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Comparative Effects of Air Heat Versus Infrared Heat on Pain and Wound Healing After Vaginal Delivery with Episiotomy: A Randomized Controlled Trial

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Abstract

Background

Episiotomy is a common intrapartum procedure, but the postpartum perineal pain and delayed wound recovery it can cause remain important concerns for maternal wellbeing. Non-pharmacological interventions such as heat therapy may support healing and reduce discomfort, but head-to-head comparisons of different heat-based modalities combined with pelvic floor exercises are lacking. This study compared the effects of air heat therapy and infrared heat therapy, each combined with Kegel exercises, on postpartum pain and episiotomy wound healing.

Methods

This randomized controlled trial was conducted at Said Meetha Hospital, Lahore, Pakistan, between November 2021 and August 2023. Thirty postpartum women aged 18–40 years with a first- or second-degree episiotomy were randomly allocated by a lottery method to an infrared heat therapy group or an air heat therapy group (15 per group). Both groups received their allocated heat treatment twice daily for 10 consecutive days, together with standardized Kegel exercises. Pain was assessed using the Numerical Pain Rating Scale (NPRS) and wound healing using the REEDA scale at baseline, day 3, day 5, and day 10. Within-group and between-group differences were analyzed using paired and independent t-tests, with significance set at $p \leq 0.05$.

Results

Both groups showed significant within-group improvement in NPRS and REEDA scores over the 10-day intervention ($p < 0.05$ for both). Mean NPRS scores fell from 9.80 ± 0.41 at baseline to 4.26 ± 0.59 at day 10 in the infrared group, and from 9.68 ± 0.41 to 5.07 ± 0.59 in the air heat group, a significant between-group difference ($p = 0.001$). Mean REEDA scores fell from 8.53 ± 1.12 to 1.80 ± 2.26 in the infrared group, and from 9.00 ± 1.29 to 3.33 ± 1.29 in the air heat group. The between-group difference was not significant at day 3 ($p = 0.41$) but became significant at day 5 ($p = 0.003$) and remained significant at day 10 ($p = 0.026$), favoring infrared therapy.

Conclusions

Infrared heat therapy combined with pelvic floor muscle exercises produced greater improvements in both pain relief and episiotomy wound healing than air heat therapy, with the advantage emerging from day 5 of treatment and sustained through day 10. Both modalities are safe, low-cost options for postpartum perineal care, and infrared therapy may be preferable where equipment allows.

Trial registration

ClinicalTrials.gov, NCT05865236. Registered on 18 April 2023.

BACKGROUND

Episiotomy, a surgical incision of the perineum made during the second stage of labour, is frequently performed to facilitate vaginal birth and to prevent severe perineal trauma in selected cases(1).Although historically justified as a means of minimizing obstetric complications, episiotomy is associated with several postpartum concerns, including perineal pain, delayed tissue repair, infection, reduced mobility, and compromised maternal comfort and quality of life(1). Identifying effective postpartum interventions that support healing and alleviate discomfort has therefore become a clinical priority(2).

Among non-pharmacological strategies, heat therapy has attracted increasing attention because of its safety, accessibility, and suitability for breastfeeding women (3). Air heat therapy enhances superficial vasodilation and reduces muscle tension (4), whereas infrared heat therapy penetrates deeper tissue layers, improving microcirculation, oxygenation, and cellular regeneration in ways that may accelerate wound recovery (5). Previous studies have reported that infrared therapy can reduce perineal pain and improve episiotomy healing, although findings vary across clinical settings(6).

Pelvic floor muscle training (Kegel exercises), first described by Kegel in 1948, strengthens pelvic musculature, promotes blood flow, and supports perineal tissue repair during the postpartum period(7). Combining heat therapy with pelvic floor exercises may offer synergistic benefits by simultaneously enhancing circulation, reducing discomfort, and improving functional recovery(8).

Comparative evidence evaluating air heat against infrared heat therapy, particularly when combined with Kegel exercises, remains limited(8). Most existing research has examined individual modalities such as sitz baths or infrared therapy alone leaving a gap in head-to-head trials that assess both pain reduction and wound healing simultaneously(9).

Previous studies have demonstrated that infrared radiation, dry heat application, and photobiomodulation therapies improve episiotomy wound healing and reduce postpartum perineal pain(1). However, evidence directly comparing air heat therapy with infrared heat therapy in women following episiotomy remains limited. Therefore, this randomized controlled trial was conducted to compare the effectiveness of air heat and infrared heat therapies, each combined with Kegel exercises, on pain reduction and wound healing among postpartum women.

METHODS

Study design and setting

This randomized controlled trial was conducted at Said Meetha Hospital, Lahore, Pakistan, between January 2023 and August 2023. The trial was registered with ClinicalTrials.gov (NCT05865236) on April 2023. It evaluated the comparative effects of infrared heat therapy and air-dry heat therapy each combined with Kegel exercises on post-episiotomy pain and wound healing in postpartum women.

Randomization and blinding

Eligible participants were randomly assigned to one of two groups using a lottery method. Sealed opaque envelopes were prepared in advance by a research coordinator who was not involved in treatment delivery. Group A received infrared heat therapy combined with Kegel exercises; Group B received air-dry heat therapy combined with the same exercise protocol. Because of the physical nature of the interventions, blinding of participants and treating physiotherapists was not feasible. Outcome assessments were performed by a single trained examiner who was blinded to group allocation, to minimize assessment bias.

Sample size

Sample size was calculated using the formula for comparing two independent means:

$n = 2(Z\alpha/2 + Z\beta)^2\sigma^2/d^2$

assuming a 95% confidence level ($\alpha = 0.05$) and 80% statistical power(1). The expected effect size was estimated from previous studies evaluating the effect of infrared therapy on episiotomy wound healing and perineal pain among postpartum women. The minimum required sample size was calculated as 15 participants per group. To account for an anticipated attrition rate of 10%, a total of 32 participants (16 per group) were recruited. Two participants were lost to follow-up, resulting in a final analyzed sample of 30 women (15 per group). Baseline variables, including age, parity, degree of episiotomy, time since delivery, and baseline NPRS and REEDA(10) scores, were recorded to assess comparability between groups.

Participants

Inclusion criteria

postpartum women aged 18–40 years who had undergone normal vaginal delivery with a first- or second-degree medio-lateral episiotomy(11, 12), recruited 12–24 hours after delivery. Participants were recruited by non-probability convenience sampling.

Exclusion criteria

women with chronic systemic illness, active perineal infection(13), a neurological disorder affecting pain perception, or a contraindication to heat therapy were excluded.

Intervention

Before the intervention, all participants received standardized baseline postpartum care prescribed by the attending obstetrician, including perineal hygiene instructions, topical antiseptics, and oral analgesia (ibuprofen 400 mg as needed). Both groups received their allocated heat treatment twice daily for 10 consecutive days, in addition to standardized Kegel exercises.

Group A infrared heat therapy

infrared therapy was delivered using a Philips IR-300 infrared lamp (Philips Healthcare, Amsterdam, Netherlands) held 45–60 cm from the perineum for 10 minutes per session, providing moderate warmth without discomfort, twice daily for 10 consecutive days. Participants also performed three sets of 10 pelvic floor muscle contractions per session, each contraction and relaxation held for 5 seconds. Correct technique was initially supervised by a qualified physiotherapist.

Group B air heat therapy

air heat therapy was delivered using a Haier HD-2100 hair dryer (Haier Pakistan, Lahore) held 30–45 cm from the perineum on medium heat for 10 minutes per session, twice daily for 10 consecutive days. Participants followed the same standardized Kegel exercise protocol as Group A.

Outcome measures

Primary outcome

episiotomy wound healing, assessed with the REEDA scale(14), which rates five parameters redness, oedema, ecchymosis, discharge, and approximation on a total scale of 0 to 15, with higher scores indicating poorer healing. Assessments were performed at baseline, day 3, day 5, and day 10 by a single trained examiner to ensure consistency(14).

Secondary outcome

post-episiotomy pain intensity, measured with the Numerical Pain Rating Scale (NPRS; 0–10), where 0 indicates no pain and 10 indicates the worst imaginable pain. Assessments were performed at the same time points as the primary outcome(15).

Statistical analysis

Data were analyzed using SPSS version 21 (IBM Corp., Armonk, NY, USA)(16). Continuous variables are expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Within-group comparisons were performed using paired t-tests, and between-group comparisons using independent t-tests. Statistical significance was set at $p \leq 0.05$. Participant recruitment, allocation, follow-up, and analysis are presented in the CONSORT flow diagram (Fig. 1).

This randomized controlled trial is reported in accordance with the CONSORT 2010 Statement.

RESULTS

Thirty participants completed the study, 15 in each group. Baseline characteristics were comparable between the infrared heat and air heat (hair dryer) groups ($p > 0.05$ for all comparisons), as detailed in Table 1. Mean age was 25.0 ± 4.5 years in the infrared group and 25.67 ± 3.04 years in the air heat group. Most participants were housewives (53.33% vs. 73.33%, respectively). Parity distribution showed 33.33% primiparous and 66.67% multiparous women in the infrared group, compared with 46.67% primiparous and 53.33% multiparous women in the air heat group. Episiotomy type was evenly distributed between groups (46.67% medio-lateral and 53.33% lateral in each). The mean duration of the first stage of labour was 13.8 ± 5.92 hours in the infrared group and 18.07 ± 5.06 hours in the air heat group; the second stage lasted 27.53 ± 7.59 and 28.73 ± 7.46 hours, respectively. Baseline NPRS and REEDA scores were similar in both groups, confirming pre-intervention comparability (Table 1).

Table 1
Baseline characteristics of participants (n = 30)

Characteristic	Infrared Group (n = 15)	Air Heat Group (n = 15)	p-value
Age (years), mean ± SD	25.0 ± 4.5	25.67 ± 3.04	0.681
Parity — Primiparous, n (%)	5 (33.33%)	7 (46.67%)	0.471
Parity — Multiparous, n (%)	10 (66.67%)	8 (53.33%)	
Occupation — Housewife, n (%)	8 (53.33%)	11 (73.33%)	0.252
Occupation — Employed, n (%)	7 (46.67%)	4 (26.67%)	
Episiotomy — Medio-lateral, n (%)	7 (46.67%)	7 (46.67%)	0.999
Episiotomy — Lateral, n (%)	8 (53.33%)	8 (53.33%)	
Duration of 1st stage (hours), mean ± SD	13.8 ± 5.92	18.07 ± 5.06	0.072
Duration of 2nd stage (hours), mean ± SD	27.53 ± 7.59	28.73 ± 7.46	0.673
Baseline NPRS score, mean ± SD	9.80 ± 0.41	9.80 ± 0.41	1.000
Baseline REEDA score, mean ± SD	8.53 ± 1.12	9.00 ± 1.29	0.322

SD standard deviation, NPRS Numerical Pain Rating Scale, REEDA Redness, Oedema, Ecchymosis, Discharge, Approximation. p-values from independent t-test (continuous variables) and chi-square test (categorical variables).

Post-episiotomy pain intensity (NPRS) decreased significantly within both groups over the 10-day intervention (within-group $p = 0.001$ for both), as shown in Table 2. At baseline, mean NPRS scores were

9.80 ± 0.41 in the infrared group and 9.68 ± 0.41 in the air heat group (p = 0.43). No significant between-group difference was present at day 3 (9.60 ± 0.36 vs. 9.70 ± 2.17; p = 0.84). By day 5, the infrared group showed markedly greater pain reduction than the air heat group (7.50 ± 0.22 vs. 8.98 ± 0.14; p = 0.001), and this advantage persisted at day 10 (4.26 ± 0.59 vs. 5.07 ± 0.59; p = 0.001). Over the full 10-day period, the mean NPRS reduction was 5.54 points in the infrared group compared with 4.61 points in the air heat group.

Table no:02. NPRS and REEDA scores at each assessment time point

Time Point	Infrared (Mean ± SD)	Air Heat (Mean ± SD)	Mean Diff.	Between-Group p
NPRS — Baseline	9.80 ± 0.41	9.68 ± 0.41	0.12	0.43
NPRS — Day 3	9.60 ± 0.36	9.70 ± 2.17	0.10	0.84
NPRS — Day 5	7.50 ± 0.22	8.98 ± 0.14	1.48	0.001*
NPRS — Day 10	4.26 ± 0.59	5.07 ± 0.59	0.81	0.001*
NPRS — Mean reduction	5.54	4.61	0.93	—
NPRS — Within-group p	0.001*	0.001*		
REEDA — Baseline	8.53 ± 1.12	9.00 ± 1.29	0.47	0.29
REEDA — Day 3	4.95 ± 1.22	5.33 ± 1.29	0.38	0.41
REEDA — Day 5	3.60 ± 1.08	5.01 ± 1.29	1.41	0.003*
REEDA — Day 10	1.80 ± 2.26	3.33 ± 1.29	1.53	0.026*
REEDA — Mean reduction	6.73	5.67	1.06	—
REEDA — Within-group p	0.001*	0.001*		

*Statistically significant (p < 0.05). — not applicable. Within-group comparisons by paired t-test; between-group comparisons by independent t-test. Mean difference = Air Heat − Infrared (absolute value shown). SD standard deviation, NPRS Numerical Pain Rating Scale, REEDA Redness, Oedema, Ecchymosis, Discharge, Approximation.

Episiotomy wound healing, assessed with the REEDA scale, also improved significantly within both groups (within-group p = 0.001 for both). Baseline REEDA scores were 8.53 ± 1.12 in the infrared group and 9.00 ± 1.29 in the air heat group, with no significant between-group difference (p = 0.29). At day 3, scores had fallen to 4.95 ± 1.22 (infrared) and 5.33 ± 1.29 (air heat); this difference was not yet statistically significant (p = 0.41). A significant between-group difference emerged at day 5 (3.60 ± 1.08

vs. 5.01 ± 1.29; p = 0.003) and remained significant at day 10 (1.80 ± 2.26 vs. 3.33 ± 1.29; p = 0.026), favoring the infrared group. Over the full intervention period, the mean REEDA reduction was 6.73 points in the infrared group compared with 5.67 points in the air heat group.

Overall, both modalities, combined with Kegel exercises, produced significant within-group improvements in pain and wound healing. However, infrared heat therapy showed a clear between-group advantage over air heat therapy for both outcomes from day 5 onward, rather than in the first three days of treatment.

DISCUSSION

This randomized controlled trial compared the effectiveness of infrared heat therapy and air heat therapy, each combined with Kegel exercises, on post-episiotomy perineal pain and wound healing. Both groups showed significant within-group improvement in pain intensity (NPRS) and wound healing (REEDA) across the 10-day intervention, and the infrared group showed a statistically significant advantage over the air heat group from day 5 onward for both outcomes.

At baseline, both groups reported comparable and severe perineal pain (mean NPRS approximately 9.7–9.8), confirming pre-intervention homogeneity(17). Pain scores remained similar between groups through day 3, but a clear divergence emerged by day 5 (7.50 ± 0.22 in the infrared group versus 8.98 ± 0.14 in the air heat group; p = 0.001) and was sustained at day 10 (4.26 ± 0.59 versus 5.07 ± 0.59; p = 0.001). This pattern suggests that although superficial air heat and deeper infrared heat share common thermo therapeutic mechanisms—including vasodilation, muscle relaxation, and improved local circulation—the deeper tissue penetration achieved by infrared therapy produces a measurable analgesic advantage only after several days of sustained treatment, rather than an immediate effect. Roma and colleagues similarly reported that dry heat application significantly reduced perineal pain scores in primiparous women, consistent with the pain-relieving effect observed in our air heat group, even though the infrared group in our trial ultimately achieved a greater reduction(3). Shao and colleagues further showed that interventions targeting perineal musculature and local circulation produced significant pain relief in perineal surgical conditions, supporting the analgesic role of thermotherapy in this region(18).

Wound healing outcomes followed a similar trajectory. REEDA scores decreased significantly from baseline to day 10 in both groups, but the infrared group achieved a numerically and statistically greater reduction (6.73 vs. 5.67 points). Unlike pain scores, REEDA scores did not differ significantly between groups at day 3 (p = 0.41), indicating that the two modalities produce comparable early superficial changes in redness, oedema, and discharge(19). A statistically significant between-group difference emerged by day 5 (p = 0.003) and was maintained at day 10 (p = 0.026), indicating that infrared therapy accelerates wound healing from the middle of the treatment course onward rather than in the first few days. This delayed but sustained advantage is physiologically plausible: infrared's deeper tissue penetration enhances microcirculation, collagen synthesis, and cellular metabolism—effects that typically require several days of cumulative exposure to become clinically apparent, rather than

producing an immediate difference. Salvi and colleagues, in a comparative evaluation of infrared radiation versus routine care for episiotomy wound healing, similarly found superior REEDA score improvements in the infrared group as treatment progressed, supporting the physiological basis of our findings(2).

Several studies have documented similar advantages of infrared therapy for perineal wounds, including reductions in oedema and ecchymosis and improved tissue approximation over the course of treatment(6, 20). An Indian observational study reported substantial wound improvement following infrared therapy over the treatment course, broadly consistent with the trajectory observed in our infrared group(2). Roma and colleagues also demonstrated that dry heat application significantly reduced redness, oedema, and discharge scores in episiotomy wounds within the first week of application; in our study, the two modalities produced comparable early-phase outcomes before infrared pulled ahead from day 5. The infrared lamp's ability to penetrate deeper below the skin surface—compared with the superficial warming effect of air heat—likely accounts for this cumulative, rather than immediate, healing advantage through enhanced local oxygen delivery and fibroblast stimulation.

No significant associations were found between healing outcomes and baseline characteristics such as age, parity, or type of episiotomy. This supports the interpretation that treatment modality, rather than demographic factors, was the primary driver of the differences observed in perineal wound healing and pain relief, which strengthens the generalizability of these results to similar perineal recovery populations. This is consistent with comparable trials that have likewise failed to identify age or parity as significant predictors of episiotomy healing rate once treatment type is controlled for.

Overall, these findings suggest that while both thermotherapy modalities reduced perineal pain and improved episiotomy wound healing from baseline, infrared therapy showed a consistent advantage over air heat therapy that became statistically significant from the mid-point of treatment (day 5) and was sustained through day 10, for both pain and wound healing outcomes. These results are especially relevant for physiotherapy-led perineal rehabilitation programmes, where non-pharmacological modalities are preferred to support recovery without systemic side effects.

Limitations

- Participants' daily activities and perineal care practices were not monitored between treatment sessions, which may have influenced perineal pain levels and healing outcomes.
- Follow-up was limited to 10 days, which precluded evaluation of longer-term perineal recovery.
- The small sample size and single-centre recruitment may limit the generalizability of the findings.
- Assessments at day 3 may not have captured subtle early differences that a shorter re-assessment interval (e.g., day 1 or day 2) could have detected.

Practical implications

These findings have direct implications for physiotherapy practice in perineal care after episiotomy. Infrared heat therapy is a simple, low-cost, non-invasive modality that can be readily integrated into postpartum ward physiotherapy protocols alongside pelvic floor rehabilitation. Given its demonstrated advantage in both pain relief and wound healing from day 5 onward—a critical window for preventing wound complications and reducing perineal pain—infrared therapy may be preferentially recommended as a first-line physical therapy adjunct after episiotomy, particularly for women expected to require more than a few days of supervised recovery. Where infrared equipment is unavailable, air heat therapy remains a viable and effective alternative for managing perineal pain and supporting wound healing, albeit with a comparatively slower trajectory. Both modalities are safe, non-invasive, compatible with breastfeeding, and suitable for low-resource maternity settings.

Future directions

Future research should address the limitations of this study by recruiting larger samples across multiple centres to improve statistical power and generalizability. Extended follow-up of four to six weeks would allow evaluation of complete perineal tissue healing, scar formation, and restoration of pelvic floor function. More frequent early assessments (for example, at day 1 and day 2) would help clarify precisely when the infrared advantage begins to emerge. Standardized monitoring of participants' perineal hygiene practices and analgesic use between treatment sessions would improve internal validity. Future trials should also incorporate patient-reported outcome measures such as quality of life, perineal comfort, and return to daily activities, to provide a more complete picture of perineal recovery. Comparative trials that include sitz baths or cold therapy as additional arms would further clarify the relative positioning of infrared and air heat modalities within the broader spectrum of perineal rehabilitation.

CONCLUSIONS

This randomized controlled trial showed that both infrared heat and air heat therapy, combined with Kegel exercises, effectively reduced post-episiotomy perineal pain and improved episiotomy wound healing from baseline. Infrared heat therapy produced significantly greater improvements in both NPRS and REEDA scores than air heat therapy, with the advantage becoming statistically significant from day 5 of treatment and sustained through day 10. These findings highlight the physiological advantages of infrared therapy including enhanced microcirculation, tissue oxygenation, and cellular repair supporting its use as a non-pharmacological intervention for perineal pain relief and wound care after episiotomy. Incorporating infrared therapy into routine perineal physiotherapy protocols, particularly from the mid-point of recovery onward, may accelerate wound healing and reduce perineal pain, especially in low-resource clinical settings.

Abbreviations

RCT
Randomized controlled trial
NPRS

Numerical Pain Rating Scale
REEDA
Redness, Oedema, Ecchymosis, Discharge, Approximation
SD
Standard deviation
IRB
Institutional Review Board.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with national ethical regulations, institutional guidelines, and the principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of Said Meetha Hospital, Lahore (Approval No.: SMH/PHY/2021/042). Written informed consent was obtained from all participants prior to enrolment. Participants were fully informed of the study purpose, procedures, potential risks, and their right to withdraw at any time without consequences.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

MT conceived and designed the study, coordinated the research activities, performed the statistical analysis, interpreted the data, and drafted the manuscript. AB contributed to participant recruitment, data collection, and data entry. RN provided overall research supervision, methodological guidance, and critically reviewed the manuscript for important intellectual content. GF contributed to study design, manuscript review, and interpretation of findings. JA contributed to study supervision, data management, manuscript revision, and interpretation of results. ES assisted with data collection, participant follow-up,

and manuscript preparation. All authors critically revised the manuscript, approved the final version for publication, and agreed to be accountable for all aspects of the work.

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Authors' information

Not applicable.

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Figures

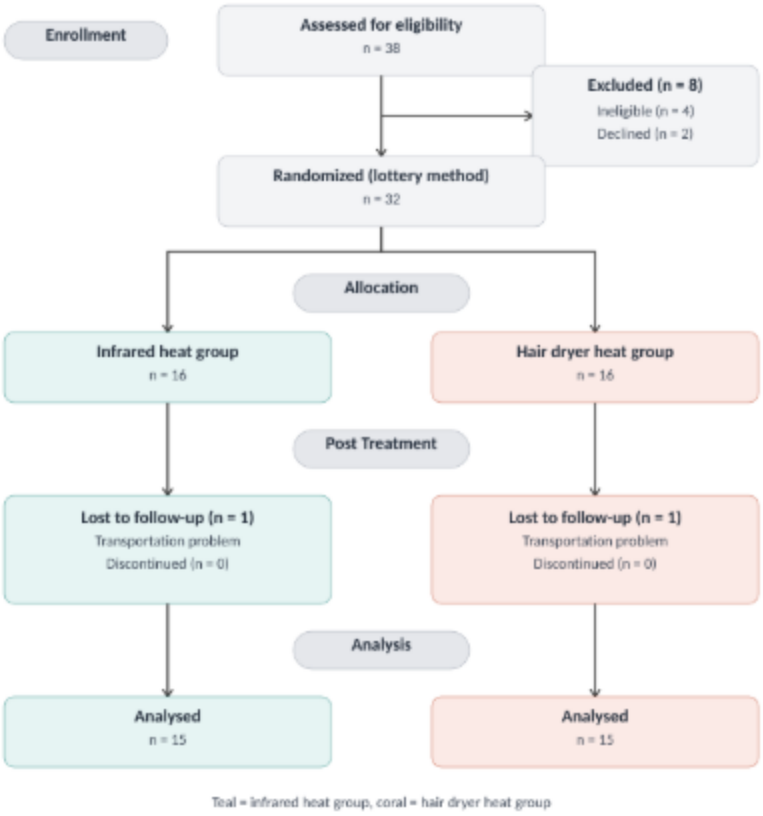


Figure 1

CONSORT flow diagram of participant recruitment, exclusion, randomization, allocation, follow-up, and analysis for the two trial arms (infrared heat therapy and hair dryer heat therapy).