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Family-Centered Tepid Water Sponging for Thermoregulation in Pediatric Complex Febrile Seizures: A Single-Case Study

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Abstract:
Hyperthermia in pediatric febrile seizures heightens the risk of neurological recurrence, necessitating prompt thermoregulatory management. This study aimed to describe the clinical implementation and outcomes of tepid water sponging integrated with a Family-Centered Care (FCC) approach to improve thermoregulation in a pediatric patient with complex febrile seizures. A single-case study design was employed involving a 3-year-old boy hospitalized with complex febrile seizures and hyperthermia at Dr. Haryoto Regional Hospital, Indonesia. Data were collected via clinical observation, parental interviews, and medical documentation review over two consecutive days. The intervention combined standardized tepid water sponging with active parental education and participation. The intervention yielded a consistent reduction in body temperature of 0.9°C to 1.4°C per session, decreasing from an initial 39.3°C to 36.9°C across the observation period, with stabilization at 36.5°C by day three. Concurrent improvements in thermoregulatory indicators included diminished skin erythema, normalized cutaneous temperature, and resolved tachycardia. The child demonstrated enhanced comfort and procedural cooperation, facilitated directly by active family engagement. Integrating tepid water sponging with a Family-Centered Care framework effectively optimizes thermoregulation in children with complex febrile seizures. This combined strategy represents a viable, supportive non-pharmacological nursing intervention. Future large-scale studies are warranted to validate these findings and establish broader clinical generalizability.

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INTRODUCTION

Febrile seizures represent one of the most common neurological emergencies in pediatric populations globally, predominantly affecting children between 6 months and 5 years of age (Corsello et al., 2024). These acute episodes are intrinsically linked to rapid, uncontrolled elevations in body temperature secondary to underlying infectious or inflammatory processes (Han & Han, 2023). The developing pediatric nervous system exhibits heightened sensitivity to such physiological stressors, making this specific demographic particularly vulnerable to temperature-induced neurological events (Scantlebury et al., 2023). Understanding the fundamental pathophysiology of these seizures is essential for establishing effective, evidence-based pediatric nursing protocols across diverse international healthcare systems (Tang et al., 2026). The global burden of pediatric febrile seizures necessitates standardized, accessible interventions deployable in diverse healthcare settings (Marangoni et al., 2024).

Hyperthermia constitutes a critical and frequent nursing problem in children presenting with febrile seizures due to its direct, deleterious impact on cellular metabolism and neuronal ion channel

function (Wu et al., 2025). Elevated core temperatures disrupt the delicate physiological balance of excitatory and inhibitory neurotransmitters, thereby substantially increasing overall neuronal excitability (Barrett et al., 2024). This biochemical imbalance predisposes the immature brain to abnormal, synchronized electrical discharges, significantly elevating the risk of seizure recurrence and worsening the overall clinical trajectory (Yi et al., 2023). Prompt and effective thermoregulation is imperative to prevent secondary neurological complications and stabilize the pediatric patient (Ferretti et al., 2024). Nurses play a pivotal role in continuous temperature monitoring and in the immediate application of an immediate cooling strategy to avert these neurological crises (Alsabri et al., 2025).

Contemporary hyperthermia management protocols increasingly emphasize external cooling measures as a foundational, non-invasive component of comprehensive nursing care. Tepid water sponging is a widely used non-pharmacological intervention that involves warm water compresses and gentle wiping over major vascular areas such as the axillae and groin (Widiyanto, 2024). This technique actively facilitates core heat dissipation through synergistic physiological mechanisms, including peripheral vasodilation, thermal conduction, and surface evaporation (Adelia et al., 2025). Unlike cold-water applications, which may induce counterproductive shivering, tepid water ensures a gradual, comfortable thermal gradient (Sukmandari et al., 2025). Previous empirical studies have consistently reported that appropriately applied tepid water sponging reduces body temperature and enhances patient comfort in febrile children (Jose et al., 2022).

Effective clinical interventions in pediatric settings require robust family involvement to optimize therapeutic outcomes and mitigate procedural distress during hospitalization (Hodgson et al., 2024). The Family-Centered Care (FCC) model prioritizes active, continuous collaboration between healthcare professionals and families through transparent communication, targeted health education, and shared decision-making (Aljawad et al., 2025). Parental presence functions as a primary psychological coping resource, actively promoting feelings of safety and mitigating procedural anxiety in hospitalized children (Mcharo et al., 2022). Integrating FCC principles into routine nursing procedures transforms passive caregivers into active, empowered partners, thereby enhancing the overall effectiveness and acceptance of the care-delivery process (Li et al., 2025). This paradigm shift recognizes the family as the constant in the child’s life, fundamentally altering traditional hierarchical dynamics of hospital care (Im et al., 2024).

A significant gap exists in the current nursing literature regarding the practical, clinical integration of physical cooling methods with holistic psychosocial care frameworks. The existing literature thoroughly documents the isolated thermoregulatory benefits of tepid-water sponging. Publications detailing its systematic implementation within a structured Family-Centered Care framework for children with febrile seizures remain notably scarce. This lack of descriptive clinical data obscures the potential synergistic effects of combining physiological temperature management with active family support in acute pediatric care environments (Latour & Rennick, 2024). Clinicians currently lack clear, evidence-based procedural guidelines for merging these two critical domains of pediatric nursing practice.

Addressing this specific literature deficit requires an in-depth, nuanced exploration of the intervention process and the complex clinical responses it elicits in real time. A single-case study design provides the methodological rigor necessary to capture the intricate dynamics between the nursing intervention, the patient’s physiological stabilization, and active family participation (Seniwati et al., 2023). This qualitative and quantitative approach yields rich, contextualized insights that broader epidemiological studies often overlook, highlighting the practical feasibility and immediate clinical impact of the integrated care model. Such detailed case documentation is vital for generating

hypotheses and establishing preliminary efficacy before advancing to large-scale randomized controlled trials.

This study aims to comprehensively describe the implementation of tepid water sponging, using a Family-Centered Care approach, to improve thermoregulation in a child with complex febrile seizures. Establishing the clinical viability of this combined strategy is highly urgent, as it offers a low-cost, highly accessible nursing intervention that can mitigate seizure risk without pharmacological side effects. The findings will provide actionable, evidence-based guidance to refine pediatric nursing guidelines and promote holistic, family-integrated care practices in diverse clinical environments (Gunduz et al., 2026). An urgent investigation is required to validate this model and ensure that vulnerable pediatric populations receive optimal, multidimensional care during acute febrile episodes.

STUDY DESIGN

Study Setting and Timeline

This single-case study was conducted from April 10–12, 2026, in the Bougenville Pediatric Ward of Dr. Haryoto Regional Hospital, Lumajang, Indonesia, a unit selected for its high incidence of febrile seizures. Using purposive sampling, the study included children aged 6 months to 5 years diagnosed with febrile seizures and hyperthermia. Patients were excluded if they presented with cold sensitivity, open wounds, severe dermatitis or eczema, severe respiratory disorders, or hemodynamic instability.

Data Collection Procedures

Data were collected via medical record screening, structured parent interviews, and direct observation. Medical records confirmed the inclusion criteria and provided diagnostic results, along with pre- and post-intervention temperature logs. Interviews assessed patient characteristics, medical and seizure history, current complaints, and parental readiness for the intervention. Observations evaluated hyperthermia indicators based on the Indonesian Nursing Diagnosis Standards, including elevated body temperature, flushed or warm skin, seizures, tachycardia, tachypnea, and family involvement.

The tepid water sponging intervention used warm water (34–36°C) for 15–20 minutes, administered 30 minutes before antipyretics. The procedure combined warm compresses on the neck, axillary, and inguinal areas with gentle wiping of the extremities, back, and buttocks, repeated over three cycles with continuous patient monitoring. A Family-Centered Care (FCC) approach was integrated by educating parents on the procedure's purpose, benefits, and steps beforehand, and actively involving them in accompanying and supporting the child throughout the intervention.

Intervention outcomes were evaluated using the Indonesian Nursing Diagnosis and Outcomes Standards. Assessments focused on hyperthermia and thermoregulation indicators, specifically tracking changes in body temperature, skin redness, skin temperature, seizures, and tachycardia.

Ethical Considerations

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Nursing, University of Jember (Approval No. 064/UN25.1.14/KEPK/2026). The researcher acted as both the intervention provider and data collector. Prior to the study, informed consent was obtained from the patient’s parents to ensure voluntary participation. Confidentiality was strictly maintained by anonymizing records with patient initials and preventing unauthorized disclosure of

medical information. All procedures adhered to core ethical principles, prioritizing participant safety, voluntary involvement, and research integrity

CLINICAL FINDINGS

The nursing assessment findings indicated that the participant was a 3-year-old boy with a medical diagnosis of complex febrile seizures accompanied by hyperthermia. The patient's family reported that the child had experienced intermittent fever since the previous day, accompanied by coughing and two seizure episodes before hospital admission. The first seizure lasted approximately 10 minutes, while the second lasted approximately 5–7 minutes. Generalized jerking movements and upward eye deviation characterized both episodes. The patient's mother also reported a history of febrile seizures six months earlier.

A nursing assessment conducted on April 10, 2026, in the Bougenville Pediatric Ward of Dr. Haryoto Regional Hospital, Lumajang, revealed subjective findings of persistent fever, hot skin on touch, and decreased appetite. Objective findings included a body temperature of 39.3°C, pulse rate of 130 beats/minute, respiratory rate of 32 breaths/minute, facial flushing, warm skin on palpation, and dry lip mucosa. Laboratory examination results showed a leukocyte count of 12.18 × 10^3/μL, suggesting an infectious process. Based on the Indonesian Nursing Diagnosis Standards, the nursing diagnosis established was hyperthermia related to a disease process (infection).

RESULT

Changes in Body Temperature

The nursing interventions were implemented in accordance with the Hyperthermia Management intervention, as outlined in the Indonesian Nursing Intervention Standards. The interventions included monitoring body temperature and vital signs, providing a comfortable environment, encouraging oral fluid intake, loosening clothing, and applying external cooling through tepid water sponging. The tepid water sponging procedure was implemented using a Family-Centered Care approach, with education provided to the patient's mother and active involvement during the intervention to enhance the child's comfort and cooperation.

Body temperature measurements showed changes following the implementation of tepid-water sponging. Temperature assessments were conducted over 2 days, with multiple evaluations performed before and after each intervention session.

Table 1. Changes in Body Temperature Before and After Tepid Water Sponge Intervention

Date	Time (Pre-intervention)	Pre-intervention Temperature (°C)	Post-intervention Temperature (°C)	Time (Post-intervention)	Temperature Reduction (°C)
April 10, 2026	06:10 a.m.	39.3	37.9	06:20 a.m.	1.4
April 10, 2026	02:20 p.m.	38.2	37.3	02:40 p.m.	0.9
April 11, 2026	06:00 a.m.	37.8	36.9	06:20 a.m.	0.9

Table note. The tepid-water sponge intervention was associated with a reduction in body temperature of 0.9-1.4°C across the three observation sessions.

As shown in the table, a reduction in body temperature was observed after 20 minutes of tepid water sponging using a Family-Centered Care approach. The table shows that body temperature decreased during the first day of hospitalization (April 10, 2026), when the intervention was

implemented twice. At 06:10 a.m. (post-intervention I), body temperature decreased by 1.4°C, from 39.3°C to 37.9°C. At 02:20 p.m. (post-intervention II), body temperature decreased by 0.9°C, from 38.2°C to 37.3°C.

On the second day (April 11, 2026), at 06:00 a.m., body temperature decreased by 0.9°C, from 37.8°C to 36.9°C. At 02:00 p.m., the patient's body temperature was 36.5°C; therefore, no intervention was performed because the temperature was within the normal range. On the third day (April 12, 2026), body temperature remained stable at 36.5°C.

Observational findings during the hospitalization period indicated improvement in the patient's condition following the intervention. The body temperature trend graph demonstrated a consistent reduction from hyperthermic levels toward the normal range.

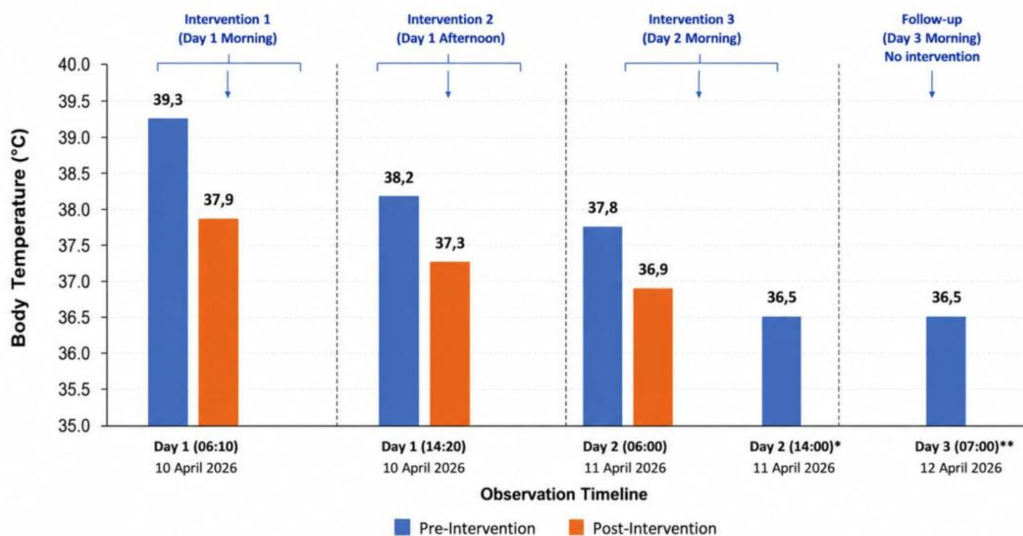

Figure 1. Changes in Body Temperature During Implementation of Tepid Water Sponge with a Family - Centered Care Approach

Thermoregulation Improvement

In addition, the nursing outcome evaluation showed improvements in the patient's thermoregulation.

Table 2. Nursing Outcome: Thermoregulation

No.	Outcome Indicator	Baseline	Final Evaluation
1	Body temperature	Severely compromised (1)	Improved (5)
2	Skin redness	Moderately increased (2)	Decreased (5)
3	Seizures	Decreased (5)	Decreased (5)
4	Tachycardia	Moderately increased (2)	Decreased (5)
5	Skin temperature	Moderately increased (2)	Improved (5)

Note. Scores were assessed according to the Indonesian Nursing Outcomes Standards (SLKI). Higher scores indicate better thermoregulation status. Scores range from 1 (severely compromised) to 5 (normal/improved condition).

The thermoregulation outcome evaluation presented in Table 1 demonstrated improvements in the patient's condition following the intervention. Body temperature improved from the “severely compromised” category (score 1) to the “improved” category (score 5). Skin redness decreased, tachycardia decreased (score 5) with a pulse rate of 110 beats/minute, and skin temperature

improved (score 5) to 36.5°C. In addition, no recurrent seizures were observed during the observation period. No adverse effects, including shivering, significant discomfort, or signs of hypothermia, were observed during tepid water sponging. The patient appeared more comfortable and cooperative throughout the intervention with family accompaniment.

DISCUSSION

The primary finding of this case study demonstrates that tepid water sponging, when integrated with a Family-Centered Care (FCC) approach, effectively facilitated thermoregulation in a 3-year-old boy diagnosed with complex febrile seizures. This demographic profile aligns precisely with established epidemiological data indicating that febrile seizures predominantly affect children between 6 months and 5 years of age, with peak incidence occurring between 12 and 18 months. The heightened vulnerability in this pediatric cohort stems from ongoing central nervous system maturation, which increases sensitivity to rapid elevations in core body temperature secondary to infectious processes (Sawires et al., 2022). The continuous presence of the mother throughout the hospitalization in the Bougenville Pediatric Ward provided a foundational context for applying the FCC model, ensuring the intervention was tailored to the child's and family's specific psychosocial and physiological needs.

The implementation of tepid water sponging yielded measurable improvements in thermoregulation, evidenced by a consistent reduction in body temperature of 0.9-1.4°C across the observation period. These clinical outcomes corroborate the findings of Akbar et al. (2025), who documented that warm water compresses reliably decreased body temperature by 0.4°C to 1.0°C per session, demonstrating a sustained downward trajectory over a three-day intervention period. The physiological efficacy of this non-pharmacological strategy is fundamentally rooted in thermodynamic principles, specifically the synergistic mechanisms of conduction, convection, and evaporation. Applying water at a controlled temperature to highly vascularized anatomical regions, such as the axillary and inguinal folds, induces peripheral vasodilation. This vascular response significantly enhances the transfer of core body heat to the skin surface, thereby facilitating efficient heat dissipation into the surrounding environment and assisting the pediatric organism in re-establishing thermal homeostasis (Souza et al., 2022).

The utilization of external cooling methods in pediatric fever management remains a subject of ongoing debate within the international medical community. A comprehensive systematic review by Green et al. (2021) highlighted substantial heterogeneity in clinical guidelines, with some endorsing tepid sponging as an adjunctive measure while others withhold recommendations due to perceived insufficient evidence and potential for patient discomfort. The absence of adverse physiological responses, such as shivering, excessive crying, or heightened distress, in the present case distinguishes this intervention from typical negative outcomes associated with physical cooling. This favorable tolerance is directly attributable to the strict maintenance of water temperature between 34°C and 36.5°C, coupled with continuous, real-time assessment of the child's physiological and behavioral responses. Clinical guidelines increasingly favor warm-water applications over cold-water alternatives, as cold exposure paradoxically triggers peripheral vasoconstriction and compensatory metabolic heat production (Green et al., 2021). Such compensatory mechanisms manifest clinically as shivering, chills, and profound discomfort, which can inadvertently elevate core temperature (Akyirem & Bossman, 2021). Warm compresses circumvent these adverse effects by promoting sustained peripheral vasodilation, thereby optimizing heat release without provoking thermogenic counter-regulatory responses (Souza et al., 2022).

The integration of a Family-Centered Care (FCC) framework served as a critical moderator in optimizing the clinical outcomes of the thermoregulatory intervention. Active parental involvement, encompassing continuous accompaniment and vigilant monitoring of the child's responses, fostered an environment in which the patient remained remarkably calm, cooperative, and free of procedural distress. This observation contrasts with the findings of Souza et al. (2022), who reported that pediatric patients frequently exhibited crying and agitation during sponging procedures, potentially confounding physiological temperature reduction due to stress-induced metabolic increases. In the current case, the sustained family support inherent to the FCC model effectively mitigated procedural anxiety, thereby allowing the physiological benefits of tepid water sponging to manifest without behavioral interference. Parental presence functions as a primary psychological coping resource for hospitalized children, fundamentally reinforcing feelings of safety, security, and environmental predictability. Engaging parents as active partners in care delivery not only diminishes pediatric resistance to clinical procedures but also cultivates a more positive, collaborative healthcare experience that enhances overall intervention adherence and efficacy.

The interpretation of these promising findings must be contextualized within several inherent methodological limitations characteristic of single-case study designs. The observed reduction in body temperature cannot be definitively attributed solely to the tepid-water sponging intervention, as the patient concurrently received standard medical treatments, including antipyretic pharmacotherapy, in accordance with institutional therapeutic protocols. The exclusive focus on a single pediatric participant over a brief three-day observation window inherently restricts the statistical power and generalizability of the results to the broader, heterogeneous population of children experiencing febrile seizures. The dual role assumed by the researcher as both the primary intervention provider and the principal data collector introduces a potential risk of observational bias, despite rigorous adherence to standardized assessment tools. The possibility of a Hawthorne effect further complicates the interpretation of behavioral outcomes, as the child’s heightened cooperation and apparent comfort may have been partially influenced by the intensified attention and active family engagement inherent to the study design rather than the intervention mechanics alone (Berkhout et al., 2022). The absence of long-term follow-up data precludes any definitive conclusions regarding the intervention's impact on preventing subsequent seizure recurrence.

These findings offer valuable, actionable insights for contemporary pediatric nursing practice regarding the management of hyperthermia in vulnerable populations. Tepid-water sponging using strictly regulated warm water represents a viable, supportive non-pharmacological strategy for assisting thermoregulation, provided the procedure is performed with meticulous adherence to established protocols and continuous patient monitoring. The concurrent application of a Family-Centered Care approach emerges as an essential component for maximizing patient comfort, minimizing procedural anxiety, and ensuring cooperative participation during clinical interventions (Adugbire et al., 2024). Healthcare providers must recognize that the efficacy of family participation may vary across diverse healthcare settings and cultural contexts, particularly in regions where familial involvement in direct clinical care differs from norms observed in Indonesia. Future research endeavors must prioritize rigorous quasi-experimental designs or randomized controlled trials (RCTs) with larger, more diverse sample sizes to definitively evaluate the independent effectiveness of tepid water sponging and to quantify the specific contribution of Family-Centered Care to thermoregulatory outcomes in pediatric febrile seizure management. Subsequent investigations should also incorporate validated pediatric comfort and pain assessment scales to objectively quantify the behavioral benefits of family participation.

CONCLUSION

The integration of tepid water sponging with a Family-Centered Care approach effectively facilitated thermoregulation in a pediatric patient presenting with complex febrile seizures and hyperthermia. This combined intervention serves as a viable, supportive non-pharmacological nursing strategy that optimizes body temperature management while leveraging active family participation to enhance patient comfort and procedural cooperation. Future research must employ rigorous experimental designs with larger, diverse sample sizes to definitively establish the generalizability and clinical efficacy of this holistic nursing model across varied healthcare environments.

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