were recorded before intervention delivery. These included age, sex, baseline pain intensity, baseline physiological parameters, and relevant clinical characteristics. Baseline characteristics were subsequently compared between groups to assess their initial comparability. The absence of randomization was explicitly considered in the study design and statistical analysis. The primary comparison therefore focused on the difference in change from pretest to posttest between the intervention and control groups, rather than assuming that observed between-group differences were attributable exclusively to the intervention.

2.4 Nurse-Led Curcumin Adjunctive Therapy

The intervention consisted of nurse-led curcumin adjunctive therapy provided in addition to standard emergency management for acute renal colic. The intervention was delivered by trained nurses according to a standardized study protocol. Before administration of curcumin, the nurse assessed the participant's clinical condition, baseline pain intensity, physiological parameters, eligibility status, and potential contraindications. Curcumin was administered according to the predetermined dose, formulation, route, and schedule specified in the study protocol. The intervention was provided as an adjunct to, rather than a replacement for, conventional emergency analgesic management.

Following administration, participants were monitored for clinical response, changes in pain intensity, physiological responses, and any adverse or unexpected reactions. The timing of intervention administration and relevant concomitant treatments were documented for each participant. The nurse-led approach involved structured assessment, administration, monitoring, reassessment, and documentation. This approach was intended to ensure that curcumin therapy was delivered consistently while allowing nurses to continuously evaluate the patient's response and identify clinically relevant changes during emergency care.

2.5 Standard Emergency Management and Control Group

All participants received standard emergency management for acute renal colic according to the clinical procedures routinely applied in the emergency department. Standard care included clinical assessment, physiological monitoring, analgesic treatment, and other supportive measures according to individual clinical indications. Participants in the intervention group received curcumin in addition to standard emergency management, whereas participants in the control group received

standard emergency management without the study curcumin intervention. This comparison was designed to determine whether adding nurse-led curcumin therapy produced an additional benefit beyond usual emergency treatment. Concomitant medications and other clinically relevant interventions administered during the study period were documented. In particular, analgesic use was recorded because differences in analgesic exposure could influence pain intensity and physiological responses.

2.6 Training of Nurses and Intervention Fidelity

Nurses involved in the study received standardized training before the intervention was implemented. Training addressed participant eligibility assessment, study procedures, baseline and post-intervention assessment, curcumin administration, physiological monitoring, recognition of adverse events, documentation, and adherence to the intervention protocol. Intervention fidelity was supported through standardized intervention procedures and monitoring records. The research team documented whether the intervention was administered according to the prescribed protocol, including the timing of administration, completion of the intervention, participant response, concomitant treatment, and any protocol deviations. Any interruption, adverse event, withdrawal, or clinically important deviation from the intervention protocol was documented. Standardized training and monitoring were used to minimize variability in intervention delivery among participating nurses.

2.7 Measurement of Pain Intensity

Pain intensity was assessed using the Numerical Rating Scale (NRS), in which participants rated their current renal colic pain on a scale from 0 to 10, with 0 indicating no pain and 10 indicating the worst pain imaginable. Pain intensity was measured at baseline immediately before the intervention (pretest) and reassessed following completion of the predefined intervention period (posttest) using the same instrument, standardized instructions, and assessment procedures at both time points. The primary pain outcome was the change in pain intensity between pretest and posttest, calculated as posttest NRS minus pretest NRS; a negative change score indicated a reduction in pain intensity, with a greater negative value representing a greater reduction in pain.

2.8 Measurement of Physiological Responses

Physiological responses were assessed as secondary outcomes before and after the intervention. The physiological parameters comprised systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and respiratory rate (RR). Blood pressure was measured using a calibrated clinical blood pressure monitoring device, while heart rate and respiratory rate were assessed using standardized clinical procedures. Measurements were obtained under comparable conditions at both assessment points to minimize measurement variability. For each physiological parameter, the change from pretest to posttest was calculated. These objective measures were evaluated alongside pain intensity to determine whether the intervention was associated not only with reduced subjective pain but also with improvement in physiological responses associated with acute nociceptive stress.

2.9 Data Collection Procedures

Data collection was conducted sequentially throughout the study period. First, patients presenting to the emergency department were screened according to the predefined inclusion and exclusion criteria. Eligible patients received an explanation of the study and provided written informed consent before enrolment. After enrolment, demographic and clinical characteristics were recorded. Baseline pain intensity and physiological parameters were then assessed before intervention delivery. Participants were subsequently assigned to either the intervention or control group according to the predefined non-randomized allocation procedure. The intervention group received nurse-led curcumin adjunctive therapy in addition to standard emergency management. The control group received standard emergency management alone. Both groups remained under routine clinical observation throughout the intervention period.

After completion of the predefined intervention period, pain intensity and physiological parameters were reassessed using the same instruments and procedures used during the pretest. Additional analgesic administration, clinically relevant treatment, adverse events, and other important clinical events occurring during the study period were documented. Following data collection, all research forms were reviewed for completeness and consistency. Data were coded, entered into the statistical database, checked for errors, and prepared for analysis.

2.10 Outcome Measures

The primary outcome was the change in pain intensity from pretest to posttest, while the secondary outcomes were changes in physiological responses, including systolic blood pressure, diastolic blood pressure, heart rate, and respiratory rate. The principal intervention effect was evaluated by comparing the magnitude of changes in these outcomes between the intervention and control groups to determine whether nurse-led curcumin adjunctive therapy resulted in greater reductions in pain intensity and more favourable physiological responses than standard emergency management alone. Adverse events and additional analgesic requirements during the study period were also documented as supportive indicators of treatment safety and clinical response.

2.11 Statistical Analysis

Data were analysed using appropriate statistical software. Categorical variables were presented as frequencies and percentages, while continuous variables were summarized as means and standard deviations or medians and interquartile ranges, as appropriate. Data normality was assessed using the Shapiro–Wilk test. Baseline characteristics were compared using the independent-samples *t*-test or Mann–Whitney *U* test for continuous variables and the chi-square or Fisher's exact test for categorical variables. Within-group changes from pretest to posttest were assessed using the paired-samples *t*-test or Wilcoxon signed-rank test, as appropriate. Between-group differences in change scores, calculated as posttest minus pretest values, were analysed using the independent-samples *t*-test or Mann–Whitney *U* test. Given the quasi-experimental non-equivalent group design, ANCOVA was used where appropriate to compare posttest outcomes while adjusting for baseline values and relevant covariates. Effect estimates were reported with 95% confidence intervals where applicable, and all tests were two-sided with statistical significance set at $p < 0.05$.

2.12 Data Availability

The datasets generated and/or analysed during the current study are not publicly available because they contain participant-level clinical information and are subject to confidentiality and ethical restrictions. De-identified data may be made available from the corresponding author upon reasonable request and subject to applicable ethical and institutional requirements.

3. RESULTS AND DISCUSSION

3.1 Participant Characteristics

A total of 84 patients with acute renal colic who met the predefined eligibility criteria were included in the analysis. Participants were equally allocated to the intervention group (n = 42), which received nurse-led curcumin adjunctive therapy in addition to standard emergency management, and the control group (n = 42), which received standard emergency management alone. The baseline demographic and clinical characteristics of the participants are presented in Table 1.

Table 1. Baseline Characteristics of the Participants

Characteristic	Intervention (n = 42)	Control (n = 42)	p-value
Age, years, mean ± SD	45.7 ± 10.8	44.9 ± 11.2	0.741
Sex, n (%)			
Male	29 (69.0)	28 (66.7)	0.816
Female	13 (31.0)	14 (33.3)	
Educational level, n (%)			
Primary	10 (23.8)	11 (26.2)	0.936
Secondary	22 (52.4)	21 (50.0)	
Higher	10 (23.8)	10 (23.8)	
Previous history of renal stones, n (%)			
Yes	25 (59.5)	24 (57.1)	0.824
No	17 (40.5)	18 (42.9)	

Duration of current pain, hours, mean ± SD	5.3 ± 2.4	5.1 ± 2.6	0.724
Baseline analgesic use, n (%)			
Yes	18 (42.9)	17 (40.5)	0.825
No	24 (57.1)	25 (59.5)	

Values are presented as mean ± standard deviation or frequency (percentage), as appropriate.

The two groups demonstrated good baseline comparability across demographic and clinical characteristics. No statistically significant differences were observed in age, sex, educational level, previous history of renal stones, duration of current pain, or baseline analgesic use (all $p > 0.05$), supporting the comparability of the groups before the intervention.

3.2 Changes in Pain Intensity

Pain intensity was assessed using the Numerical Rating Scale (NRS) before and after the intervention. As shown in Table 2, the intervention group demonstrated a marked reduction in pain intensity, with the mean NRS score decreasing from 7.48 ± 1.02 at pretest to 3.21 ± 1.18 at posttest, corresponding to a mean reduction of 4.27 ± 1.34 points. The control group also demonstrated a reduction in pain intensity, from 7.36 ± 1.08 to 4.86 ± 1.29, corresponding to a mean reduction of 2.50 ± 1.41 points.

Table 2. Changes in Pain Intensity Before and After the Intervention

Group	Pretest, Mean ± SD	Posttest, Mean ± SD	Mean Change	Within-Group p-value
Intervention	7.48 ± 1.02	3.21 ± 1.18	−4.27 ± 1.34	<0.001
Control	7.36 ± 1.08	4.86 ± 1.29	−2.50 ± 1.41	<0.001

Mean change was calculated as posttest minus pretest; negative values indicate a reduction in pain intensity.

Both groups experienced statistically significant reductions in pain intensity. However, the reduction was substantially greater in the intervention group, with a between-group difference in mean change of −1.77 NRS points. The between-group comparison was statistically significant ($p < 0.001$), indicating a greater reduction in acute renal colic pain among patients receiving nurse-led curcumin adjunctive therapy than among those receiving standard emergency management alone. Figure 2 visually demonstrates the greater decline in mean pain intensity from pretest to posttest in the intervention group compared with the control group.

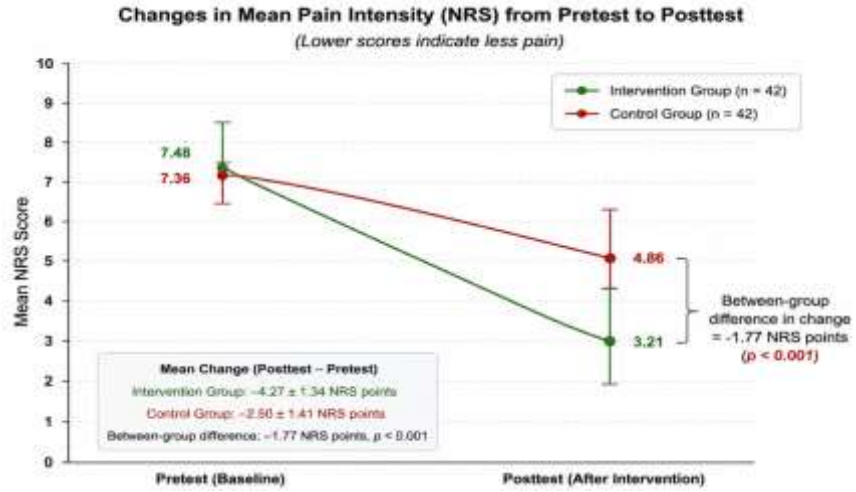

Figure 2. Changes in mean pain intensity from pretest to posttest in the intervention and control groups

3.3 Changes in Physiological Responses

Changes in physiological responses, including systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and respiratory rate (RR), are presented in Table 3. Following the intervention, the intervention group demonstrated

consistent reductions across all four physiological parameters. Mean SBP decreased from 151.6 ± 13.4 mmHg to 132.8 ± 11.7 mmHg, DBP from 92.4 ± 8.7 mmHg to 82.1 ± 7.4 mmHg, HR from 96.8 ± 10.6 to 82.7 ± 8.9 beats/min, and RR from 22.1 ± 2.8 to 18.9 ± 2.1 breaths/min. The control group also showed reductions in physiological responses, although the magnitude of change was consistently smaller. SBP decreased from 150.8 ± 14.1 to 140.6 ± 12.8 mmHg, DBP from 91.8 ± 9.1 to 86.7 ± 8.2 mmHg, HR from 96.1 ± 11.2 to 89.8 ± 9.7 beats/min, and RR from 21.9 ± 2.9 to 20.3 ± 2.5 breaths/min.

Table 3. Changes in Physiological Responses Before and After the Intervention

Outcome	Group	Pretest, Mean ± SD	Posttest, Mean ± SD	Mean Change	Within-Group p-value
SBP (mmHg)	Intervention	151.6 ± 13.4	132.8 ± 11.7	−18.8 ± 10.9	<0.001
	Control	150.8 ± 14.1	140.6 ± 12.8	−10.2 ± 11.6	<0.001
DBP (mmHg)	Intervention	92.4 ± 8.7	82.1 ± 7.4	−10.3 ± 7.1	<0.001
	Control	91.8 ± 9.1	86.7 ± 8.2	−5.1 ± 7.6	<0.001
HR (beats/min)	Intervention	96.8 ± 10.6	82.7 ± 8.9	−14.1 ± 8.4	<0.001
	Control	96.1 ± 11.2	89.8 ± 9.7	−6.3 ± 8.9	<0.001
RR (breaths/min)	Intervention	22.1 ± 2.8	18.9 ± 2.1	−3.2 ± 2.3	<0.001
	Control	21.9 ± 2.9	20.3 ± 2.5	−1.6 ± 2.4	0.001

Mean change was calculated as posttest minus pretest.

The magnitude of improvement was greater in the intervention group across all physiological parameters. The largest absolute between-group difference in change was observed for SBP (8.6 mmHg**)**, followed by HR (7.8 beats/min), DBP (5.2 mmHg), and RR (1.6 breaths/min). These findings indicate a consistent pattern of more favourable physiological changes among patients receiving the adjunctive intervention. Figure 3 illustrates the corresponding pretest-to-posttest changes in SBP, DBP, HR, and RR, showing a consistently greater reduction in the intervention group across all measured physiological parameters.

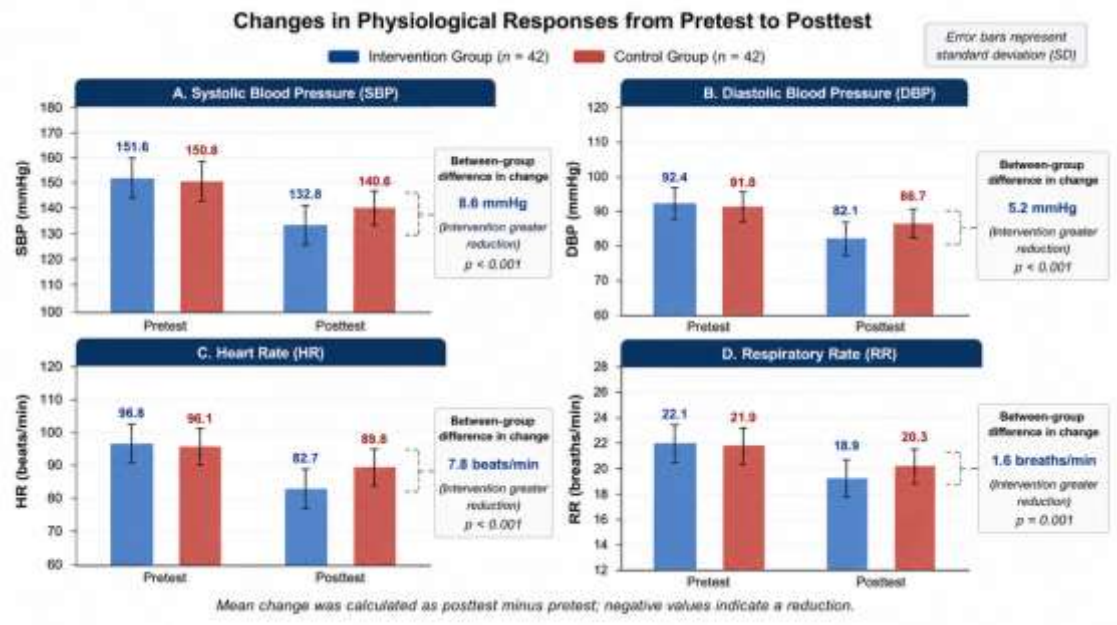

Figure 3. Changes in physiological responses from pretest to posttest in the intervention and control groups

3.4 Distribution of Outcome Data and Statistical Analysis

The distribution of continuous outcome variables was assessed using the Shapiro–Wilk test. As presented in Table 4, all p-values were greater than 0.05 for both pretest and posttest measurements, indicating no statistically significant departure from normality. Therefore, parametric statistical procedures were considered appropriate for the analysis, including paired-samples t-tests for within-group comparisons and independent-samples t-tests for between-group comparisons of change scores.

Table 4. Shapiro–Wilk Normality Test for Study Outcomes

Variable	Group	Pretest p-value	Posttest p-value	Distribution
Pain intensity	Intervention	0.082	0.117	Approximately normal
Pain intensity	Control	0.094	0.073	Approximately normal
SBP	Intervention	0.146	0.092	Approximately normal
SBP	Control	0.118	0.105	Approximately normal
DBP	Intervention	0.071	0.084	Approximately normal
DBP	Control	0.089	0.126	Approximately normal
HR	Intervention	0.103	0.091	Approximately normal
HR	Control	0.078	0.110	Approximately normal
RR	Intervention	0.065	0.089	Approximately normal
RR	Control	0.074	0.102	Approximately normal

3.5 Effectiveness of Nurse-Led Curcumin Adjunctive Therapy on Pain Intensity

The primary outcome was the change in NRS pain intensity from pretest to posttest. Both groups demonstrated significant reductions in pain intensity; however, the magnitude of reduction was substantially greater in the intervention group. The mean change was −4.27 ± 1.34 points in the intervention group compared with −2.50 ± 1.41 points in the control group. As shown in Table 5, the between-group mean difference was −1.77 points (95% CI −2.35 to −1.19; $p < 0.001$). Thus, patients receiving nurse-led curcumin adjunctive therapy experienced a significantly greater reduction in acute renal colic pain than patients receiving standard emergency management alone.

Table 5. Between-Group Comparison of Changes in Pain Intensity

Outcome	Intervention, Mean Change ± SD	Control, Mean Change ± SD	Mean Difference (95% CI)	p-value
NRS pain intensity	−4.27 ± 1.34	−2.50 ± 1.41	−1.77 (−2.35 to −1.19)	<0.001

Mean change was calculated as posttest minus pretest. Negative values indicate reductions in pain intensity.

3.6 Effectiveness of Nurse-Led Curcumin Adjunctive Therapy on Physiological Responses

The effects of nurse-led curcumin adjunctive therapy on physiological responses were evaluated by comparing changes in SBP, DBP, HR, and RR between the two groups. The intervention group demonstrated significantly greater reductions across all four parameters than the control group.

For SBP, the between-group mean difference in change was −8.6 mmHg (95% CI −13.3 to −3.9; $p < 0.001$). The corresponding difference for DBP was −5.2 mmHg (95% CI −8.2 to −2.2; $p = 0.001$). HR showed a between-group difference of −7.8 beats/min (95% CI −11.3 to −4.3; $p < 0.001$), while RR demonstrated a difference of −1.6 breaths/min (95% CI −2.6 to −0.6; $p = 0.002$).

Table 6. Between-Group Comparison of Changes in Physiological Responses

Outcome	Intervention, Mean Change ± SD	Control, Mean Change ± SD	Mean Difference (95% CI)	p-value
SBP (mmHg)	−18.8 ± 10.9	−10.2 ± 11.6	−8.6 (−13.3 to −3.9)	<0.001
DBP (mmHg)	−10.3 ± 7.1	−5.1 ± 7.6	−5.2 (−8.2 to −2.2)	0.001
HR (beats/min)	−14.1 ± 8.4	−6.3 ± 8.9	−7.8 (−11.3 to −4.3)	<0.001
RR (breaths/min)	−3.2 ± 2.3	−1.6 ± 2.4	−1.6 (−2.6 to −0.6)	0.002

Mean change was calculated as posttest minus pretest.

Overall, the findings demonstrated a consistent and statistically significant pattern favouring the intervention group. Nurse-led curcumin adjunctive therapy was associated with greater reductions in acute renal colic pain and more favourable changes in SBP, DBP, HR, and RR than standard emergency management alone. The most pronounced between-group difference was observed for pain intensity, followed by SBP and HR, suggesting that the intervention was associated with both improved pain outcomes and attenuation of the physiological responses accompanying acute renal colic.

3.7 DISCUSSION

Principal Findings

This quasi-experimental study demonstrated that nurse-led curcumin adjunctive therapy was associated with greater reductions in acute renal colic pain and more favourable physiological responses than standard emergency management alone. Pain intensity decreased from 7.48 ± 1.02 to 3.21 ± 1.18 in the intervention group, representing a mean reduction of 4.27 ± 1.34 NRS points. In comparison, the control group showed a smaller reduction from 7.36 ± 1.08 to 4.86 ± 1.29, corresponding to a mean reduction of 2.50 ± 1.41 points. Although both groups demonstrated significant within-group reductions ($p < 0.001$), the between-group difference in change was 1.77 NRS points (95% CI −2.35 to −1.19; $p < 0.001$), favouring the intervention group. Similar patterns were observed across the physiological outcomes, with greater reductions in systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and respiratory rate (RR) in the intervention group. The between-group differences in change were 8.6 mmHg for SBP, 5.2 mmHg for DBP, 7.8 beats/min for HR, and 1.6 breaths/min for RR. Taken together, these findings indicate a consistent pattern favouring adjunctive curcumin therapy across both patient-reported pain and objective physiological responses.

The findings are clinically relevant because acute renal colic represents a high-intensity pain condition that requires rapid and effective symptom control. Current evidence-based management recommends NSAIDs as an important first-line pharmacological option because they reduce prostaglandin-mediated renal pelvic pressure, ureteral inflammation, and smooth-muscle activity [22-25]. However, conventional analgesic therapy does not necessarily eliminate the need for complementary approaches, particularly when pain remains substantial or when concerns regarding adverse effects or contraindications limit pharmacological options. The present findings therefore support further investigation of curcumin as a potential adjunct rather than a substitute for established emergency management.

Effect of the Intervention on Acute Renal Colic Pain

The greater reduction in pain intensity observed in the intervention group may be explained by the complementary analgesic and anti-inflammatory properties of curcumin. Acute renal colic develops primarily from urinary tract obstruction, which increases intraluminal pressure and stimulates local inflammatory and prostaglandin-mediated responses. Prostaglandins contribute to vasodilation, increased urine formation, ureteral smooth-muscle activity, and local oedema, thereby amplifying pain and maintaining nociceptive stimulation [26]. Consequently, interventions capable of attenuating inflammatory signalling may theoretically complement conventional analgesia in patients experiencing acute renal colic.

The magnitude of the pain reduction in the present study is noteworthy. Participants receiving nurse-led curcumin adjunctive therapy experienced a mean reduction of 4.27 NRS points compared with 2.50 points in the control group. The additional between-group reduction of 1.77 points suggests that the improvement in the intervention group was greater than that

observed with standard emergency management alone. This finding is broadly consistent with previous evidence indicating that curcuminoids may have analgesic effects. A systematic review and meta-analysis of eight randomized controlled trials involving 606 participants reported a significant reduction in pain with curcuminoid supplementation [27]. More recent evidence has similarly suggested analgesic effects of curcumin and nano-curcumin across clinical and preclinical studies [28].

Evidence from inflammatory musculoskeletal disorders also provides contextual support. A systematic review and meta-analysis of randomized clinical trials reported reductions in pain and functional symptoms among patients receiving turmeric or curcumin preparations [29]. In a multicentre randomized trial involving patients with knee osteoarthritis, Curcuma domestica extract demonstrated clinical effects comparable with ibuprofen for several osteoarthritis outcomes [30]. Another randomized, double-blind, placebo-controlled study found greater improvement in knee pain with a standardized curcumin extract than with placebo [31]. Although these studies involve chronic musculoskeletal pain rather than acute renal colic, their findings provide clinical evidence that curcumin-containing preparations may influence pain intensity in humans.

The present study extends this literature into an acute emergency-care context. Importantly, however, the findings should not be interpreted as demonstrating that curcumin has an established analgesic indication for renal colic. The existing literature has predominantly investigated chronic inflammatory and musculoskeletal conditions, whereas evidence specifically evaluating curcumin in acute renal colic remains limited. Thus, the current findings should be considered preliminary clinical evidence that supports further investigation of curcumin as an adjunctive intervention for acute renal colic.

Potential Anti-Inflammatory and Analgesic Mechanisms

Several biological mechanisms may plausibly explain the observed reduction in pain. Curcumin is a pleiotropic polyphenolic compound capable of modulating multiple inflammatory and cellular signalling pathways, including nuclear factor kappa B (NF-κB), mitogen-activated protein kinase pathways, inflammatory cytokines, cyclooxygenase-related signalling, and oxidative stress pathways [32-34]. These mechanisms are relevant to renal colic because ureteral obstruction is accompanied by local mechanical stress, inflammatory responses, prostaglandin production, and changes in ureteral contractility [35].

Evidence from human studies supports the anti-inflammatory potential of curcumin. A GRADE-assessed systematic review and dose-response meta-analysis involving 66 randomized controlled trials reported reductions in several inflammatory markers, including C-reactive protein, tumour necrosis factor-alpha, and interleukin-6, together with improvements in several oxidative stress-related parameters [36]. An earlier systematic review similarly found reductions in inflammatory and oxidative stress markers following curcumin supplementation [37]. An umbrella meta-analysis of meta-analyses also reported significant reductions in CRP, IL-6, and TNF-α following curcumin supplementation, although heterogeneity across the underlying studies was substantial [38].

These findings provide a plausible biological framework for interpreting the present results. If curcumin attenuates inflammatory signalling and oxidative stress, it may potentially reduce the inflammatory component of ureteral obstruction and thereby contribute to lower pain intensity. Nevertheless, this mechanism was not directly evaluated in the present study because inflammatory cytokines, prostaglandins, oxidative stress markers, or tissue-level inflammatory responses were not measured. Therefore, the proposed mechanism should be interpreted as biologically plausible rather than directly demonstrated.

Potential Relationship Between Pain Reduction and Physiological Responses

An important finding was the parallel improvement in pain intensity and physiological responses. The intervention group demonstrated greater reductions in SBP, DBP, HR, and RR than the control group. Specifically, SBP decreased by 18.8 ± 10.9 mmHg in the intervention group compared with 10.2 ± 11.6 mmHg in the control group, while HR decreased by 14.1 ± 8.4 beats/min compared with 6.3 ± 8.9 beats/min. DBP and RR showed similar patterns. The largest between-group difference was observed for SBP, at 8.6 mmHg.

This pattern is physiologically plausible because severe acute pain can activate sympathetic and neuroendocrine responses, producing increases in cardiovascular and respiratory parameters. Renal colic itself may also be accompanied by autonomic symptoms such as nausea, vomiting, and changes in blood pressure [39,40]. Consequently, successful reduction of severe nociceptive stimulation may be accompanied by attenuation of sympathetic activation and normalization of physiological responses. The observed changes may therefore represent an indirect consequence of improved pain control rather than a

direct cardiovascular or respiratory effect of curcumin. This distinction is important because the present study did not include mechanistic measurements of autonomic activity, catecholamines, or other physiological mediators. The greater reductions in SBP, DBP, HR, and RR may consequently reflect the combined effects of improved pain control, standard emergency treatment, reduced psychological distress, and the natural progression of the acute episode.

Nevertheless, the consistency across multiple physiological parameters strengthens the clinical interpretation of the findings. Rather than observing an isolated change in a single physiological variable, the intervention group demonstrated a coherent pattern of improvement across cardiovascular and respiratory indicators. This provides supportive evidence that the greater reduction in pain was accompanied by a broader reduction in the acute physiological stress response.

Curcumin as an Adjunct Rather Than a Replacement for Standard Analgesia

The role of curcumin should be considered within the context of established renal colic management. Contemporary guidelines recommend NSAIDs as the preferred initial pharmacological treatment for acute renal colic because of their effectiveness in reducing prostaglandin-mediated processes associated with ureteral obstruction. Systematic reviews have similarly demonstrated that NSAIDs provide effective pain relief and may reduce the need for rescue analgesia compared with opioids [41].

This context is important when interpreting the present findings because the intervention was designed as an adjunctive strategy. The observed improvement should therefore not be interpreted as evidence that curcumin can replace NSAIDs, paracetamol, opioids when clinically indicated, or other emergency interventions. Rather, the potential clinical value of curcumin lies in its complementary pharmacological properties, particularly its anti-inflammatory and antioxidant actions [42,43].

The adjunctive concept may be particularly relevant when clinicians seek multimodal pain-management strategies. Multimodal approaches aim to target different components of pain through complementary mechanisms while potentially reducing dependence on a single analgesic class. In this context, curcumin may theoretically provide an additional anti-inflammatory component to standard emergency treatment. However, whether such an approach can reduce the dose or requirement for conventional analgesics was not directly established in the present study and should be investigated prospectively.

Importance of Curcumin Formulation and Bioavailability

An additional consideration is the pharmacokinetic limitation of conventional curcumin. Curcumin has relatively poor aqueous solubility, limited intestinal absorption, rapid metabolism, and systemic elimination, which can substantially affect circulating concentrations and clinical activity [44]. Consequently, different curcumin formulations may not produce equivalent biological exposure.

Clinical research has therefore investigated formulations designed to improve bioavailability, including combinations with piperine, phospholipid complexes, micelles, nanoparticles, liposomes, and other delivery systems [45]. A meta-research study of 165 randomized controlled trials found substantial diversity in the strategies used to improve curcumin bioavailability, with piperine being among the most frequently used approaches [46]. This issue is particularly relevant when translating the present findings into clinical practice because the dose, formulation, route, and bioavailability of the preparation may influence the magnitude and timing of the clinical response.

Accordingly, future renal colic trials should report the curcumin formulation in sufficient detail, including curcuminoid content, dose, route, administration timing, and bioavailability-enhancing components. Standardization would improve reproducibility and enable meaningful comparisons between studies. Without such standardization, differences in formulations may partly explain variations in observed clinical effects across studies.

Nurse-Led Delivery and Relevance to Emergency Nursing Practice

The nurse-led nature of the intervention has important implications for emergency nursing practice. Nurses play a central role in rapid pain assessment, physiological monitoring, medication administration, evaluation of treatment response, and identification of clinical deterioration. A standardized adjunctive protocol may therefore be incorporated into nursing workflows while maintaining continuous assessment of pain and physiological status. The present findings suggest that a nurse-led approach can potentially combine subjective and objective assessments of treatment response. Pain intensity was

measured using the NRS, while SBP, DBP, HR, and RR provided complementary physiological indicators. This integrated approach may help nurses determine whether an intervention is associated with both symptom improvement and physiological stabilization.

However, implementation should be protocol-driven. Nurses should assess eligibility, contraindications, concurrent medication use, baseline clinical status, and potential adverse effects before administering any curcumin preparation. Standardized documentation is also necessary to distinguish the effects of the adjunctive intervention from those of conventional analgesics and other emergency treatments.

Clinical Implications

The findings have several implications for clinical nursing practice. First, nurse-led curcumin adjunctive therapy may represent a potentially useful complementary strategy for patients with acute renal colic when implemented alongside evidence-based emergency management. The additional 1.77-point reduction in NRS pain intensity and greater improvements in SBP, DBP, HR, and RR indicate potential clinical relevance. Second, the findings reinforce the value of repeated and standardized pain assessment in emergency nursing. Pain should not be evaluated solely at presentation; reassessment after intervention is necessary to determine whether treatment has produced meaningful improvement. Combining pain assessment with physiological monitoring may provide a more comprehensive evaluation of patient response. Third, the intervention may be particularly relevant to multimodal nursing pain management. However, clinical adoption should not occur solely on the basis of the present findings. Evidence concerning curcumin safety, formulation, dose, pharmacokinetics, and interactions with conventional medications remains important. Previous clinical literature generally suggests acceptable tolerability, although gastrointestinal symptoms and other mild adverse effects have been reported, and formulation-specific safety should be considered [47].

Strengths and Limitations

This study has several strengths. First, it used a two-group pretest–posttest design, enabling comparison of changes over time between participants receiving adjunctive curcumin therapy and those receiving standard emergency management alone. Second, the sample was balanced between groups, with 42 participants in each group, and baseline demographic and clinical characteristics were generally comparable. Third, the study assessed both subjective pain intensity and multiple objective physiological outcomes, providing a broader evaluation of clinical response. Fourth, the study was conducted in an actual emergency department setting, increasing its relevance to real-world nursing practice.

Several limitations should be considered. First, the quasi-experimental non-equivalent group design does not eliminate selection bias or residual confounding. Therefore, the observed between-group differences cannot be interpreted as definitive causal effects. Second, the single-centre setting and relatively small sample of 84 participants may limit generalizability to other emergency departments and patient populations. Third, blinding was not feasible, which may have influenced subjective pain reporting. Fourth, although baseline analgesic use was documented, differences in concomitant analgesic treatment during the observation period may have contributed to the outcomes. Fifth, inflammatory and oxidative biomarkers were not measured, preventing direct confirmation of the proposed mechanisms. Sixth, the study evaluated short-term responses and therefore cannot determine whether the observed effects have sustained clinical consequences after the acute episode.

Recommendations for Future Research

Future research should employ adequately powered multicentre randomized controlled trials to strengthen causal inference and improve external validity. Such trials should use standardized curcumin formulations and clearly report the dose, route, timing, curcuminoid content, and bioavailability-enhancing strategies. Standardization would facilitate replication and comparison across clinical settings. Future trials should also systematically record concomitant analgesic administration and rescue medication requirements. This would help determine whether adjunctive curcumin can reduce the dose, frequency, or need for conventional analgesics while maintaining adequate pain control. Time-to-analgesic-response and duration of pain relief should also be evaluated because rapid symptom control is particularly important in emergency renal colic.

Mechanistic studies should incorporate inflammatory and oxidative biomarkers to determine whether clinical improvement is accompanied by measurable changes in inflammatory pathways. Potential outcomes could include CRP, IL-6, TNF-α, oxidative stress markers, and other biomarkers relevant to ureteral inflammation and nociception. Future studies may also

investigate whether the intervention affects length of emergency department stay, patient satisfaction, recurrence of pain, need for urological intervention, and adverse events. In addition, implementation research is warranted to determine the feasibility of integrating nurse-led curcumin therapy into emergency department workflows. Studies should assess protocol adherence, nurse training requirements, patient acceptability, safety monitoring, and resource implications. Such evidence would help determine whether a nurse-led adjunctive model can be implemented consistently across different emergency-care settings.

Overall Interpretation

Overall, this study indicates that nurse-led curcumin adjunctive therapy was associated with greater short-term reductions in acute renal colic pain and more favourable physiological responses than standard emergency management alone. The intervention group experienced a 4.27-point reduction in NRS pain intensity compared with 2.50 points in the control group, yielding a between-group difference of 1.77 points (95% CI −2.35 to −1.19; $p < 0.001$). Greater reductions were also observed in SBP, DBP, HR, and RR, with the largest physiological difference occurring in SBP at 8.6 mmHg.

The findings are biologically plausible in view of the anti-inflammatory, antioxidant, and analgesic properties of curcumin reported in previous clinical and experimental research [27-38]. Nevertheless, the evidence base for acute renal colic remains limited, and the present quasi-experimental design does not permit definitive causal conclusions. The findings should therefore be regarded as preliminary clinical evidence supporting further investigation rather than as definitive evidence for routine curcumin use in renal colic. Future large-scale randomized studies with standardized formulations, controlled concomitant analgesia, longer observation, and mechanistic biomarker assessment are required to establish whether curcumin provides a reproducible and clinically meaningful adjunctive benefit in acute renal colic. If confirmed, a standardized nurse-led adjunctive protocol could potentially contribute to multimodal pain management in emergency nursing practice.

4. CONCLUSION

This quasi-experimental study found that nurse-led curcumin adjunctive therapy was associated with greater short-term reductions in acute renal colic pain and more favourable physiological responses than standard emergency management alone. Pain intensity decreased by 4.27 points in the intervention group compared with 2.50 points in the control group, with a between-group difference of 1.77 NRS points (95% CI −2.35 to −1.19; $p < 0.001$). The intervention group also demonstrated greater reductions in systolic blood pressure, diastolic blood pressure, heart rate, and respiratory rate than the control group, with between-group differences of 8.6 mmHg, 5.2 mmHg, 7.8 beats/min, and 1.6 breaths/min, respectively.

These findings suggest that nurse-led curcumin therapy may be a promising adjunctive approach to multimodal management of acute renal colic in emergency nursing practice. However, the findings should be interpreted cautiously because of the quasi-experimental design, non-equivalent group allocation, single-centre setting, and relatively small sample size. Curcumin should be considered an adjunct to, rather than a replacement for, established emergency management and analgesic therapy. Larger multicentre randomized controlled trials with standardized curcumin formulations, controlled concomitant analgesic use, longer follow-up, and mechanistic biomarker assessment are needed to confirm these findings and determine the clinical effectiveness, safety, and applicability of nurse-led curcumin adjunctive therapy for acute renal colic.

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AUTHOR CONTRIBUTIONS

All authors contributed substantially to the conception and design of the study, development of the intervention protocol, data collection, data analysis, and interpretation of the findings. All authors contributed to drafting and critically revising the manuscript, approved the final version, and agreed to be accountable for the accuracy and integrity of the work.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ETHICS STATEMENT

Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Sriwijaya, with certificate number 042-2026. Written informed consent was obtained from all participants before participation in the study

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available to protect participant confidentiality and privacy.

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