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Combined Foot Massage and Warm Saltwater Soaking for Pregnancy Related Leg Edema: A Quasi-Experimental Study

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ABSTRACT

***Introduction**: Edema in third trimester of pregnancy occurs due to compression of pelvic veins and retention of interstitial fluid. Combination foot massage and warm saline foot soaks can facilitate peripheral venous return and reabsorption of interstitial fluid into systemic circulation.* ***Methods:** Quasi experimental, nonequivalent pretest-posttest control group, sample 76 women experiencing mild to moderate physiological edema. Participants were recruited sequentially and divided into an intervention group (n=38) and control group (n=38). Intervention group received gentle foot massage using centripetal strokes for 20 minutes, followed by warm saline foot soak (30g Epsom salt in water at 38°C) for 10 minutes and five consecutive days, alongside routine antenatal care. Control group received only routine antenatal counseling. Circumferences of the ankle, heel, and foot were measured before and after the 5-day protocol using standardized non-elastic flexible measuring tape. Data were analyzed using Wilcoxon signed-rank test and Mann-Whitney U test.* ***Results** Both groups showed reduction in foot circumference measurements ($p < 0.001$). Intervention group demonstrated significantly greater mean reduction compared to control group across all measurement points: ankle (1.28 cm vs 0.21 cm), heel (1.30 cm vs 0.25 cm), and foot (1.00 cm vs 0.20 cm). Calculated effect size was large for all measurement locations ($r = 0.848–0.856$).* ***Conclusion**: Combination edema massage and warm-water salt foot baths have significant effect on circumference of the ankles, heels, and feet compared to routine antenatal counseling alone, with measurable magnitude of effect on these circumferences.*

***Keywords:** edema, foot massage, warm saltwater soaking, pregnancy, third trimester*

INTRODUCTION

Edema in the legs during the third trimester of pregnancy is a common complaint, affecting approximately 75% of pregnant women during this phase [1]. However, based on reports from obstetricians, this condition is found in more than 90% of pregnant women [2]. This condition occurs because the uterus exerts pressure on the inferior vena cava, which hinders the return of blood from the legs to the heart, leading to fluid accumulation in the tissues of the legs[3][4][5] . During pregnancy, leg edema is generally harmless and typically resolves after childbirth [6][7][8]. However, excessive leg edema can cause discomfort, pain, and difficulty walking. Although not classified as a serious danger, the condition still requires management, if left unaddressed, it may increase the risk of infections and deep vein thrombosis [9][1][5].

Foot massage is an intervention used to reduce lower-extremity edema in third-trimester pregnant women [10]. Foot massage stimulates tissues, enhances circulation, and supports venous and lymphatic return from the lower extremities [11]. Research by Wulandari et al. demonstrated a difference in the severity of edema among third-trimester pregnant women before and after receiving foot massage [8]. Another study involving third-trimester pregnant women concluded that foot massage can be administered as conventional intervention to help reduce extremity edema [12].

In addition to foot massage, soaking the feet in warm, salted water is an accessible, cost-effective, and relaxing form of hydrotherapy for pregnant women experiencing swelling in their feet or lower extremities [13]. Soaking the feet in warm water promotes both local and systemic relaxation, stimulates peripheral vasodilation, reduces vascular resistance, and facilitates fluid redistribution from the interstitial compartment through hydrostatic pressure [14][15]. The addition of salt to warm water creates hypertonic osmotic gradient that aids in fluid movement and muscle relaxation, while the dissolved minerals provide mild anti-inflammatory effects and soothing sensation [16]. Comparative studies on hydrotherapy indicate that using warm water that is hypertonic or supplemented with salt results in greater reduction in edema volume compared to using plain warm water[18]. Rianita et al. observed significant reduction in the severity of edema measured using the "pitting edema" scale following foot soaks in warm, salted water [17].

In this study, edema in the limbs of women in the third trimester of pregnancy was

measured using pre-established, specific anatomical landmarks. While many clinical settings still rely on the assessment of "pitting edema" semi quantitative measure this study utilized a measuring tape (in centimeters). This approach provides a more sensitive, objective, and reproducible method for evaluating edema in specific areas, such as the ankles, heels, and the metatarsal region [7] [5]. This aligns with research by Brodovitch et al., who noted that the assessment of pitting edema is highly subjective; the pressure applied by healthcare providers can vary significantly—for instance, the distinction between "applying gentle pressure" and "applying firm pressure without causing pain" depends heavily on individual interpretation.

Preliminary study conducted in October 2025 at the Batang 3 Community Health Center (Puskesmas) revealed that 13 pregnant women in their third trimester reported a persistent sensation of heaviness in their legs, paresthesia (tingling or numbness), and sleep disturbances resulting from edema in their lower extremities. Currently, standard antenatal care at the primary healthcare level is limited to verbal counseling such as advice on leg positioning while sleeping or sitting, the scheduling of rest periods, and recommendations to avoid standing for long durations. The 13 pregnant women interviewed were involved solely for the purpose of gathering basic clinical data relevant to the proposed study, they will not be included as participants in the research itself.

Objective of this study was to compare pretest to posttest changes in ankle, heel, and foot circumference between third trimester pregnant women with physiological lower extremity edema who received combined foot massage and warm saline foot soaking in addition to routine antenatal care and those who received routine antenatal care alone.

METHODS

This study employs a quasi-experimental, non-equivalent pretest-posttest design with a control group to measure the effectiveness of a combination of foot massage and warm-water-and-salt foot soaks for third-trimester pregnant women. Participants were divided into two equal groups: an intervention group, which received the combination of foot massage and warm water and salt foot soaks alongside routine antenatal care, and a control group, which received only counseling and routine antenatal care. The study was conducted over two months within the working area of the Batang 3 Community Health Center (Puskesmas). The population consisted of 110 third-trimester pregnant women registered in the records of the Batang 3 Community Health Center. The sample size was

determined using a formula for comparing two independent groups, with an effect size of 0.80, a two-tailed significance level of 0.05, and a statistical power of 90% [19]. Accounting for a 10% potential dropout rate, 38 participants were recruited for each group, resulting in a final total sample of 76 participants. Consecutive sampling was used until the required quota was met.

Inclusion criteria for this study were: third-trimester pregnant women (28–38 weeks of gestation) experiencing physiological bilateral edema of the lower extremities, absence of preeclampsia symptoms (normal blood pressure, not exceeding 140/90 mmHg, and no proteinuria), singleton pregnancies without complications, and the absence of open wounds, infections, dermatitis, or varicose ulcers on the skin of the lower extremities. Exclusion criteria included: gestational hypertension, pregnancy complications (such as renal failure, cardiovascular dysfunction, or diabetes mellitus), deep vein thrombosis, and cognitive impairments that would hinder the implementation of the study intervention.

Measurements were taken using a flexible, standardized, centimeter-calibrated measuring tape at specific anatomical landmarks: ankle circumference (measured at the narrowest point, just proximal to the medial and lateral malleoli), heel circumference (measured around the heel and the anterior ankle flexure), and foot circumference (measured at the widest point across the metatarsophalangeal joints) [16]. All measurements were performed twice by the researcher once for the pretest and once for the posttest with the respondents in a seated position, their feet relaxed and resting flat on the floor. Respondents in the intervention group received a combined treatment consisting of a 20-minute foot massage (using gentle, structured, centripetal strokes) followed by a 10-minute warm-water foot soak with Epsom salt (30 grams of salt per one liter of warm water, maintained at 38°C). The intervention was administered once daily in the afternoon for 5 consecutive days. The control group received standard antenatal care, which includes recommendations for regular rest, elevating the feet, and avoiding prolonged standing.

Statistical analysis was conducted using SPSS version 26.0. A Shapiro-Wilk test for normality indicated a non-normal distribution ($p < 0.05$). Consequently, the Wilcoxon signed-rank test was used to assess differences between pretest and posttest results, while the Mann-Whitney U test was used to analyze differences between groups (based on the

reduction in circumference, calculated as pretest value minus posttest value). The effect size (r) was calculated using the formula r=|Z|/√N. Ethical approval was obtained from Universitas Karya Husada Semarang (protocol number 025/KEP/UNKAHA/LPPM/I/2026). Research permission was obtained from the head of the Batang 3 Community Health Center (Puskesmas). All respondents were provided with an informed consent form before participating in this study.

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Table 1. Characteristics of pregnant women in third trimester with edema in the intervention and control groups

Baseline Characteristic	Intervention (n=38)	Control (n = 38)	*p-value*
Maternal age, years, median (IQR)	27.00 (8.00)	26.50 (8.00)	0.613
Gestational age, median (IQR)	32.50 (5.00)	33.50 (5.00)	0.230
Education Level, n (%)			
Junior High School	10 (26.3)	10 (26.3)	0.104
Senior High School	10 (26.3)	9 (23.7)	
Diploma	8 (21.1)	9 (23.7)	
Bachelor degree	10 (26.3)	10 (26.3)	
Parity History, n (%)			
Primigravida	17 (44.7)	17 (44.7)	1.000
Multigravida	21 (55.3)	19 (50.0)	
Grande Multipara	0 (0.0)	2 (5.3)	
Occupation, n (%)			
Housewife	13 (34.2)	13 (34.2)	0.447
Trader	15 (39.5)	15 (39.5)	
Civil Servent	5 (13.2)	5 (13.2)	
Private Employee	5 (13.2)	5 (13.2)	
Baseline leg circumference measurement, median (IQR)			
Ankle circumference	25.05 (1.85)	24.65 (2.32)	0.633
Heel circumference	30.15 (1.52)	29.80 (2.25)	0.987
Foot circumference	24.10 (1.37)	23.90 (1.35)	0.578

****Source Primary data form October 2025***

As shown in Table 1, the study involved an intervention group of 38 respondents and a control group of 38 respondents. No statistically significant differences were found between the groups regarding maternal age, gestational age, education, parity, occupation, or the initial measurements of the ankle, heel, and foot circumference (all $p > 0.05$), indicating that the baseline characteristics measured were comparable.

Table 2. Pretest and posttest measurements of leg circumference in pregnant women with edema for both the intervention and control groups (N = 76)

Indicator of edema	Group	Pre-test Mean ± SD (cm)	Post-test Mean ± SD (cm)	Mean Reduction ± SD (cm)
Ankle circumference	Intervention (n=38)	24.85 ± 1.33	23.57 ± 1.39	1.284 ± 0.375
	Control (n=38)	24.71 ± 1.40	24.50 ± 1.39	0.213 ± 0.222
Heel circumference	Intervention (n=38)	29.86 ± 1.04	28.49 ± 1.21	1.374 ± 0.401
	Control (n=38)	29.82 ± 1.56	29.56 ± 1.61	0.253 ± 0.220
Foot circumference	Intervention (n=38)	24.18 ± 1.11	23.16 ± 1.14	1.026 ± 0.261
	Control (n=38)	24.04 ± 1.04	23.80 ± 1.02	0.239 ± 0.150

Table 2 shows that both study groups experienced a reduction in foot circumference measurements. However, the magnitude of this reduction was greater in the intervention group compared to the control group. Ankle circumference decreased intervention group versus 1.28cm control group 0.21 cm, heel circumference decreased 1.37cm compared 0.26cm, and foot circumference decreased 1.02cm compared 0.24cm.

Table 3. Within-group comparison of pretest and posttest circumferences

Indikator of Edema	Group	Z	*p-value*
Ankle circumference	Intervention (n=38)	−5,389	<0,001
	Control (n=38)	−4,517	<0,001
Heel circumference	Intervention (n = 38)	−5,384	<0,001
	Control (n = 38)	−4,731	<0,001
foot circumference	Intervention (n = 38)	−5,383	<0,001
	Control (n = 38)	−5,187	<0,001

**** Wilcoxon Signed-Rank Test***

Based on the results in Table 3, measurements of lower extremity circumference in third-trimester pregnant women with edema show statistically significant changes in both groups ($p < 0.001$). The control group experienced a significant reduction, as they received routine counseling such as advice to avoid standing for too long and to get adequate rest while the intervention group showed a greater clinical change.

Table 4. Between-group comparison of edema circumference reduction

Indicator of Edema	Mean Rank Intervensi	Mean Rank Kontrol	Δ Intervention	Δ Kontrol	p-value	Effect size (r)
Ankle circumference	57.18	19.82	1.28 cm	0.21 cm	<0,001	0,848
Heel circumference	57.32	19.68	1.30 cm	0.25 cm	<0,001	0,853
foot circumference	57.38	19.62	1.00 cm	0.20 cm	<0,001	0,856

Table 4 presents comparison of the reduction in circumferences between the intervention group and the control group. The intervention group showed greater reduction in ankle circumference (1.28 cm), heel circumference (1.30 cm), and foot circumference (1.00 cm) compared to the control group (0.21 cm, 0.25 cm, and 0.20 cm, respectively). The mean ranks were consistently higher in the intervention group across all three measurement locations. These differences were statistically significant ($p < 0.001$), with effect sizes for ankle circumference ($r = 0.848$), heel circumference ($r = 0.853$), and foot circumference ($r = 0.856$).

DISCUSSION

This study examines and evaluates a midwifery intervention that combines structured foot massage with warm saline foot baths, administered over five consecutive days. The primary results indicate that this combination is significantly more effective in reducing physiological foot edema compared to standard routine antenatal counseling alone. Women in the intervention group experienced an average reduction of 1.28 cm in ankle circumference, 1.30 cm in heel circumference, and 1.00 cm in foot circumference. These figures are substantially higher than the reductions observed in the control group 0.21 cm, 0.25 cm, and 0.20 cm, respectively. The differences between the groups are highly significant ($p < 0.001$), with an effect size (r) ranging from 0.848 to 0.853. These findings provide clinical evidence that a combination of physical stimulation and hydrotherapy offers more substantial benefits than relying solely on passive verbal advice for healthy women in the third trimester of pregnancy.

Physiological edema in the third trimester of pregnancy is caused by pregnancy induced hypervolemia, generalized capillary relaxation resulting from increased progesterone levels, and significant mechanical obstruction of the inferior vena cava and

iliac veins by the enlarging uterus [20][21]. These factors increase venous hydrostatic pressure in the lower extremities overcoming the oncotic pressure and lead to excessive transudation of serous fluid into the interstitial tissue spaces[22][3]. Therapeutic leg massage utilizes gentle, centripetal mechanical movements to facilitate the movement of interstitial fluid into initial lymphatic capillaries and enhance the rate of venous blood flow toward the central circulation [23][24]. These findings reinforce the results of a study by Khan et al. (2023), which indicated that regular therapeutic massage can significantly reduce ankle circumference during the third trimester of pregnancy[2]. Furthermore, these results are supported by a meta-analysis by Yang and Li (2024), which confirms that therapeutic manipulation of the lower extremities in pregnant women can improve maternal hemodynamic parameters, reduce peripheral vascular resistance, and alleviate discomfort in the lower extremities[10].

The elements and components of a warm-water foot soak at a temperature of 38°C provide interrelated therapeutic effects [25][9]. The localized heat stimulates thermoreceptors in the skin, triggering peripheral vasodilation and reducing smooth muscle tone in superficial blood vessels. The addition of salt to the warm water creates an osmotic effect and promotes muscle relaxation, while the minerals present in the salt help reduce mild inflammation [16]. These findings align with research by Rianita et al. (2022), which observed significant changes in foot edema among third-trimester pregnant women following the use of a warm, salted-water soak [17]. Similarly, research by Rachman (2026) highlights the additional benefit of vascular relaxation achieved through foot immersion in water combined with salt [18]. According to Aprianti and Oktavia (2024), warm-water baths whether mixed with herbal ingredients or salt can induce various relaxation effects, with the warm water itself playing the primary role in generating hydrostatic and thermal responses [1]. In this multicomponent procedure, the mechanisms of massage, thermal vasodilation, hydrostatic compression, and the warm, salted-water soak work in synergy. Because the intervention components are interconnected, their individual contributions cannot be entirely isolated; rather, the observed results reflect the broad efficacy of the combination as a whole.

Measuring edema in the feet of pregnant women in their third trimester using a non-elastic tape to assess circumferences at predetermined anatomical landmarks specifically the ankle, heel, and foot provides a more objective, quantitative approach

[26][27][5]. In contrast, the "pitting edema" assessment relies heavily on the examiner's visual and tactile estimation[28]. Circumference-based assessment captures the redistribution of interstitial fluid across all distal compartments of the foot, rather than merely reflecting tissue stiffness at a single point[29]. This aligns with research by Mollaelahi (2023), which suggests that edema in third-trimester pregnant women can be evaluated through continuous, millimeter-based measurements using a tape measure, this method offers a more comprehensive detection of minor reductions in fluid retention compared to the pitting edema assessment [7]. Similarly, a study by Nishimura (2020) found that using a non-elastic tape measure at anatomical bony landmarks yields a very high intraclass correlation coefficient, making it a more reproducible standard for assessment in experimental research [30]. Although the pitting edema assessment is widely used in routine midwifery practice, recent research highlights its limitations, namely its susceptibility to inter-rater variability and low sensitivity to small changes in volume. Measuring edema via foot circumferences at standardized bony landmarks produces continuous, ratio-scale data with superior inter-rater reliability, thereby enabling precise parametric statistical analysis for evaluating non-pharmacological therapies.

STRENGTHS AND LIMITATIONS

The strengths of this study include its prospective experimental design and an adequate sample size. The research employs objective and standardized measurement indicators specifically the use of a measuring tape at predetermined anatomical landmarks and demonstrates a high level of participant adherence.

there are several limitations that warrant attention. First, although respondents were divided into intervention and control groups based on inclusion criteria, the use of a non-randomized, quasi-experimental design may introduce confounding factors that cannot be entirely controlled. Second, the nutritional intake of the pregnant women including sodium consumption was monitored via self-reporting rather than through strict dietary control, and physical activity levels were not recorded. Future research could build upon this study by conducting a randomized controlled trial (RCT) that compares various interventions, such as massage alone, soaking in warm saltwater, or a combination of both. Attention should also be paid to the clinical indications of pathological edema in pregnant women.

CONCLUSIONS

Combinationof of 20 minute foot massage using strokes directed toward the center of the body (centripetal) followed by soaking the feet in warm salt water (30 grams of Epsom salt per liter of water at 38°C), performed daily for five consecutive days, has been shown to be statistically effective in reducing physiological edema in the lower extremities of pregnant women in their third trimester. This intervention results in a more significant reduction in the circumference of the ankles, heels, and feet compared to routine antenatal counseling alone, with measurable effect sizes observed in the ankle, heel, and foot circumferences.

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