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THE EFFECTIVENESS OF BALL SQUEEZING THERAPY AND WARM COMPRESS ON POST-CAESAREAN SECTION PAIN LEVELS

Alfinia Ni'ma Fitriasari , Taufan Arif , Fitriana Kurniasari Solikhah , Sulastyawati
Department of Nursing, Health Polytechnic-Ministry of Health Malang, Indonesia

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ABSTRACT

Pain following caesarean section is one of the problems that can hinder the recovery process if it is not properly managed. Non-pharmacological interventions such as ball squeezing therapy and warm compresses can be used to improve the effectiveness of pain management. The purpose of this study was to analyze the effectiveness of ball squeezing therapy and warm compresses on pain levels among post-sectio caesarea patients at Ngudi Waluyo Wlingi Regional Hospital. The study used a three-group quasi-experimental pretest-posttest design, consisting of two intervention groups and one control group, involving 54 respondents selected using purposive sampling, with 18 respondents in each group. Pain levels were measured using the Numeric Rating Scale five minutes before and after the intervention. Warm compress therapy was applied using a Warm Water Zak (WWZ) at a temperature of 45–50°C twice, with each session lasting 10 minutes. Ball squeezing therapy was performed by rhythmically grasping and releasing a rubber ball according to breathing patterns and was administered twice, with each session lasting 10 minutes. The Kruskal–Wallis test was used to compare pain levels among the three groups, while the Mann–Whitney U test was used for pairwise comparisons between two groups. The average pain reduction in the control group was 2.39 points. The average pain reduction in the ball squeezing therapy group was 2.50 points. The average pain reduction in the warm compress group was 3.89 points. The reduction in pain between the control and warm compress groups averaged 1.66 points, with a p-value of 0.001, while the reduction in pain between the control and ball squeezing therapy groups averaged 0.50 points, with a p-value of 0.117. Warm compresses work through vasodilation and reduce inflammatory mediators around the surgical area, thereby providing a faster analgesic effect. Meanwhile, ball squeezing therapy works through the Gate Control Theory mechanism, but its distraction effect makes it less optimal because it does not directly affect the painful area. It was concluded that warm compresses are more effective than ball squeezing therapy in reducing post-caesarean section pain.

Kata Kunci:

tingkat nyeri; post sectio caesarea; ball squeezing therapy; kompres hangat

ABSTRAK

Nyeri pasca sectio caesarea merupakan salah satu masalah yang dapat menghambat proses pemulihan apabila tidak dikelola dengan baik. Intervensi nonfarmakologis seperti ball squeezing therapy dan kompres hangat dapat digunakan untuk meningkatkan efektivitas manajemen nyeri. Penelitian ini bertujuan menganalisis efektivitas ball squeezing therapy dan kompres hangat terhadap tingkat nyeri pasien post sectio caesarea di RSUD Ngudi Waluyo Wlingi. Penelitian menggunakan desain quasi-experiment pretest-posttest dengan tiga kelompok, yang terdiri atas dua kelompok intervensi dan satu kelompok kontrol pada 54 responden yang dipilih melalui teknik purposive sampling. Masing-masing kelompok terdiri atas 18 responden. Tingkat nyeri diukur menggunakan Numeric Rating Scale (NRS) lima menit sebelum dan sesudah intervensi. Kompres hangat diberikan menggunakan Warm Water Zak (WWZ) bersuhu 45-50°C yang diberikan sebanyak dua kali dan masing-masing selama 10 menit, sedangkan ball squeezing therapy dilakukan dengan menggenggam dan melepaskan bola karet secara ritmis sesuai pola napas yang diberikan sebanyak dua kali dan masing-masing selama 10 menit. Uji Kruskal–Wallis digunakan untuk membandingkan tingkat nyeri antara tiga kelompok, sedangkan uji Mann–Whitney U digunakan untuk membandingkan dua kelompok secara berpasangan. Penurunan nyeri rata-rata pada kelompok kontrol adalah 2,39 poin. Penurunan nyeri rata-rata pada kelompok ball squeezing therapy adalah 2,5 poin. Penurunan nyeri rata-rata pada kelompok kompres hangat adalah 3,89 poin. Penurunan nyeri antara kelompok kontrol dan kompres hangat rata-rata 1,66 dengan nilai p 0,001, sedangkan penurunan nyeri antara kelompok kontrol dan terapi meremas bola rata-rata 0,50 dengan nilai p 0,117. Kompres hangat bekerja melalui mekanisme vasodilatasi dan menurunkan mediator inflamasi di sekitar area operasi, sehingga memberikan efek analgetik lebih cepat. Sementara itu, ball squeezing therapy bekerja melalui

mekanisme Gate Control Theory, namun efek distraksi menjadikannya kurang optimal karena tidak berpengaruh langsung pada area nyeri. Disimpulkan bahwa kompres hangat lebih efektif dibandingkan dengan ball squeezing therapy dalam menurunkan nyeri pasca sectio caesarea.

✉ **Corresponding Author:**
Taufan Arif
Email: taufanarif.polkesma@gmail.com

INTRODUCTION

Childbirth is a physiological process that has a significant impact on a mother, physically, psychologically, and socially. When vaginal delivery is not possible due to complicating factors such as preeclampsia, fetal distress, and cephalopelvic disproportion, a cesarean section (C-section) is an option to save the mother and baby. Although this procedure is considered safe and quite common, post-operative complications, such as surgical wounds and post-operative pain, can directly impact the mother's recovery period. This can delay early mobilization, increase the risk of deep vein thrombosis, prolong hospitalization, and hinder breastfeeding (Wahyu & Lina, 2019).

In 2021, the global C-section rate reached approximately 21% of all births and is expected to increase to 29% by 2030 (WHO, 2021). The prevalence of C-section deliveries in Indonesia in 2018 was 17.6% (Kemenkes RI, 2018). Meanwhile, in 2023, the prevalence of CS delivery reached 25.9%, an increase from the previous five years (Kemenkes RI, 2023). Meanwhile, in East Java itself, in 2023, CS deliveries were recorded at 31.2%, placing this province in the seventh-highest ranking in Indonesia (Kemenkes RI, 2023). This certainly represents an increase compared to 2020, which was 22.36% (Dinkes Jatim, 2020). Meanwhile, studies show that more than 80% of women report experiencing moderate to severe pain in the first 24 hours after CS, characterized by visceral and somatic pain (Aksoy, 2025).

Based on the results of a preliminary study conducted at Ngudi Waluyo Wlingi Regional Hospital, the number of C-section operations in the past year was 269, with the majority experiencing post-C-section pain. Pain management in the ward involved pharmacological therapy with the analgesic ketorolac and non-pharmacological therapy, including deep breathing relaxation techniques, according to the hospital standard operating procedures (SOP) at Ngudi Waluyo Wlingi Regional Hospital.

Post-cesarean section patients commonly experience severe abdominal pain due to the incision. This tissue damage causes the release of inflammatory mediators, such as histamine, bradykinin, and prostaglandins, which stimulate pain receptors. These pain impulses are then transmitted through peripheral nerve fibers to the central nervous system and are perceived as pain (Perry & Potter, 2016). Pain impulses that reach the spinal cord, brainstem, and hypothalamus activate the autonomic nervous system as part of the stress response. Activation of the sympathetic nervous system causes peripheral vasoconstriction, increased blood pressure, and muscle tension, which can worsen post-operative wound conditions. If left untreated, this pain can lead to serious complications, such as shock and even death (Sulistyo, 2016).

One study showed that C-section deliveries had a 27.3% higher pain level compared to vaginal deliveries, which were approximately 9% higher (Wahyu & Lina, 2019). Post-cesarean section pain management is generally achieved with pharmacological analgesics such as opioids and NSAIDs. However, the use of analgesics, especially opioids, often causes side effects such as nausea, vomiting, constipation, drowsiness, and even long-term dependence (Giordano et al., 2023). Furthermore, analgesics are only about 60% effective as pain relievers (Aryanti & Fauziah, 2024). Meanwhile, non-pharmacological methods are easy to perform, effective, and free from adverse side effects (Perry & Potter, 2016). Therefore, combining pharmacological and non-pharmacological methods is the most effective way to reduce post-operative pain levels by approximately 20-30% and accelerate recovery (Xu et al., 2025).

Ball squeezing therapy is a relatively new non-pharmacological pain management therapy that utilizes the principle of distraction to help divert patients' attention from the sensation of pain (Dinamiyanti et al., 2024). This therapy involves repeatedly squeezing a ball, which stimulates large nerve fibers, thereby inhibiting the transmission of pain signals to the brain, according to the Gate

Control Theory mechanism (Aslan et al., 2025). This therapy can reduce physical tension and increase comfort, allowing patients to achieve optimal levels of comfort (Dinamiyanti et al., 2024).

Warm compress therapy has also been shown to be effective in reducing pain levels, increasing blood flow to the painful area, relaxing muscle tension, and providing a comforting effect (Rohmawati et al., 2025). Applying a warm compress to a specific area can increase local vasodilation by up to 40%, improve blood flow, accelerate tissue metabolism, and reduce muscle tension, ultimately reducing the perception of pain caused by muscle contractions and increasing comfort (Aksoy, 2025; Kaur et al., 2020). Warm compresses are beneficial for providing relaxation and psychological comfort to patients, thus accelerating healing (Sun et al., 2024).

The novelty of this study lies in comparing the effectiveness of warm compress therapy versus ball-squeezing therapy for reducing post-Cesarean section pain—an area that has not yet been extensively researched. This study contributes by evaluating the effectiveness of ball-squeezing therapy and warm compresses; these are proposed as innovative non-pharmacological interventions that can serve as complementary therapies alongside the pharmacological analgesics and deep-breathing relaxation techniques that currently constitute the standard operating procedure for post-Cesarean pain management in hospitals.

Based on the above background, the high prevalence of post-C-section pain, the limitations of pharmacological pain management, and the significant potential for non-pharmacological interventions such as ball squeezing therapy and warm compresses, which can significantly reduce pain levels, the study, which has not yet established which intervention is more effective, warrants this research. This study aimed to analyze the effectiveness of ball squeezing therapy and warm compresses on post-C-section pain levels at Ngudi Waluyo Wlingi Regional Hospital.

METHOD

Type of Research

This study used a quasi-experimental design with a three-group pretest-posttest with control group design approach. The researcher submitted an application for ethical clearance to Ngudi Waluyo Regional General Hospital and obtained an ethical clearance certificate with number T/070/DIKLAT/4614/409.52.4/2025. In this study, there were three groups, consisting of two experimental groups, namely the group given ball squeezing therapy and the group given warm compress interventions, and one control group. Warm compress therapy was applied using a Warm Water Zak (WWZ) at a temperature of 45–50°C twice, with each session lasting 10 minutes, while ball squeezing therapy was performed by rhythmically grasping and releasing a rubber ball according to breathing patterns, given twice, with each session lasting 10 minutes. The positive control group was given deep breathing relaxation therapy twice, with each session lasting 10 minutes. The instruments used were the NRS questionnaire sheet to measure pain levels and the SOP for each intervention. Data analysis consisted of univariate and bivariate analysis. The paired two-sample test used the Wilcoxon test, while the unpaired two-sample test used the Mann–Whitney test. The Kruskal–Wallis test was used to test three unpaired groups.

Place and Time of Research

The study took place at Ngudi Waluyo Wlingi Regional General Hospital between August and October 2025.

Population and Sample

The population of this study involved post-cesarean section patients experiencing pain at Ngudi Waluyo Wlingi Regional General Hospital. The sample size was determined using Federer's formula: $(n-1)(t-1) \geq 15$, with an additional allowance for a 10% dropout rate. Based on this calculation, the minimum required sample size was 30 participants, divided into three groups. To minimize bias, the study utilized 18 participants per group, resulting in a total sample size of 54 respondents selected using a block purposive sampling method based on inclusion and exclusion criteria. The inclusion criteria were post-cesarean section patients who had been given analgesics after 6 hours, were of sound mind and cooperative, and experienced pain on a scale of 1–6 according to the NRS measurement. The exclusion criteria were patients who experienced upper extremity dysfunction, tremors or severe spasms

in the hands, or serious complications, such as severe bleeding, deep vein thrombosis, emotional disturbances, and surgical wound infections.

Data Collection

Data collection was conducted through several systematic steps, starting with submitting an ethical clearance application and obtaining a research permit from the Research and Development Department of Ngudi Waluyo Regional Hospital, along with a proposal and a permit from the educational institution. After obtaining approval, the researcher coordinated with the nursing staff to conduct the study. Then, the researcher identified respondents who met the inclusion criteria as the research sample. The researcher approached the respondents and requested their willingness to participate by signing an informed consent form. The researcher conducted initial interviews to collect data on the respondents' characteristics and provided education on ball squeezing therapy and warm compresses.

The researcher divided the participants using a block system: the first five respondents received ball squeezing therapy, the next five received warm compresses, and the next five served as a positive control group, receiving deep breathing relaxation, for a total of 54 participants. Respondents received interventions according to their respective group's standard operating procedures (SOP). Interventions were administered once daily for two consecutive days. A pre-test was conducted to observe pain levels on the first day, 5 minutes before the intervention was administered. A post-test was conducted to observe pain levels 5 minutes after the intervention on the second day. The measurement and intervention processes were repeated on the second day using the same procedures.

Data Analysis and Processing

Univariate analysis was performed to describe the level of pain after the intervention. The collected data were processed and presented in a table. Bivariate analysis was performed to assess the effectiveness of ball squeezing therapy and warm compresses on pain levels in post-CS patients. The Wilcoxon test was used to compare paired samples before and after treatment. The Mann–Whitney test examined the mean difference between the two samples with a significance level of $\alpha = 0.05$. The decision-making principles are as follows: (1) If $p > 0.05$, then H0 is accepted, indicating that ball squeezing therapy and warm compresses are not effective in reducing post-CS pain levels. (2) If $p < 0.05$, then H0 is rejected, indicating that ball squeezing therapy and warm compresses are effective in reducing post-CS pain levels.

RESULT

This study was conducted at Ngudi Waluyo Wlingi Regional Hospital, East Java Province, Indonesia, involving post-cesarean section (SC) mothers experiencing pain on a scale of 1–6 (NRS scale). Data were collected 5 minutes before and after each group received the appropriate intervention. Fifty-four participants participated. To provide comprehensive information on the demographic characteristics of the sample, including age, occupation, education, and surgical history, the data are presented in the table below:

Table 1 shows the characteristics of the respondents in this study, including age, education level, occupation, and surgical history. Based on age distribution, the majority of respondents in the control group were between 26 and 35 years old, with 8 respondents (44%), while in the BST group, the largest age groups were also in the 17–25 and 26–35 year age groups, with 7 respondents (38.9%) each. In the warm compress group, the majority of respondents were between 26 and 35 years old, representing 50.0%. This indicates that early adulthood dominated the distribution of respondents in this study. In terms of education, the majority had a high school education, with 12 respondents (66.7%) in both the control and BST groups, while 16 respondents (88.9%) in the warm compress group were housewives.

The majority of respondents in all three groups were housewives. There were 10 respondents in the control group (55.6%), 11 respondents in the BST group (61.1%), and 10 respondents in the warm compress group (55.6%). Most respondents had no history of previous surgery. There were 13 respondents in the control group (72.2%), 12 respondents in the BST group (66.7%), and 12 respondents in the warm compress group (66.7%). Overall, the study results showed that most respondents were 26–

35 years old, had a high school education, were housewives, and were undergoing surgery for the first time, which may influence their perception and anxiety levels regarding postoperative pain.

Table 1. Distribution of Respondent Characteristics of Post-Caesarean Section Patients Based on Age, Education Level, Occupation, and Surgical History in the Dewi Kunthi Ward, Ngudi Waluyo Wlingi Regional Hospital in the Period August-October 2025

Characteristics	Positive Control Group		Ball Squeezing Therapy Group		Warm Compress Group		Total	
	(F)	(%)	(F)	(%)	(F)	(%)	(F)	(%)
Age								
17-25	4	22.2	**7**	**38.9**	8	44.4	19	35.2
26-35	**8**	**44.4**	**7**	**38.9**	**9**	**50.0**	24	44.4
36-45	6	33.3	4	22.2	1	5.6	11	20.4
Total	18	100.0	18	100.0	18	100.0	54	100.00
Education Level								
Primary School	0	0.00	1	5.6	0	0.00	1	1.90
Junior High School	0	0.00	2	11.1	0	0.00	2	3.70
High School	**12**	**66.7**	**12**	**66.7**	**16**	**88.9**	40	74.10
Bachelor's Degree	6	33.3	3	16.7	2	11.1	11	20.40
Total	18	100.00	18	100.00	18	100.00	54	100.00
Occupation								
Private Sector	8	44.4	6	33.3	7	38.9	21	38.90
Self Employed	0	0.00	1	5.6	1	5.6	2	3.70
Housewife	**10**	**55.6**	**11**	**61.1**	**10**	**55.6**	31	57.40
Total	18	100.00	18	100.00	18	100.00	54	100.00
Surgical History								
Ever	5	27.8	6	33.3	6	33.3	17	31.40
Never	**13**	**72.2**	**12**	**66.7**	**12**	**66.7**	37	68.50
Total	18	100.00	18	100.00	18	100.00	54	100.00

Figure 1 shows a decrease in pain levels across all study groups, including the control group, the ball squeezing therapy group, and the warm compress group. In the control group, the decrease in pain levels did not show a significant change, with the average pain scale decreasing from 5.83 in the pre-test to 5.11 in observation 1, then decreasing to 4.56 in observation 2, and reaching 3.44 in the post-test.

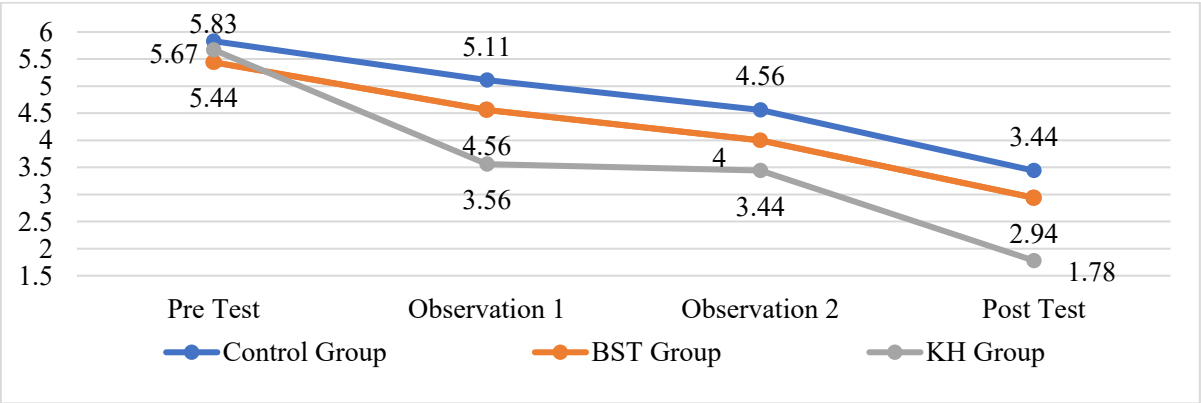

Figure 1. Graph of the Decrease in Pain Levels of Respondents of Post-SC Patients in the Dewi Kunthi Room, Ngudi Waluyo Wlingi Regional Hospital in the Period August-October 2025

In the ball squeezing therapy group, there was a greater decrease than in the control group, from 5.67 in the pre-test to 3.56 in observation 1, decreasing to 3.44 in observation 2, and reaching 2.94 in

the post-test. Meanwhile, the most significant decrease was seen in the warm compress group, where the average pain level decreased from 5.44 in the pre-test to 3.56 in observation 1, then decreased to 3.44 in observation 2, and reached 1.78 in the post-test.

Based on the description above, it can be concluded that the greatest reduction in pain levels occurred after treatment on the second day. However, since the first day of treatment, the pain level graph has shown a decrease in all groups, including the control group, the ball squeezing therapy group, and the warm compress group.

Table 2. Results of the Wilcoxon Signed Rank Test for Post-CS Patients in the Dewi Kunthi Ward, Ngudi Waluyo Wlingi Regional Hospital, August-October 2025

Variables	N	Min	Max	*Mean*	*Mean Difference*	*p-value*
Pre-test pain level control group	18	5	6	5.83	2.39	0.000
Post-test pain level control group	18	2	5	3.44		
Pre-test pain level for the ball squeezing therapy group	18	4	6	5.44	2.50	0.000
Post-test pain level for the ball squeezing therapy group	18	2	5	2.94		
Pre-test pain level for the warm compression group	18	5	6	5.67	3.89	0.000
Post-test pain level for the warm compression group	18	1	3	1.78		

Based on Table 2, in the control group receiving the deep breathing relaxation intervention (positive control group), the average pain level before the intervention was 5.83 and decreased to 3.44 after the intervention, with a mean difference of 2.39. The Wilcoxon test results showed a p-value of 0.000 ($p < 0.05$), indicating a significant difference between pain levels before and after deep breathing relaxation.

In the Ball Squeezing Therapy (BST) group, the average pain level before the intervention was 5.44 and decreased to 2.94 after the therapy, with a mean difference of 2.50. The p-value of 0.000 ($p < 0.05$) indicates a significant difference between the pre-test and post-test. Meanwhile, in the warm compress group, the average pain level before the intervention was 5.67 and decreased to 1.78 after the warm compress, with a mean difference of 3.89. A p-value of 0.000 ($p < 0.05$) indicates a significant difference between pain levels before and after warm compresses.

Table 3. Mann-Whitney Test Results in Post-CS Patients in the Dewi Kunthi Ward, Ngudi Waluyo Wlingi Regional Hospital, August-October 2025

Variables	N	Mean	Mean Difference	p-value
Post-test pain level in the positive control group	18	3.44	0.50	0.117
Post-test pain level in the ball squeezing therapy group	18	2.94		
Post-test pain level in the positive control group	18	3.44	1.66	0.001
Post-test pain level in the warm compress group	18	1.78		
Post-test pain level in the ball squeezing therapy group	18	2.94	1.16	0.001
Post-test pain level in the warm compress group	18	1.78		

Based on Table 3, the comparison between the positive control group and the ball squeezing therapy group showed average pain levels of 3.44 and 2.94, respectively, with a mean difference of 0.50. The Mann–Whitney test showed a p-value of 0.117 ($p > 0.05$), indicating no significant difference between the two groups. Furthermore, the comparison between the control group and the warm compress group showed average pain levels of 3.44 and 1.78, respectively, with a mean difference of 1.66. The

Mann–Whitney test yielded a p-value of 0.001 (p < 0.05), indicating a significant difference between the two groups. This indicates that warm compresses were more effective in reducing pain levels than deep breathing relaxation interventions. Meanwhile, the comparison between the ball squeezing therapy group and the warm compress group showed average pain levels of 2.94 and 1.78, respectively, with a mean difference of 1.16. The Mann–Whitney test showed a p-value of 0.001 (p < 0.05), indicating a significant difference between the two groups.

Table 4. Kruskal-Wallis Test Results in Post-CS Patients in the Dewi Kunthi Ward, Ngudi Waluyo Wlingi Regional Hospital, August-October 2025

Variables	N	*Mean*	*p-value*
Pre-test pain level control group	18	32.08	0.095
Pre-test pain level for the ball squeezing therapy group	18	22.75	
Pre-test pain level for the warm compression group	18	27.67	
Post-test pain level control group	18	37.75	0.000
Post-test pain level for the ball squeezing therapy group	18	31.33	
Post-test pain level for the warm compression group	18	13.42	

Based on Table 4, the Kruskal–Wallis test demonstrated that there was no statistically significant difference in baseline pain scores among the three groups at the pre-test assessment (p > 0.05), indicating comparable initial conditions. However, significant differences were observed at observation day 1, observation day 2, and post-test (p < 0.05). These findings indicate that the interventions produced different effects on pain reduction over time, supporting further pairwise comparisons using the Mann–Whitney U test to determine which intervention contributed to the observed differences.

DISCUSSION

Based on the research results presented in Table 2, it is known that there is a difference in effectiveness between ball squeezing therapy and warm compress therapy in reducing pain levels in post-cesarean section patients. In the group given ball squeezing therapy, the average pain level decreased from 5.44 before the intervention to 2.94 after the intervention, with a difference of 2.50 in the average reduction. Meanwhile, in the group given warm compresses, the average pain level decreased from 5.67 to 1.78, with a difference of 3.89 in the average reduction. Based on the paired two-sample test, it was shown that all groups had an influence on reducing pain (p-value = 0.000).

The reduction in pain between the control and warm compress groups averaged 1.66, with a p-value of 0.001 based on the Mann–Whitney U test, while the reduction in pain between the control and ball squeezing therapy groups averaged 0.50, with a p-value of 0.117 based on the Mann–Whitney U test. These findings indicate that all three interventions are effective in reducing post-cesarean section pain levels. However, warm compresses demonstrated superior effectiveness, both statistically and clinically, compared to deep breathing relaxation techniques and ball squeezing therapy.

The Kruskal–Wallis analysis further supports these findings. The absence of a significant difference at the pre-test confirms that the three groups had comparable baseline pain levels before receiving any intervention. In contrast, significant differences observed on day 1, day 2, and at the post-test indicate that the interventions exerted different effects on pain reduction throughout the study period. These results strengthen the internal validity of the study because the observed differences in pain reduction are more likely attributable to the interventions rather than to initial differences among the groups.

Based on the theories of pain memory and central sensitization, previous pain experiences can lead to increased pain sensitivity through emotional and sensory memory mechanisms stored in the central nervous system (Suwondo et al., 2017). With these pain memories, individuals tend to be more alert and have negative expectations about post-operative pain, thereby increasing sympathetic activity and exacerbating pain perception.

Theoretically, these differences in effectiveness can also be explained by the physiological mechanisms of each intervention. Ball squeezing therapy works by shifting the patient's focus from pain to light motor activity, which induces relaxation and reduces muscle tension (Septia et al., 2024). Meanwhile, warm compresses work through more complex physiological mechanisms, namely by

increasing local vasodilation, improving blood flow, accelerating the removal of inflammatory metabolic waste, and stimulating heat receptors that can inhibit pain impulses. According to the theory of Perry & Potter (2016), heat therapy has a strong analgesic effect because it activates heat receptors that compete with pain receptors in the central nervous system, providing a relaxing effect that increases patient comfort and decreases anxiety.

Warm compresses can cause vasodilation of blood vessels by increasing the intake of nutrients, leukocytes, and oxygen to the tissues, thereby reducing pain levels, decreasing muscle stiffness, minimizing inflammation, and accelerating soft tissue healing (Wahyuni and Nurhidayat, 2008) in ((Sari et al., 2019). One study also found that warm compresses work through conductive heat transfer, where the heat transferred to body tissues triggers vasodilation, thus optimizing blood flow, oxygen distribution, and nutrient delivery (Subekti, 2016 as cited in Puspita et al., 2023). Furthermore, applying warm compresses can reduce muscle tension, produce a relaxing effect, and ultimately contribute to a reduction in the patient's perception of pain.

These findings align with those of Aslan et al. (2025), who reported that distraction techniques effectively reduce postoperative pain, but the effect is more moderate than heat-based interventions because their influence is more dominant on the cognitive-distraction aspect than the physiological one. Other studies by Dwiningrum et al. (2020) and Iswani et al. (2024), also showed that heat therapy through warm compresses resulted in greater pain reduction and a longer-lasting analgesic effect than distraction therapy. The similarity of these results strengthens the empirical evidence that warm compresses have higher effectiveness in reducing pain than ball squeezing therapy, both through physiological and psychological mechanisms.

The sequential findings from the Kruskal–Wallis test also indicate that the therapeutic effects became more apparent after repeated intervention sessions. Although no difference existed before treatment, significant differences emerged from the first evaluation and persisted until the post-test. This pattern suggests that repeated application of the interventions progressively enhanced pain reduction, with warm compress therapy demonstrating the greatest clinical benefit among the three treatment groups.

Warm compresses are applied to the lower back or lumbosacral region because the spinal cord contains a collection of nerves that function as temperature receptors and transmit a warm sensation to the post-CS wound without needing to be applied directly to the incision site (Akbarzadeh et al., 2018; Hall, 2019). Based on these research findings and physiological mechanisms, the authors argue that warm compresses are more effective in reducing pain because the heat received through the spinal nerve pathways can quickly reach the inflamed area. Furthermore, warm compresses can theoretically accelerate vasodilation and increase tissue perfusion around the wound area, resulting in a more rapid reduction of inflammatory mediators such as prostaglandins and bradykinin, ultimately reducing the transmission of pain impulses. Meanwhile, ball squeezing therapy takes longer to produce a vasodilatory response because stimulation is performed on an area of the hand far from the source of inflammation. The mechanism of action of BST relies more on sensory distraction through stimulation of A-beta fibers, so the pain-reducing effect is not as rapid as interventions that work directly on physiological pathways near the wound.

Ball squeezing therapy works based on Gate Control Theory, stimulating A-beta fibers through pressure and muscle contractions in the hand to inhibit the transmission of pain impulses to the central nervous system. However, the effectiveness of this mechanism is greatly influenced by the psychological state and mental readiness of the patient. In patients with a history of surgery and who are likely to experience higher levels of anxiety, the pain modulation "gate" at the spinal level is not optimally closed, resulting in a less effective distraction effect.

On the other hand, relaxation has the ability to reduce pain more quickly than distraction because it works directly on the central nervous system. These effects can be even more rapid if relaxation techniques or heat stimulation are applied to areas closer to the pain site, as pain modulation responses can occur simultaneously through both peripheral and central pathways. Therefore, warm compresses and relaxation tend to be more effective than distraction.

The clinical implications of warm compress therapy and ball-squeezing therapy include a direct positive impact on patient-centered care and the acceleration of the mother's physical recovery following surgery. Both therapies have been proven effective in managing pain levels, thereby reducing anxiety.

The resulting sense of comfort and reduced pain intensity enable mothers to engage in early mobilization with confidence. This ability to move sooner directly supports successful breastfeeding initiation, strengthens the mother-infant bond, and accelerates recovery, ultimately shortening the hospital stay.

CONCLUSION AND SUGGESTION

Warm compress therapy has been proven to be the most effective therapy for reducing pain levels in post-cesarean section patients compared to ball squeezing therapy and deep breathing relaxation therapy. It is hoped that Ngudi Waluyo Wlingi Regional Hospital can implement warm compress interventions, especially after 8 hours post-surgery, as an effective non-pharmacological measure to help reduce pain levels in post-cesarean section patients.

REFERENCES

Akbarzadeh, M., Nematollahi, A., Farahmand, M., & Amooee, S. (2018). The Effect of Two-Staged Warm Compress on the Pain Duration of First and Second Labor Stages and Apgar Score in Prim Gravida Women : a Randomized Clinical Trial. *Tabriz University of Medical Sciences*, *7*(1), 21–26. https://doi.org/10.15171/jcs.2018.004

Aksoy, Y. E. (2025). The Effect of Hot Bag/Warm Application on Feet After Cesarean Delivery on Postpartum Comfort, Pain, and Flatus. *National Library of Medicine*.

Aryanti, D., & Fauziah, L. (2024). Asuhan Keperawatan Pada Ibu Post Sectio Caesarea Untuk Menurunkan Intensitas Nyeri Dengan Tindakan Foot Massage. *Journal of Baja Health Science*, *4*(01), 72–81. https://doi.org/10.47080/joubahs.v4i01.2870

Aslan, F., Tosun, B., Altınok Ersoy, N., & Ozen, N. (2025). The Effect of a Stress Ball on Pain and Anxiety During Sharp Debridement in Patients with Diabetic Foot Ulcers: A Randomized Controlled, Single-Blind Study. *Journal of Tissue Viability*, *34*(2), 0–5. https://doi.org/10.1016/j.jtv.2025.100861

Dinamiyanti, Wati, S. E., & Aizah, S. (2024). Penerapan Terapi Finger Hold (Genggam Jari) dengan Media Bola Squishy untuk Mengurangi Tingkat Nyeri Akut Pasien dengan Diagnosis Medis Post Sectio Caesarea di RS Muhammadiyah Ahmad Dahlan Kota Kediri. *Seminar Nasional Sains, Kesehatan, Pembelajaran 2024*, 476–484. https://doi.org/10.29407/y3b64529

Dinkes Jatim. (2020). Statistik Kesehatan Provinsi Jawa Timur 2020. In *Laporan Provinsi Jawa Timur 2020* (Vol. 11, Issue 1).

Dwiningrum, E., Wahyuni, N. S., & Isro'in, L. (2020). Efektivitas Kompres Hangat Terhadap Perubahan Tingkat Nyeri Pada Pasien Post Operasi Turp Di Ruang Rawat Inap Rsi Siti Aisyah Madiun. *Health Sciences Journal*, *4*(1), 43. https://doi.org/10.24269/hsj.v4i1.402

Giordano, N. A., Kent, M. L., Kroma, R. B., Rojas, W., Lindl, M. J., Lujan, E., Buckenmaier, C. C., & Highland, K. B. (2023). Acute Postoperative Pain Impact Trajectories and Factors Contributing to Trajectory Membership. *Pain Medicine*, *24*(7), 829–836. https://doi.org/10.1093/pm/pnac203

Hall. (2019). *Guyton and Hall Textbook of Medical Physiology* (J. E. Hall (ed.); 13 th). Beijing da xue yi xue chu ban she.

Iswani, R., Ernita, E., & Erlina, E. (2024). Efektivitas Aromaterapi Lemon dan Kompres Hangat terhadap Nyeri Post SC di RSIA ABBY Kota Lhokseumawe. *MAHESA : Malahayati Health Student Journal*, *4*(6), 2230–2239. https://doi.org/10.33024/mahesa.v4i6.14377

Kaur, J., Sheoran, P., Kaur, S., & Sarin, J. (2020). Effectiveness of Warm Compression on Lumbo-Sacral Region in Terms of Labour Pain Intensity and Labour Outcomes among Nulliparous Women: An Interventional Study. *Journal of Caring Sciences*, *9*(1), 9–12. https://doi.org/10.34172/jcs.2020.002

Kemenkes RI. (2018). Laporan Nasional Riskesdas 2018. In *Laporan Nasional Riskesdas 2018* (Vol. 44, Issue 8).

Kemenkes RI. (2023). Survei Kesehatan Indonesia (SKI) tahun 2023. *Laporan Nasional SKI 2023*, 1–68.

Perry, & Potter. (2016). *Buku Ajar Fundamental Keperawatan: Konsep, Proses dan Praktik* (Vol 2). Elsevier Health Sciences.

Puspita, T., Widadi, S. Y., Alfiansyah, R., Rilla, E. V., Octavia, D., & Estria, S. (2023). Pengaruh kompres hangat terhadap nyeri pada penderita hipertensi. *Jurnal Kesehatan Dan Kedokteran*, *2*(1),

8–11. https://doi.org/10.56127/jukeke.v2i1.514

Rohmawati, D. L., Nisak, R., & Lukitaningtyas, D. (2025). *Kompres Hangat dalam Penatalaksanaan Hipertensi : Inovasi Berbasis Bukti* (1st ed.). Nuansa Fajar Cemerlang.

Sari, D. P., Supardi, & Hamranani, S. S. T. (2019). Efektivitas Foot Massage dan Kompres Hangat terhadap Nyeri Post Operasi Sectio Caesarea di Rumah Sakit Islam Klaten. *Jurnal Ilmu Kesehatan*, *14*(01), 93–112. https://doi.org/10.61902/motorik.v14i1.19

Septia, F., Lili, F., & Emil, H. (2024). *Latihan Genggam Bola Karet pada Pasien Penyakit Ginjal Kronik (PGK) Post-Operasi AV Shunt Hemodialisis* (1st ed.). Eureka Media Aksara.

Sulistyo, A. (2016). *Konsep & Proses Keperawatan Nyeri*. Ar-Ruzz.

Sun, R., Huang, J., Zhu, X., Hou, R., Zang, Y., Li, Y., Pan, J., & Lu, H. (2024). *Effects of Perineal Warm Compresses during the Second Stage of Labor on Reducing Perineal Trauma and Relieving Postpartum Perineal Pain in Primiparous Women: A Systematic Review and Meta-Analysis*. *12*(7). https://doi.org/10.3390/healthcare12070702

Suwondo, B., Lucas, M., & Sudadi. (2017). *Buku Ajar Nyeri*. Perkumpulan Nyeri Indonesia.

Wahyu, & Lina, L. (2019). Terapi Kompres Hangat dengan Jasmine Essential Oil terhadap Penurunan Intensitas Nyeri pada Pasien Post Sectio Caesarea. *Journal of Telenursing (JOTING)*, *11*(2). https://doi.org/10.31539/joting.v1i2.860

WHO. (2021). C-Section Rates Continue to Rise Amid Growing Inequalities in Access. *WHO News Item*.

Xu, J., Liu, X., Zhao, J., Li, H., Ye, H., & Ai, S. (2025). Comprehensive Review on Personalized Pain Assessment and Multimodal Interventions for Postoperative Recovery Optimization. *Journal of Pain Research*, *18*, 2791–2804. https://doi.org/10.2147/JPR.S516249