

Modified Dry Cupping for Back Pain in Older Adults: A Nursing Innovation in Complementary Therapy

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ABSTRACT

Background: Back pain is a common musculoskeletal problem among older adults, leading to reduced mobility, loss of independence, and decreased quality of life. Although dry cupping therapy has been shown to alleviate pain, its conventional application requires therapist supervision, limiting accessibility for the elderly. **Objectives:** This study aimed to evaluate the effectiveness of a modified dry cupping therapy device with an automatic control system as an innovative complementary nursing intervention for reducing back pain and promoting self-care in older adults. **Methods:** A quasi-experimental two-group pretest–posttest design was conducted with 102 elderly participants in Kendari City, divided equally into an intervention and control group (n = 51 each); the analysis used a paired-sample *t*-test. **Results:** At baseline, both groups reported moderate back pain (intervention: mean = 5.12 ± 0.52; control: mean = 5.10 ± 0.36). Following the intervention, the intervention group demonstrated a significant reduction in pain intensity (mean = 2.76 ± 0.65, *p* < 0.001, Cohen's *d* = 4.01), with 98% of participants reporting mild pain. In contrast, the control group showed no significant change (mean = 5.10 ± 0.36, *p* = 1.000). The between-group comparison confirmed a significant difference (mean difference = 2.34, 95% CI: 2.13–2.55, *p* < 0.001). **Conclusion:** Modified dry cupping therapy with an automatic control system is an effective, safe, and practical complementary nursing intervention for reducing back pain in older adults. This innovation supports self-care independence and may be integrated into community and gerontological nursing practices.

Keywords: Back Pain; Modified Dry Cupping Therapy; Nursing Innovation; Older Adult

INTRODUCTION

Back pain is one of the most common musculoskeletal problems among older adults and can significantly reduce quality of life by limiting mobility, impairing daily activities, and increasing dependency (Davis *et al.*, 2023). In Indonesia, back pain remains a major health complaint among older adults, contributing to mobility limitations and functional decline (Kemenkes BKPK, 2023). Data from the 2023 Indonesian Health Survey showed that 10.2% of adults aged 55–59 years experienced mobility impairment, while musculoskeletal complaints continue to increase in several regions, including Southeast Sulawesi and Kendari City (Badan Pusat Statistik Provinsi Sulawesi Tenggara (BPS-Sultra), 2024; Kemenkes BKPK, 2023).

Back pain is a widespread condition that can significantly affect quality of life in older adults, leading to limited mobility, impaired daily activities, and an increased risk of health complications. Its prevalence has been reported at 65–90% annually, with approximately 25 million older adults affected worldwide (Saes-Silva *et al.*, 2021). In the United States, the incidence of back pain increases with age (Mu *et al.*, 2022), while in

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Brazil, around 70% of the elderly experience musculoskeletal complaints associated with pain (Queiroz *et al.*, 2022). Globally, the number of back pain sufferers is projected to reach 1.5 billion by 2025 (Koivunen *et al.*, 2023), including a substantial burden in Indonesia.

Back pain most commonly occurs among individuals aged 30 to 60 years and above and is exacerbated by factors such as occupational posture, body weight, and sex (Habir & Sani, 2023; Li *et al.*, 2025). If left untreated, this condition may lead to sleep disturbances, reduced quality of life, restricted mobility, and decreased productivity (Ginnerup-Nielsen *et al.*, 2022; Yabe *et al.*, 2022). Therefore, effective and practical therapeutic approaches are urgently needed to address back pain in the elderly.

Several interventions have been utilized to manage back pain, including pharmacological therapy, exercise, yoga, acupuncture, and cupping therapy. Previous studies by Shen *et al.* (2022) demonstrated that cupping therapy is effective in reducing pain among patients with Low Back Pain (LBP) (Shen *et al.*, 2022). Another study examined the effectiveness of cupping therapy in alleviating LBP among university lecturers. One form of this treatment is dry cupping therapy, which provides relaxation and comfort in painful musculoskeletal areas (Lisnawati *et al.*, 2024; Naleem *et al.*, 2024). However, the application of this therapy typically requires therapist supervision, which may become a physical and financial burden for older adults and their caregivers.

Conventional management of back pain commonly involves pharmacological therapy, physiotherapy, and medical procedures (Bertelmann *et al.*, 2021). However, these approaches may be costly, less accessible in resource-limited settings, and associated with side effects from long-term medication use, particularly in older adults (Andas *et al.*, 2026). Therefore, safe, affordable, and practical complementary therapies are needed to support independent pain management among older adults (Zhu *et al.*, 2023). Dry cupping therapy has been widely reported as an effective complementary intervention for reducing low back pain and improving comfort in musculoskeletal disorders (Lisnawati *et al.*, 2024). Nevertheless, conventional dry cupping generally requires therapist supervision and manual pressure adjustment, which may limit its feasibility for independent home use among older adults (Ampiah *et al.*, 2024).

This study introduces a modified dry cupping therapy device equipped with an automatic control system. The innovation includes automated suction pressure regulation to maintain stable and consistent negative pressure, reduce human error, and improve patient safety and comfort during therapy. In addition, the device is designed to be simple and practical, enabling older adults or caregivers to perform therapy independently at home without continuous professional supervision. This modification also has the potential to reduce healthcare costs and improve accessibility to complementary pain management services.

Although previous studies have demonstrated the effectiveness of cupping therapy for back pain, limited research has focused on the development of technology-assisted, self-administered dry cupping devices specifically designed for older adults. Therefore, this study aims to evaluate the effectiveness of a modified dry cupping therapy device with an automatic control system in reducing back pain among older adults.

METHODOLOGY

The feasibility test of the modified dry cupping therapy based on an automatic control system was conducted through a series of technical, functional, and clinical evaluations to ensure accuracy, reliability, safety, and therapeutic effectiveness.

The technical assessment showed that the pressure control system achieved the target setpoint with an accuracy of $\pm 8\%$ and an average pressure fluctuation of $\leq 5\%$, with a settling time of less than 25 seconds and an overshoot below 10%, thereby meeting the therapeutic stability standards. The safety interlock feature functioned effectively, responding within ≤ 2 seconds under overpressure conditions or sensor failures. In

addition, the data logging system successfully recorded 100% of session data without file loss.

A quasi-experimental design with a two-group pretest–posttest approach was utilized to evaluate the effectiveness of the modified Dry Cupping Therapy with an automatic control system in reducing back pain among older adults (Fety *et al.*, 2023).

Sampling and Randomization

Participants were divided into two groups: an intervention group and a control group, with the following sample sizes (Zou & Xu, 2023).

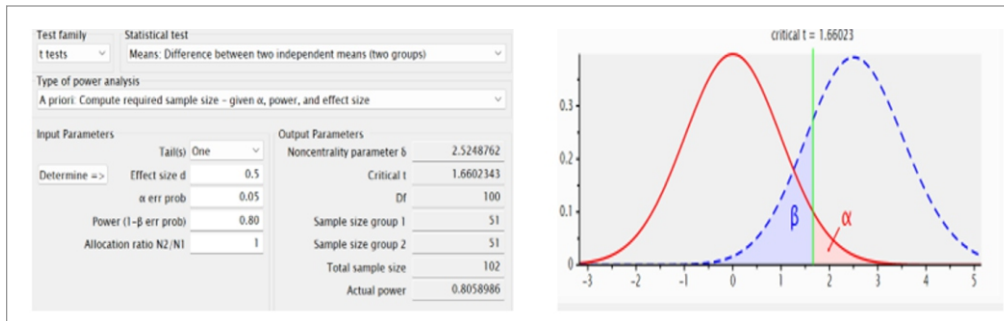


Figure 1: G*Power Sample Size of the Study

The sample size calculation was performed using G*Power for a study design comparing two independent groups (*difference between two independent means*). An independent *t*-test with *a priori* analysis was applied to determine the minimum required sample size before conducting the study (Purnamasari *et al.*, 2025). The input parameters included an effect size of 0.5, indicating a medium effect, a significance level (α) of 0.05, and a statistical power of 0.80 (80%). A one-tailed test with an equal allocation ratio between groups (1:1) was also used. The analysis indicated that the minimum required sample size was 102 participants, consisting of 51 participants in the intervention group and 51 participants in the control group.

Sampling was conducted using a simple random sampling technique to ensure that each eligible older adult had an equal opportunity to be selected as a participant (Aleessawi, 2026). Initially, a list of older adults diagnosed with back pain was obtained from records at the community health center. Each potential participant was assigned a unique identification number, and the selection process was performed using a computer-based random number generator (Politano *et al.*, 2022). Participants who met the inclusion criteria, including older adults without communication barriers and those willing to participate until the end of the study, were recruited. A total of 102 eligible participants were subsequently allocated into the intervention group and the control group ($n = 51$ each) using a computer-generated randomization list. This randomization procedure was conducted to minimize selection bias and ensure comparability of demographic and clinical characteristics between the two groups (Khan *et al.*, 2023).

The intervention group received modified dry cupping therapy using a device equipped with an automatic control system. The therapy was administered for a total duration of three minutes. During the procedure, suction was applied to the skin surface for 20 seconds, followed by a 10-second relaxation period, and this cycle was repeated continuously for three minutes. All therapy parameters, including suction duration and relaxation intervals, were pre-set and automatically regulated by the modified dry cupping device to ensure consistent pressure and patient safety. Meanwhile, the control group did not receive any intervention during the study period and only underwent pain observation. For ethical considerations, the control group was offered the intervention after the study was completed.

Pain intensity was assessed using the Visual Analog Scale (VAS), a subjective measurement tool widely used to evaluate pain intensity (Koo & Yang, 2025). The VAS score ranged from 0 to 10, where 0 indicated “no pain” and 10 represented “worst pain imaginable” (Pelawati *et al.*, 2022). In addition, observation sheets were used to document participant progress and monitor responses during the intervention.

Pain assessments were conducted at baseline (pretest) and after the intervention (posttest). The collected data was analyzed using the paired sample *t*-test to compare pretest and posttest pain scores within each group.

Ethical Consideration

This study was approved by the Research Ethics Committee of Universitas Bani Saleh, Indonesia, with reference number 223/II.1.AU/KET.ETIK/VIII/2021, on 24th June 2025.

RESULTS

This study involved 102 elderly respondents experiencing back pain. The characteristics of the study respondents are as follows:

A. Characteristics of Respondents

Table 1: Distribution of Respondents Based on Respondent Characteristics

Variable	Category	Intervention Group (51)		Control Group (51)	
		<i>f</i>	%	<i>f</i>	%
Age	50-59 yrs	28	54.9	22	43.1
	60-69 yrs	14	27.5	17	33.3
	70-79 yrs	7	13.7	12	23.5
	>79 yrs	2	3.9	0	0
Total		51	100	51	100
Gender	Male	13	25.5	12	23.5
	Female	38	74.5	39	76.5
Total		51	100	51	100
Education	No formal education	0	0	0	0
	Primary School	1	2.0	1	2.0
	Junior High School	0	0	4	7.8
	Senior High School	37	72.5	36	70.6
	Higher Education	13	25.5	10	19.6
Total		51	100	51	100
Occupation	Homemaker	33	64.7	34	66.7
	Civil Servant	6	11.8	3	5.9
	Self-employed	6	11.8	5	9.8
	Retired	5	9.8	4	7.8
	Unemployed	1	2.0	5	9.8
Total		51	100	51	100

This study involved 102 participants aged 50 years and older experiencing back pain. Table 1 presents the distribution of demographic characteristics. In the intervention group, the majority of participants were aged 50–59 (54.9%), predominantly female (74.5%), with secondary education or higher (97.5%), and mostly homemakers (64.7%). The control group showed similar demographic patterns, with 43.1% aged 50–59 years, 76.5% female, 90.2% having secondary education or higher, and 66.7% being homemakers. No statistically significant differences were observed between groups for any demographic variable (*p* > 0.05), indicating successful randomization and group comparability.

B. Back Pain

Table 2: Back Pain Scale in Older Adult before and after Intervention

Back Pain	Intervention (51)				Control (51)			
	Pretest		Posttest		Pretest		Posttest	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Mild (1-3)	0	0	50	98	0	0	0	0
Moderate (4-6)	51	100	1	2.0	51	100	51	100
Severe (7-10)	0	0	0	0	0	0	0	0
Mean	5.12		2.76		5.10		5.10	
Standard Deviation	0.516		0.651		0.361		0.361	
Minimum	4		1		4		4	
Maximum	7		5		6		6	

Table 2 presents the distribution of back pain intensity before and after the intervention. At baseline, all participants in both groups reported moderate back pain (intervention: mean = 5.12 ± 0.52 ; control: mean = 5.10 ± 0.36). No participants in either group reported mild or severe pain at baseline. Following the intervention, the intervention group demonstrated a marked improvement, with 98.0% of participants shifting to the mild pain category and only 2.0% remaining in the moderate category. No participants reported severe pain. The mean pain score decreased substantially from 5.12 ± 0.52 to 2.76 ± 0.65 . In contrast, the control group showed no change in pain distribution, with 100% remaining in the moderate category (mean = 5.10 ± 0.36 at both measurements).

C. Effect of Modified Dry Cupping Therapy Using an Automatic Control System on Back Pain in the Elderly

Table 3: Effect of Modified Dry Cupping Therapy on Back Pain in Older Adult

Group		Mean	SD	95% Confidence Interval		<i>t</i>	<i>P</i> -value	<i>Cohen's d</i>
				Lower	Upper			
Intervention (51)	Pretest	5.12	0.52	2.152	2.554	23.462	<0.001	4.01
	Posttest	2.76	0.65					
Control (51)	Pretest	5.10	0.36	-0.056	0.056	0.128	1.000	4.01
	Posttest	5.10	0.36					
Between Group Comparison		Mean diff	-	2.13	2.55	22.49	<0.001	4.45

Table 3 presents the statistical analysis of the intervention effect. In the intervention group, the paired-sample *t*-test revealed a significant reduction in pain intensity (mean difference = -2.36, 95% CI: -2.53 to -2.19, $t = 23.46$, $p < 0.001$). The effect size was very large (Cohen's $d = 4.01$, 95% CI: 3.20-4.82). In the control group, no significant change was observed (mean difference = 0.00, 95% CI: -0.06 to 0.06, $t = 0.13$, $p = 1.000$). The independent *t*-test comparing the mean differences between groups confirmed a significant between-group effect (mean difference = 2.34, 95% CI: 2.13-2.55, $t = 22.49$, $p < 0.001$). The very large between-group effect size (Cohen's $d = 4.45$) underscores the strong therapeutic impact of the modified dry cupping intervention.

DISCUSSION

The findings of this study demonstrate that *modified dry cupping therapy with an automatic control system* was highly effective in reducing back pain among older adults. In the intervention group, almost all participants (98%) experienced a significant decrease in pain intensity in the mild category, whereas in the control group, pain levels remained largely unchanged. The mean back pain score in the intervention group decreased from 5.12 ± 0.52 at pretest to 2.76 ± 0.65 at posttest ($p < 0.001$), while the control group showed no significant difference (5.10 ± 0.36 at both measurements, $p = 1.000$). This clear contrast indicates that the intervention, not time or placebo effect, was responsible for the substantial reduction in pain.

The contrast between groups is consistent with findings by Chiu *et al.* (2020), who reported that dry cupping effectively alleviated soft tissue pain in athletes. Similarly, Lisnawati *et al.* (2024) found that cupping therapy significantly reduced lower back pain among lecturers. However, unlike conventional dry cupping, participants in the control group of this study who received no such intervention did not experience measurable pain relief (Lisnawati *et al.*, 2024). The present findings reinforce this evidence by demonstrating that incorporating an automatic control system makes cupping therapy more practical, safe, and feasible for home use without requiring supervision from healthcare professionals.

Physiologically, dry cupping reduces pain through several mechanisms (Xu *et al.*, 2025). First, the suction process applied to the skin increases blood circulation and tissue oxygenation, thereby reducing local ischemia, which is often a major cause of muscle pain (Dergaa *et al.*, 2024). Second, the mechanical stimulation of negative pressure can activate the gate control theory of pain by engaging A-beta nerve fibers that inhibit pain signal transmission to the brain, thus lowering pain perception. Third, dry cupping stimulates the release of endorphins and other endogenous analgesic neurotransmitters that act as natural pain modulators (Silva *et al.*, 2022). Fourth, improved microcirculation assists in the clearance of pain-inducing metabolites such as lactic acid, thereby accelerating tissue recovery (Pinto *et al.*, 2026). Among older adults, who are

generally prone to musculoskeletal degeneration, these mechanisms are particularly beneficial as they help relieve pain without the additional pharmacological burden (Zhang *et al.*, 2024).

The statistically significant difference between the intervention and control groups underscores the potential of modified dry cupping therapy as a clinically effective complementary intervention for managing back pain in older adults. Unlike pharmacological treatments, which can cause adverse effects with long-term use, the therapy offers a safe, non-pharmacological alternative. These findings align with those of Li *et al.* (2025), who emphasized the value of complementary therapies in improving the quality of life among older adults with musculoskeletal disorders.

The pain-reducing effect of the modified dry cupping therapy is closely related to the working mechanism of its automatic control system. The device operates by generating controlled negative pressure through a programmed suction-relaxation cycle, in which suction is applied for 20 seconds followed by a 10-second release phase. This rhythmic pressure modulation creates repeated mechanical stimulation on the skin and underlying soft tissues, promoting intermittent vasodilation and improving local blood perfusion. The cyclic suction also facilitates muscle decompression, reduces tension in paraspinal muscle fibers, and decreases localized stiffness commonly associated with back pain (Jan & Cheung, 2026). Furthermore, the alternating negative pressure stimulates cutaneous mechanoreceptors, which modulate nociceptive signal transmission through spinal inhibitory pathways, thereby reducing pain perception. The automated regulation ensures that pressure remains constant within a safe therapeutic threshold, preventing excessive tissue strain while maximizing physiological responses that contribute to analgesia and muscular relaxation.

Moreover, this innovation addresses key limitations of traditional cupping therapy. The integration of an automatic control system ensures stable suction pressure, reduces human error, and improves user comfort (Tankha *et al.*, 2024). This is particularly relevant for community-dwelling older adults, as shown by the control group results, where the absence of intervention maintained persistent pain levels. Therefore, this innovation not only provides clinical benefits but also supports the global trend toward home-based and self-managed care, especially in regions with limited healthcare resources (da Silva *et al.*, 2025).

The findings of this study have important implications for nursing practice, particularly in the field of community and gerontological nursing. The modified dry cupping therapy with an automatic control system can be applied as a complementary, non-pharmacological intervention that supports pain management in older adults. From a nursing perspective, the device not only reduces pain intensity but also promotes self-care and independence, which are key elements in elderly care.

Limitations

This study has several limitations that should be acknowledged. The quasi-experimental design limited the ability to control for all potential confounding factors compared to a randomized controlled trial. The intervention was conducted in a single geographic area (Kendari City), which may limit the applicability of the findings to broader populations with different cultural or health system contexts. Pain intensity was assessed using a subjective self-reported tool (VAS), which, although widely accepted, may be influenced by individual perception and reporting bias. This study only focused on short-term outcomes and did not evaluate long-term effects, such as recurrence of pain, functional improvement, or quality-of-life changes over time.

Future Scope

Future research should focus on conducting larger multi-center trials to validate the effectiveness and safety of the modified dry cupping device across different elderly populations and settings. Further development of the device's design, such as incorporating digital monitoring, pressure sensors, or mobile-based control systems, could enhance usability and precision. Additionally, qualitative studies exploring user satisfaction, adherence, and cost effectiveness would better understand the feasibility of implementing this innovation in routine nursing practice.

CONCLUSION

This study concludes that modified dry cupping therapy with an automatic control system is an effective

complementary nursing intervention for reducing back pain in older adults. The therapy supports independence, is safe for home use, and enhances quality of life by reducing reliance on long-term pharmacologic treatments. Nurses play an important role in education, initial supervision, and evaluation of therapy outcomes, so this intervention can be integrated into community and gerontological nursing practice.

CRedit Authorship Contribution Statement

L.L: Conceptualization, Methodology, Writing – original draft, Project administration. N.N: Formal analysis, Investigation, Data Curation. D.K.S: Supervision, Writing – Review and Editing. A.P: Investigation, Resources. A.M.A: Software, Data Curation. I.W.R: Validation, Visualization.

AI Assistance Declaration

During the preparation of this manuscript, the authors used ChatGPT, a generative AI tool, to assist with language translation from Indonesian to English and for grammar correction and proofreading. After using this tool, all authors thoroughly reviewed and revised the content and take full responsibility for the final version of the manuscript. No other AI tools were used for data analysis, interpretation, or drawing scientific conclusions.

Conflict of Interest

The authors declare that they have no conflict interests.

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