



Celery Juice as a Gate Control Theory-Based Nursing Intervention for Chronic Pain in Hypertensive Older Adults

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ABSTRACT

Introduction: Chronic pain is a frequent yet under-recognized complication of hypertension, arising from persistent vascular stress, sympathetic overactivity, and impaired tissue perfusion. Although *Apium graveolens* (celery) has demonstrated antihypertensive and anti-inflammatory properties, evidence supporting its application as a community-based nursing intervention remains limited. This study evaluated the effect of home-administered celery juice on chronic pain and blood pressure among hypertensive older adults using the Gate Control Theory of Pain as the theoretical framework.

Methods: A quasi-experimental study employing a non-equivalent two-group pretest–posttest design was conducted at the Gadingrejo Community Health Center, Pasuruan City. Two hypertensive older adults meeting identical inclusion criteria were enrolled and received standardized nursing education and intervention recommendations. One participant adhered to the intervention, whereas the other did not. The intervention consisted of 200 mL of freshly prepared celery juice consumed one to two times daily for seven consecutive days in addition to standard nursing care. Pain intensity was measured using the Numeric Rating Scale (NRS), while blood pressure was assessed with a calibrated sphygmomanometer before and after the intervention.

Results: Both participants presented with baseline pain scores of 6 and blood pressure of 160/100 mmHg. After seven days, the adherent participant demonstrated a clinically meaningful reduction in pain to an NRS score of 3, accompanied by decreased blood pressure and improved functional comfort. In contrast, the non-adherent participant showed only a slight reduction in pain (NRS score of 5) with minimal change in blood pressure.

Conclusion: Regular consumption of celery juice, when combined with standard nursing care and sustained patient adherence, was associated with greater reductions in chronic pain and blood pressure among hypertensive older adults. These findings support celery juice as a safe, inexpensive, and feasible complementary nursing intervention for community hypertension management, although larger controlled studies are warranted to confirm its effectiveness.

KEYWORDS

Hypertension; Celery Juice; Chronic Pain; Gate Control Theory; Quasi-Experimental Nursing Care.

Received: 31 May 2026

Revised: 23 June 2026

Accepted: 08 July 2026

How to cite: Fithria, Zahrotul et al. (2026). Celery Juice as a Gate Control Theory-Based Nursing Intervention for Chronic Pain in Hypertensive Older Adults. *Inovasi Lokal: Keberdayaan Masyarakat dalam Pembangunan Berkelanjutan*. 4(1): 36-44.





INTRODUCTION

Hypertension continues to rank among the most pervasive yet insidious threats to global health, silently reshaping the cardiovascular system long before it produces overt symptoms (Liu et al., 2025; Rad, Moohebaty, & Mohajeri, 2022b). Sustained elevation in arterial pressure does more than endanger the heart and kidneys; it also inflicts a frequently overlooked toll on the nervous system, expressed clinically as chronic pain (Agustin & Addelia, 2026). As blood vessel walls are repeatedly stretched and sympathetic nervous system activity intensifies, tissue perfusion becomes persistently compromised, generating headaches, shoulder pain, neck stiffness, and discomfort that linger for months rather than days. What begins as a hemodynamic disorder therefore evolves into a chronic pain syndrome that erodes patients' quality of life long after a single blood pressure reading would suggest.

The scale of this dual burden in Indonesia is striking. The 2023 Indonesian Health Survey (SKI) reported a hypertension prevalence of 30.8% among adults aged 18 and above, rising to 64% among older adults - a population already vulnerable to multiple comorbidities (Oktarina & Rahmawaty, 2022). Compounding this burden, more than half of patients with hypertension report pain concentrated in the head, neck, and back, and several studies document moderate-to-severe pain rated 6–8 out of 10 accompanied by blood pressure readings above 140/90 mmHg (Uddin et al., 2021). Left unmanaged, this combination of elevated pressure and chronic pain disrupts daily activity and sleep quality and heightens the risk of cardiovascular complications underscoring that pain and pressure are not separate problems to be treated in isolation, but a single physiological cascade that demands integrated nursing management (Wu et al., 2021).

Contemporary nursing practice increasingly recognizes that pharmacological antihypertensive therapy alone rarely resolves this cascade, prompting growing interest in nonpharmacological adjuncts capable of interrupting the pain–pressure cycle at its source. Celery (*Apium graveolens*) has emerged as one such adjunct: its juice is rich in apigenin, flavonoids, apiin, potassium, magnesium, and phthalides, bioactive compounds associated with vasodilation, reduced vascular resistance, and dampened sympathetic outflow, thereby contributing to blood pressure reduction (Alobaidi & Saleh, 2024; Che et al., 2021; Mondal et al., 2022). The plausibility of translating this hemodynamic effect into pain relief is best explained through Melzack and Wall's Gate Control Theory, which frames pain perception as the product of a dynamic interplay between peripheral nociceptive input and central nervous system modulation (Azizah et al., 2020). Within this framework, prolonged hypertension amplifies the transmission of pain impulses, whereas a reduction in blood pressure narrows the physiological 'gate' through which these impulses travel toward the spinal cord, thereby dampening the pain signal itself and enhancing patient comfort. Celery juice, then, is not merely a folk remedy but a physiologically grounded intervention with a testable theoretical mechanism.

This theoretical promise, however, has rarely been examined through structured, comparative nursing evaluation at the community level. A preliminary assessment conducted in the service area of the Gadingrejo Community Health Center, Pasuruan City,



in February 2026 identified 673 older adults living with hypertension over the preceding year, among whom chronic pain was one of the most frequently voiced complaints. Yet these patients had limited access to nursing interventions that are simple enough to be self-administered at home, affordable, and grounded in an explicit theoretical rationale (Kusumawati & Pranata, 2025). This gap motivated the present study, which was designed to evaluate, through a quasi-experimental nursing approach, the effect of home-administered celery juice on chronic pain and blood pressure among hypertensive patients in the Gadingrejo Community Health Center service area, and to interpret the resulting evidence through the lens of the Gate Control Theory of pain (Fariji et al., 2025; Nuraini et al., 2025).

MATERIALS AND METHODS

Research Design

This study employed a quasi-experimental, non-equivalent two-group pretest–posttest design, comparing chronic pain and blood pressure outcomes between a hypertensive patient who adhered to a celery juice regimen and one who did not. Because treatment exposure followed observed patient adherence rather than random allocation, this report follows the recommendations of the TREND (Transparent Reporting of Evaluations with Nonrandomized Designs) statement, the EQUATOR Network-endorsed guideline for nonrandomized intervention studies, so that participant selection, intervention delivery, and outcome assessment are documented transparently.

Setting and Duration

The study was conducted in the service area of the Gadingrejo Community Health Center, Pasuruan City, over seven consecutive days in May 2026.

Participants and Sampling

Two hypertensive patients experiencing chronic pain were recruited using purposive sampling based on predetermined criteria. Inclusion criteria were: hypertension with chronic pain lasting more than three months, age over 60 years, receiving home-based care, willingness to participate, and ability to communicate effectively. Exclusion criteria were a history of severe gastritis, kidney failure, or allergy to celery (*Apium graveolens*). Both patients received identical health education and an identical offer of the celery juice intervention; Patient 1 consumed the juice regularly as recommended across all seven days (adherent group), while Patient 2 received the same education and intervention but did not consume the juice consistently, most often due to forgetfulness and dislike of the taste (non-adherent comparison group). Both patients continued routine antihypertensive medical therapy and standard nursing care throughout the study.

Sequence of Activities

Day 1 (baseline/pretest) began with informed consent, followed by a comprehensive nursing assessment covering patient identity, medical history, pain characteristics, and functional status, together with screening for celery allergy. Pretest measurements of pain intensity (NRS) and vital signs (blood pressure, pulse, respiratory rate) were then recorded, after which individualized education was delivered on hypertension pathophysiology and the rationale, preparation, and expected benefits of celery juice. During the intervention phase spanning Day 1 through Day 7, 200 mL of celery juice - prepared by blending 100 grams of fresh celery leaves with 250 mL of boiled





water without added sweeteners was administered 1–2 times daily, accompanied by daily monitoring of vital signs and pain scores and ongoing pain-management support delivered in accordance with the Indonesian Nursing Intervention Standards (SIKI) for pain (PPNI, 2018). On Day 7 (posttest/evaluation), pain and blood pressure were reassessed, and outcomes were synthesized using the SOAP (Subjective, Objective, Assessment, Planning) approach.

Instruments

Pain intensity was measured using the Numeric Rating Scale (NRS, range 0–10), and blood pressure was measured using a calibrated sphygmomanometer.

Data Analysis

Data were analyzed descriptively by comparing pretest and posttest pain scores and blood pressure within each patient and between the two groups, presented in both narrative form and daily progress tables to illustrate differences in response between the adherent and non-adherent patient.

Ethical Considerations

This study adhered to research ethics principles, including informed consent, anonymity, and confidentiality of respondent data; all data collected were used solely for research and scientific reporting purposes while protecting participant privacy.

RESULTS AND DISCUSSION

Patient 1 was a 60-year-old woman with a medical diagnosis of hypertension persisting for more than three years. At the pretest assessment (Day 1), she reported shoulder pain radiating to the back of her head that had lasted more than three months, with a pain score of 6 (moderate); her blood pressure was 160/100 mmHg, pulse 84 beats per minute, and respiratory rate 20 breaths per minute. Having consumed 200 mL of celery juice 1–2 times daily throughout the seven-day intervention as recommended, her posttest (Day 7) pain score declined to 3 (mild), accompanied by a downward trend in blood pressure, greater comfort, and improved ability to perform daily activities.

Patient 2, a 62-year-old woman with the same diagnosis and an identical pretest presentation - chronic shoulder-to-occipital pain, NRS score of 6 (moderate), and blood pressure of 160/100 mmHg - received the same education and intervention offer but did not consume celery juice consistently, most often due to forgetfulness and dislike of its taste. By posttest (Day 7), her pain had declined only to a score of 5 (moderate), with blood pressure remaining largely unchanged and shoulder and occipital discomfort persisting through the end of the evaluation period.

Table 1 presents the day-by-day pain trajectory of both patients across the seven-day observation period



Day	Patient 1 (Adherent to Celery Juice) – NRS Score	Pain Category	Patient 2 (Non-Adherent) – NRS Score	Pain Category
1	6	Moderate	6	Moderate
2	6	Moderate	6	Moderate
3	5	Moderate	6	Moderate
4	5	Moderate	5	Moderate
5	4	Mild	5	Moderate
6	4	Mild	5	Moderate
7	3	Mild	5	Moderate

Table 2 summarizes the pretest–posttest comparison used to evaluate intervention effect

Variable	Patient 1 (Adherent) Pretest (Day 1) → Posttest (Day 7)	Patient 2 (Non-Adherent) Pretest (Day 1) → Posttest (Day 7)	Direction of Change
Pain intensity (NRS 0–10)	6 → 3	6 → 5	Greater reduction in adherent patient
Pain category	Moderate → Mild	Moderate → Moderate	Category shift only in adherent patient
Blood pressure (mmHg)	160/100 → trending downward	160/100 → largely unchanged	Decline observed mainly with regular consumption
Functional comfort	Improved; better tolerance of daily activity	Persistent shoulder/occipital discomfort	Improved only in adherent patient

The pretest–posttest comparison indicates that regular consumption of celery juice was associated with a clinically meaningful reduction in pain intensity - a full two-category shift from moderate to mild - whereas irregular consumption produced only a marginal decline



that remained within the moderate category. This differential response is plausibly explained at two complementary levels. Physiologically, the bioactive compounds in celery, including apigenin, flavonoids, apiin, potassium, magnesium, and phthalides, are understood to promote vasodilation and reduce vascular resistance, thereby lowering blood pressure this reduction in vascular workload appears to translate directly into reduced pain, aligning with the Gate Control Theory proposed by Melzack and Wall (Haryati et al., 2022; Illes, 2021). According to this theory, pain perception results from the balance between peripheral nociceptive stimulation and central nervous system modulation; sustained hypertension amplifies the transmission of pain impulses through the spinal 'gate,' whereas a reduction in blood pressure narrows that gate, diminishing the volume of pain impulses reaching the central nervous system and, consequently, the intensity of pain experienced (Indrawati & Yulianto, 2023; Mou et al., 2024). Patient 1's trajectory - a steady decline in both categories over seven days as the intervention was sustained - mirrors this proposed mechanism almost linearly, while Patient 2's plateau at a moderate score is consistent with insufficient and irregular vasodilatory stimulus to meaningfully narrow the pain gate (Rad, Moohebat, MohammadEbrahimi, et al., 2022).

At a second level, the divergence between the two patients can be interpreted through Orem's Self-Care Deficit Nursing Theory. Both patients received identical health education and an identical intervention recommendation, yet only Patient 1 possessed the self-care agency to translate that recommendation into consistent daily behavior. Patient 2's inconsistent adherence, driven by forgetfulness and taste aversion, reflects a self-care deficit that education alone did not fully resolve, indicating a need for a more compensatory or supportive-educative nursing system for example, reminder systems, caregiver involvement, or taste modification strategies rather than education delivered as a single, one-time event. Read together, the two theoretical lenses suggest that the effectiveness of celery juice as a nonpharmacological therapy is not solely a function of its phytochemical properties but is co-determined by the nursing strategies used to sustain patient adherence (Rad, Moohebat, & Mohajeri, 2022a; Syam & Ismanti, 2022). This reinforces findings from prior research showing that celery-based interventions can meaningfully lower blood pressure and associated symptoms when consumption is consistent, while also cautioning, in line that herbal adjuncts such as celery juice should be monitored for potential interaction with concurrent antihypertensive medication rather than administered as an unsupervised substitute for pharmacological therapy.

Taken together, these findings support the use of celery juice as a theory-consistent, low-cost, and readily accessible complementary therapy for chronic pain in hypertensive patients, provided that nursing care extends beyond initial education to actively monitoring and reinforcing adherence throughout the intervention period (Khademian et al., 2020).





This study is subject to several limitations that warrant cautious interpretation of its findings. The quasi-experimental comparison relied on only two patients, precluding statistical inference and limiting generalizability to the broader hypertensive population; group allocation was based on naturally observed adherence rather than random assignment, introducing the possibility of selection bias and unmeasured confounding related to each patient's baseline health behaviors; adherence itself was assessed through self-report and observation over a comparatively short seven-day period, which may be subject to recall or social-desirability bias and is insufficient to establish sustained or long-term effects on blood pressure and pain; and potential confounding factors such as dietary sodium intake, concurrent analgesic use, and psychosocial stress were not systematically controlled. Future studies employing a larger sample, longer follow-up, and a more rigorous quasi-experimental or randomized design with statistical testing are needed to confirm the effectiveness and safety of celery juice as an adjunctive nursing intervention for chronic pain in hypertensive patients.

CONCLUSIONS

Over the course of a single week, two women with the same diagnosis, the same starting pain score, and the same recommendation walked strikingly different paths toward comfort, illustrating that in chronic disease management, adherence is often the difference between a promising intervention and a realized outcome. Guided by the Gate Control Theory, this study's findings affirm that lowering blood pressure through celery juice's vasodilatory bioactive compounds can narrow the physiological gate through which pain impulses travel to the central nervous system, translating into meaningfully lower pain scores when consumption is sustained as recommended; viewed alongside Orem's Self-Care Deficit Nursing Theory, the diverging trajectories of the two patients further reveal that nursing's role does not end at prescribing a remedy but must actively cultivate patients' capacity to sustain self-care behaviors at home. Celery juice therefore stands as a safe, economical, and theory-consistent nonpharmacological adjunct for chronic pain in hypertensive patients, provided that nursing care extends beyond one-time education to the ongoing support that makes adherence - and its benefits - genuinely attainable; patients and families are encouraged to consume celery juice as recommended while continuing prescribed medication and a healthy lifestyle, and future studies with larger samples and stronger designs are needed to confirm these findings.

Acknowledgement

The author would like to express gratitude to the Faculty of Nursing at the University of Jember, Pasuruan City Campus; the Gadingrejo Community Health Center in Pasuruan City; the academic advisor; and all those who provided support and assistance throughout the research process and the preparation of this article.





Funding Source

This study did not receive any specific funding from government agencies, commercial entities, or nonprofit organizations. The entire research process and the preparation of this article were conducted independently by the author.

Conflict of Interest

The author declares that there were no conflicts of interest in the conduct of this research or the preparation of this article. All data and research results are presented objectively in accordance with the findings obtained in the field.

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