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COMPARISON OF WARM WATER FOOT HYDROTHERAPY WITH AND WITHOUT EPSOM SALT ON LOWER EXTREMITY EDEMA AMONG THIRD-TRIMESTER PREGNANT WOMEN

Sartika[1*], Sylvia Meristika Rachman[2], Noorlinda[3]
[1,2,3]Politeknik Kesehatan Bhakti Pertiwi Husada
Corresponding Email*: sartikaaikka@gmail.com

ABSTRACT

Lower-extremity edema is a common discomfort during the third trimester. This study compared warm-water foot hydrotherapy with and without Epsom salt in reducing physiological edema among third-trimester pregnant women in Weru District, Cirebon Regency. A quasi-experimental pretest-posttest control-group design was used. Thirty participants were selected through purposive sampling and divided equally into an Epsom-salt group and a warm-water-only group. Both groups received foot hydrotherapy for 15-20 minutes daily for seven consecutive days. Edema was assessed using a standardized pitting-edema scale. Changes within each group were analyzed using the Wilcoxon signed-rank test, while posttest differences between groups were analyzed using the Mann-Whitney U test. Edema scores decreased significantly in the Epsom-salt group ($p = 0.001$) and the warm-water-only group ($p = 0.008$). Posttest scores also differed significantly between groups ($p = 0.001$), with lower edema scores in the Epsom-salt group. These findings suggest that adding Epsom salt to warm-water hydrotherapy may provide greater edema reduction than warm water alone. This simple, affordable, and non-pharmacological intervention may support antenatal comfort care after pathological causes of edema have been excluded. However, larger randomized studies with blinded assessment are needed to confirm its effectiveness and safety before routine clinical implementation in maternal healthcare settings.

Keywords

Pregnancy, Edema, Epsom Salt, Hydrotherapy, Third Trimester

INTRODUCTION

Pregnancy is a physiological process accompanied by anatomical, hormonal, physiological, and psychological changes in women. Although these adaptations support fetal growth and maternal health, they often cause discomfort during pregnancy, especially in the third trimester. One of the most common discomforts experienced by pregnant women is lower extremity edema. Physiological edema occurs due to increased

uterine pressure on the pelvic veins and inferior vena cava, resulting in impaired venous return and accumulation of interstitial fluid in the lower extremities (Arisman et al., 2024; Chadwick, 2022).

Lower extremity edema remains a common problem among pregnant women worldwide. Approximately 75–80% of pregnant women experience varying degrees of edema during late pregnancy, particularly in the third trimester. Edema frequently appears after 28 weeks of gestation and tends to worsen after prolonged standing, excessive physical activity, or nighttime conditions. Although physiological edema is generally considered a normal condition during pregnancy, unmanaged edema may interfere with maternal mobility, daily activities, comfort, sleep quality, and psychological well-being (Rita Aninora et al., 2023; Sawitry et al., 2020).

In Indonesia, edema among third-trimester pregnant women is still frequently identified during antenatal care visits, particularly in rural and semi-rural communities. Many pregnant women consider edema a normal condition that does not require specific management. Consequently, management is generally limited to rest and leg elevation, despite prolonged edema causing heaviness in the legs, discomfort during activities, tingling sensations, fatigue, and sleep disturbances that may reduce maternal quality of life during pregnancy (Fitria & Sulastri, 2024).

Non-pharmacological approaches are frequently used to manage pregnancy-related discomfort because they are accessible and can complement routine antenatal care. Warm-water foot immersion may promote peripheral vasodilation, hydrostatic fluid redistribution, venous return, and relaxation. Recent evidence reviews also suggest that foot baths and related complementary therapies may relieve minor pregnancy symptoms, including ankle and foot edema, although the underlying studies are heterogeneous and often at risk of bias (Moini Jazani et al., 2023; Liang et al., 2023; Iso et al., 2024).

Previous studies have reported reductions in lower-extremity edema after warm-water immersion, salt-water soaking, foot massage, or combined approaches (Rita Aninora et al., 2023; Arisman et al., 2024; Fitria & Sulastri, 2024; Mardliyana, 2024). However, most studies evaluated a single intervention against usual care or combined warm water with massage or herbal ingredients. Consequently, they do not isolate the incremental effect of Epsom salt when water temperature, immersion duration, treatment frequency, and edema assessment are held constant.

Epsom salt (magnesium sulfate) is widely used in home-based soaking practices and is proposed to enhance relaxation. Nevertheless, evidence for clinically meaningful transdermal magnesium absorption remains uncertain; therefore, any added benefit should be evaluated empirically rather than attributed to an unconfirmed mechanism. The scientific novelty of this study lies in its active-comparator design: both groups received an identical standardized warm-water protocol, and the only planned difference was the addition of Epsom salt. This design provides preliminary evidence about the incremental value of Epsom salt, a question that has received limited attention in community-based midwifery research.

Based on a preliminary study conducted by the researcher involving 20 third-trimester pregnant women in Weru District, Cirebon Regency, it was found that 14 respondents experienced moderate lower extremity edema, while 6 respondents experienced mild edema. Most respondents complained of heaviness in the legs, discomfort during activities, tingling sensations, and difficulty sleeping,

especially during nighttime. Management of edema was generally limited to leg elevation and warm water soaking without standardized procedures. None of the respondents had previously received foot hydrotherapy using Epsom salt as a complementary intervention.

Therefore, this study aimed to compare warm-water foot hydrotherapy with and without Epsom salt for reducing physiological lower-extremity edema among third-trimester pregnant women in Weru District, Cirebon Regency. Its intended contribution to complementary midwifery care is a practical, standardized, and directly comparative protocol that can inform larger effectiveness trials and cautious symptom-management guidance in community antenatal services.

METHOD

This quantitative study used a quasi-experimental pretest-posttest control-group design. The design was selected because individual randomization was not feasible in the community service setting, while an active comparison group was required to distinguish the effect of adding Epsom salt from the effect of warm water itself. Participants were allocated to two independent groups: warm-water foot hydrotherapy with Epsom salt and warm-water foot hydrotherapy without Epsom salt. Both groups underwent measurements before and after the seven-day intervention.

The study was conducted in Weru District, Cirebon Regency, from January to March 2026. The target population comprised third-trimester pregnant women with physiological lower-extremity edema who attended maternal health services in the study area.

Purposive sampling was used to recruit participants who met the clinical and procedural requirements of the intervention. This approach was chosen because the study specifically required women with observable physiological edema who could complete seven consecutive treatment sessions. Inclusion criteria were gestational age of at least 28 weeks, physiological lower-extremity edema, willingness to participate, ability to communicate, and no pharmacological treatment for edema. Exclusion criteria were preeclampsia, hypertension, severe lower-extremity injury or deformity, cardiac disease, renal disease, or another condition suggesting pathological edema. These criteria were applied to improve participant safety and reduce clinical heterogeneity, but the non-probability sampling limits generalizability.

The sample comprised 30 participants, with 15 participants in each group. The sample was treated as a preliminary quasi-experimental sample based on feasibility and the minimum group size commonly used in comparable intervention studies (Arisman et al., 2024; Patola & Tridiyawati, 2022), rather than as the result of a formal a priori power calculation. Accordingly, the findings should be interpreted as preliminary and require confirmation in a larger adequately powered trial.

The intervention group received warm-water foot hydrotherapy with Epsom salt, whereas the comparison group received warm-water foot hydrotherapy without any additive. Before the first session, lower-extremity edema was assessed using the pitting-edema scale. In both groups, the feet were immersed once daily for 15-20 minutes over seven consecutive days in water maintained at approximately 38-39 degrees C. The same immersion duration, frequency, and temperature range were used in both groups; only the addition of Epsom salt differed. Posttest edema was assessed after completion of the intervention period. The procedure was adapted from published warm-water and salt-soaking protocols (Rita

Aninora et al., 2023; Arisman et al., 2024; Iso et al., 2024).

Data collection used a participant-characteristics form, an intervention SOP, and a standardized clinical pitting-edema grading sheet. Edema was classified according to indentation depth: Grade I (2 mm), Grade II (3-4 mm), Grade III (5-6 mm), and Grade IV (8 mm). Construct validity was supported by the scale's direct operationalization of the observable depth of pitting rather than by an unreported questionnaire score. Measurement consistency was supported through the same written SOP, anatomical assessment area, pressure-and-release procedure, and grading criteria at pretest and posttest. Because formal inter-rater reliability coefficients and blinding were not documented, these are acknowledged as measurement limitations rather than assumed strengths.

Univariate analysis summarized age, parity, education, occupation, and edema grade using frequencies, percentages, medians, ranges, means, and standard deviations as appropriate. Because edema grade is ordinal and the sample was small, medians and non-parametric tests were emphasized; means and standard deviations are retained only to facilitate comparison with earlier studies.

Distributional assumptions were examined using the Shapiro-Wilk test. All pretest and posttest variables had p-values below 0.05, indicating departures from normality. The Wilcoxon signed-rank test was therefore used to assess pretest-posttest changes within each group, and the Mann-Whitney U test was used to compare posttest edema scores between groups. Statistical significance was set at alpha = 0.05. The between-group test was interpreted as evidence of association in this nonrandomized design, not as definitive proof of causality.

RESULTS

1. Characteristics of Respondents

Table 1. Characteristics of Respondents

Category	F	%
Age		
Non-risk (20–35 years)	28	93.3
Risk (>35 years)	2	6.7
Total	30	100.0
Education		
Low (Elementary–Junior High School)	19	63.3
High (Senior High School–College)	11	36.7
Total	30	100.0
Occupation		
Working	14	46.7
Not working	16	53.3
Total	30	100.0
Gravida		
Primigravida	8	26.7
Multigravida	22	73.3
Total	30	100.0

Based on Table 1, most respondents were categorized as non-risk reproductive age (20–35 years), totaling 28 respondents (93.3%), while only 2 respondents (6.7%) were categorized as high-risk age (>35 years). Based on educational level, most respondents had low educational backgrounds (elementary to junior high school), totaling 19 respondents (63.3%), whereas 11 respondents (36.7%) had higher educational backgrounds (senior high school to college level). Based on occupational status, most respondents were not working, totaling 16 respondents (53.3%), while 14 respondents (46.7%) were categorized as working respondents. Furthermore, based on gravida status, the majority of respondents were multigravida mothers, totaling 22 respondents (73.3%), while 8 respondents (26.7%) were primigravida mothers.

2. Normality Test Results

Table 2. Normality Test Results

Variable	p-value
Pretest intervention group	0.002
Posttest intervention group	0.002
Pretest control group	0.001
Posttest control group	0.024

Based on Table 2, the results of the Shapiro-Wilk normality test showed that all variables had p-values less than 0.05 ($p < 0.05$), indicating that the data were not normally distributed. Therefore, non-parametric statistical tests, namely the Wilcoxon Signed Rank Test and Mann-Whitney U Test, were used for further analysis.

3. Differences in Edema Scores Before and After Intervention

Table 3. Differences in Edema Scores Before and After Intervention

Group	Measu-rement	Median (Min–Max)	Mean ± SD	Z	p-value
Epsom salt	Pretest	3 (2–3)	2.73 ± 0.45	-3.272	0.001
	Posttest	1 (1–3)	1.40 ± 0.63		
Warm water	Pretest	3 (2–3)	2.67 ± 0.48	-2.646	0.008
	Posttest	2 (1–3)	2.20 ± 0.56		

As shown in Table 3, the median edema score in the Epsom-salt group decreased from 3 (range 2-3) before intervention to 1 (range 1-3) after intervention; the mean score decreased from 2.73 +/- 0.45 to 1.40 +/- 0.63. The Wilcoxon signed-rank test indicated a statistically significant within-group change ($p = 0.001$).

In the warm-water-only group, the median edema score decreased from 3 (range 2-3) to 2 (range 1-3), and the mean score decreased from 2.67 +/- 0.48 to 2.20 +/- 0.56. The within-group change was also statistically significant ($p = 0.008$), although the descriptive reduction was smaller than in the Epsom-salt group.

4. Comparison of Posttest Edema Scores Between Intervention and Control Groups

Table 4. Comparison of Posttest Edema Scores Between Intervention and Control Groups

Group	Median (Min–Max)	Mean ± SD	Mean Rank	Z	p-value
Epsom salt	1 (1–3)	1.40 ± 0.63	10.80	-3.180	0.001
Warm water	2 (1–3)	2.20 ± 0.56	20.20		

Based on Table 4, the median posttest edema score in the Epsom salt group was 1 (1–3), with a mean score of 1.40 ± 0.63, while the warm water group showed a median score of 2 (1–3), with a mean score of 2.20 ± 0.56. The Mann-Whitney U Test showed a p-value of 0.001 ($p < 0.05$), indicating a significant difference in posttest edema scores between the intervention and control groups.

The intervention group receiving foot hydrotherapy with Epsom salt demonstrated lower mean rank scores (10.80) compared with the warm water group (20.20). These findings indicate that foot hydrotherapy with Epsom salt was more effective in reducing lower extremity edema among third-trimester pregnant women compared with warm water foot hydrotherapy alone.

DISCUSSION

1. Differences in Edema Scores Before and After Intervention

The principal finding was that both standardized warm-water protocols reduced edema, but posttest edema was lower when Epsom salt was added. The median decreased by two grades in the Epsom-salt group and by one grade in the warm-water-only group. This pattern addresses the study's central question more directly than a comparison with no treatment: it suggests an incremental benefit beyond the thermal and hydrostatic effects shared by both groups.

The improvement in both groups is biologically plausible because warmth can promote peripheral vasodilation and relaxation, while immersion exerts hydrostatic pressure that may support venous and interstitial fluid redistribution. The recent foot-bath literature similarly identifies relaxation and relief of minor pregnancy symptoms as potential benefits, but also emphasizes variation in protocols and limited certainty of evidence (Iso et al., 2024). Thus, the present findings support the use of a standardized soaking protocol while avoiding claims that warm water alone resolves the physiological causes of edema.

The direction of effect is consistent with Indonesian studies of warm-water, salt-water, massage, and herbal-combination interventions (Rita Aninora et al., 2023; Arisman et al., 2024; Fitria & Sulastri, 2024; Mardliyana, 2024). However, those studies used different co-interventions and designs. The present study extends that literature by using an active comparator with the same temperature, duration, and frequency, thereby narrowing the comparison to the added Epsom-salt component.

Physiological edema in late pregnancy is related to uterine compression of pelvic veins, slower venous return, increased plasma volume, hormonal fluid retention, gravity, and prolonged standing. These mechanisms also explain why symptom improvement may be temporary when participants resume daily activities. Importantly, sudden, severe, asymmetric, or clinically concerning edema requires assessment for hypertensive, thrombotic, cardiac, or renal causes and should not be managed solely with home hydrotherapy.

The broader complementary-therapy literature warrants cautious interpretation. A 2023 systematic review found that reflexology studies reported benefits for several pregnancy symptoms, including ankle and foot edema, but most included trials had a high risk of bias (Liang et al., 2023). This limitation parallels the present study's small nonrandomized sample and reinforces the need to distinguish promising symptom relief from definitive effectiveness evidence.

Recent local evidence also supports warm-water-based approaches. Arisman et al. (2024) reported improvement after warm-water immersion, while Mardliyana (2024) and Fitria and Sulastri (2024) evaluated warm-water protocols combined with massage or galangal. Agreement across these studies increases contextual relevance, but differences in treatment composition, edema grading, and study quality prevent direct estimates of comparative efficacy.

Macwan and Savaliya (2021) also reported reduced antenatal foot edema after an Epsom-salt intervention. The present active-comparator result is compatible with that report, but the mechanism remains unresolved. In

particular, clinical improvement should not be interpreted as proof of transdermal magnesium absorption; relaxation, osmotic conditions at the skin surface, expectancy, adherence, or unmeasured baseline differences may also contribute.

Participant characteristics provide context but should not be treated as demonstrated effect modifiers because no stratified or interaction analysis was conducted. Most participants were aged 20-35 years and were multigravida, and many reported activities involving prolonged standing. These features may influence baseline edema or recovery, yet the present sample was too small to determine whether age, parity, education, or occupation changed the treatment effect.

From a practical perspective, the protocol is inexpensive, simple, and potentially suitable as adjunctive comfort care in community midwifery. Its use should follow antenatal assessment to exclude pathological edema, clear instructions on water temperature and duration, and advice to stop treatment and seek care if warning symptoms occur. Subjective reports of lighter or more comfortable legs are clinically relevant but were not measured with a validated comfort or quality-of-life scale in this study.

2. Comparison Between Epsom Salt Hydrotherapy and Warm Water Hydrotherapy

The Mann-Whitney U test showed lower posttest edema scores in the Epsom-salt group than in the warm-water-only group ($p = 0.001$). Descriptively, the median posttest score was 1 versus 2, and the mean rank was 10.80 versus 20.20. Because participants were not randomly assigned and baseline-adjusted analysis was not reported, this difference should be interpreted as preliminary comparative evidence rather than a definitive causal effect.

Improvement was more consistent in the Epsom-salt group: 13 participants improved and 2 were unchanged, compared with 7 improved and 8 unchanged in the warm-water-only group. This distribution strengthens the clinical interpretation of the rank-based comparison, although confidence intervals and an effect-size estimate would provide a clearer measure of precision and magnitude in future studies.

The shared response in both groups is most plausibly linked to thermal relaxation and the hydrostatic effects of immersion. The additional group difference may reflect Epsom salt or contextual factors that were not controlled. Accordingly, the study contributes a testable comparative signal, not confirmation of a specific magnesium-mediated biological pathway.

The result is directionally consistent with Macwan and Savaliya (2021) and with recent studies of salt, herbal, or massage-enhanced soaking protocols (Rita Aninora et al., 2023; Arisman et al., 2024; Fitria & Sulastri, 2024; Mardliyana, 2024). The direct active-comparator design is the study's distinctive contribution because both groups received the same warm-water exposure.

Recent reviews provide a more cautious frame. Iso et al. (2024) found potential relaxation and minor-symptom benefits from foot baths during pregnancy, while Liang et al. (2023) highlighted substantial risk of bias in much of the complementary-therapy evidence. The present findings therefore add locally relevant preliminary data but do not remove the need for stronger trials.

For clinical translation, Epsom-salt foot soaking should be positioned as an adjunct for uncomplicated physiological edema, not as a substitute for antenatal evaluation. Standardized instructions, monitoring for skin irritation or excessive heat, and screening for preeclampsia or other pathological causes are essential safeguards.

The study's strengths include an active comparator, identical treatment duration and water-temperature targets, and repeated pretest-posttest assessment. These features improve the specificity of the research question compared with uncontrolled case reports or multi-component interventions.

Several limitations temper the conclusions. The sample was small and purposively selected from one district; allocation was nonrandom; assessor blinding, formal inter-rater reliability, adherence verification, control of daily activity, dietary sodium, ambient temperature, and concurrent self-care were not documented; and follow-up ended immediately after seven days. The ordinal outcome was also analyzed without a reported confidence interval or baseline-adjusted effect estimate.

Future studies should use concealed random allocation, blinded outcome assessment, a prespecified power calculation, reliability testing, standardized Epsom-salt concentration, adherence monitoring, and longer follow-up. Reporting change-score effect sizes with confidence intervals and adding validated measures of discomfort, mobility, sleep, and quality of life would clarify both statistical and practical importance.

Within these limitations, the findings are relevant to complementary midwifery because they operationalize a low-resource protocol that can be replicated and tested. The added scientific value is the preliminary isolation of the Epsom-salt component against an active warm-water comparison rather than another demonstration that soaking as a whole may help.

CONCLUSIONS

In this small quasi-experimental study, both warm-water foot hydrotherapy protocols were associated with lower physiological edema scores, and the group receiving Epsom salt had lower posttest scores than the warm-water-only group. Theoretically, the findings suggest that an additive component may provide benefit beyond the shared thermal and hydrostatic effects of warm-water immersion, although the biological mechanism was not tested. Practically, the standardized seven-day protocol may be considered as adjunctive comfort care in community midwifery after pathological causes of edema have been excluded and safety instructions have been provided. Because of nonrandom sampling, limited measurement-reliability data, and the small single-site sample, routine recommendation should await larger randomized and assessor-blinded trials with effect-size estimates, confidence intervals, and longer follow-up.

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