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Research Article

EFFECT OF DIAPHRAGMATIC BREATHING ON PERCEIVED STRESS AND MILK LET-DOWN REFLEX IN BREASTFEEDING MOTHERS: A NONRANDOMIZED PRE-POST INTERVENTIONAL STUDY

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ABSTRACT

Psychological stress during the postpartum period can suppress oxytocin release and impair the milk let-down reflex, potentially compromising breastfeeding. Diaphragmatic breathing is a simple, non-pharmacological relaxation technique that may lower stress and support lactation, but evidence in postpartum populations remains limited. This nonrandomized, one-group pre-post interventional study evaluated the effect of a seven-day diaphragmatic breathing programme on perceived stress and self-reported milk let-down reflex among breastfeeding mothers, and examined whether the change in one outcome was associated with the change in the other. Thirty exclusively breastfeeding mothers aged 20-35 years with elevated baseline stress were enrolled through convenience sampling from a maternity hospital and community centres in Visnagar, Gujarat, India. Participants practiced diaphragmatic breathing twice daily for seven consecutive days. Perceived stress and milk let-down reflex were assessed before and after the intervention using the Perceived Stress Scale (PSS-10) and a self-reported Milk Let-Down Reflex Questionnaire (MLDRQ). Results: All 30 participants completed the programme with no dropouts. Mean perceived stress scores fell substantially after intervention, and the proportion of mothers in the high-stress category dropped sharply. Mean milk let-down reflex scores rose significantly. However, the magnitude of individual change in stress was not significantly correlated with the magnitude of change in let-down reflex. A brief, low-cost diaphragmatic breathing programme was associated with reduced perceived stress and improved self-reported milk let-down reflex among breastfeeding mothers, supporting its consideration as an adjunct in postpartum lactation care.

Keywords: Breastfeeding, Diaphragmatic breathing, Milk let-down reflex, Perceived stress, Postpartum.

INTRODUCTION

Breastfeeding remains the most physiologically appropriate and cost-effective means of infant nutrition, and exclusive breastfeeding for the first six months of life is recommended by international health authorities because of its established benefits for infant immunity, growth and development, as well as for maternal recovery (World Health Organization, 2023; Kaur *et al*., 2025). Effective breastfeeding, however, depends not only on adequate milk synthesis but also on the efficient transfer of milk from the alveoli to the infant, a process governed by the milk let-down (ejection) reflex. Suckling-induced stimulation of the nipple activates a neuroendocrine pathway that culminates in the release of oxytocin from the posterior pituitary; oxytocin acts on myoepithelial cells surrounding the alveoli, causing them to contract and expel milk into the ductal system (Crowley & Armstrong, 1992; Hassiotou & Geddes, 2013; Ramsay *et al*., 2005). The efficiency of this reflex is highly sensitive to the mother's psychological state. Maternal anxiety, fear and emotional distress have repeatedly been shown to blunt oxytocin secretion and to activate the sympathetic nervous system, both of which interfere with milk ejection (Wahyuni *et al*., 2021; Deif *et al*., 2021; Middleton *et al*., 2025). Chronic psychological

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distress additionally raises circulating cortisol and can suppress prolactin, delay the onset of copious milk production and reduce milk volume over time (Nagel *et al*., 2022; Matyas *et al*., 2024; Lau, 2001). The early postpartum period is a time of particular vulnerability, since sleep deprivation, physical recovery from delivery, and the demands of newborn care converge to elevate maternal stress precisely when successful lactation needs to be established. Diaphragmatic breathing is a simple relaxation technique in which slow, deep, abdominally-directed breathing is used to shift autonomic balance away from sympathetic dominance toward parasympathetic activity. Narrative and systematic reviews report consistent reductions in perceived stress, anxiety and physiological arousal following diaphragmatic breathing training in a range of adult populations (Hamasaki, 2020; Ma *et al*., 2017; Russo *et al*., 2017; Hopper *et al*., 2019). Because parasympathetic activation is mechanistically linked to enhanced oxytocin release, diaphragmatic breathing has been proposed as a plausible, low-cost strategy for supporting the milk let-down reflex in breastfeeding women (Uvnas-Moberg *et al*., 2020; Brown & Gerbarg, 2013). Relaxation-based interventions of other kinds, including guided imagery, music therapy and structured relaxation training, have previously been associated with improved milk output and reduced maternal stress in postnatal samples (Feher *et al*., 1989; Keith *et al*., 2012; Ak *et al*., 2017; Mohd Shukri *et al*., 2019; Shukri *et al*., 2018), lending indirect support to this hypothesis.

In spite of this theoretical rationale, direct evidence on diaphragmatic breathing specifically as an intervention for perceived stress and milk let-down reflex in breastfeeding mothers is scarce, and no comparable Indian study was identified. The present study was therefore undertaken to evaluate, using a nonrandomized pre-post design, whether a seven-day diaphragmatic breathing programme reduces perceived stress and improves self-reported milk let-down reflex in exclusively breastfeeding mothers, and to determine whether the extent of stress reduction is associated with the extent of improvement in let-down reflex at the level of the individual participant. It was hypothesised, a priori, that perceived stress scores would decrease and milk let-down reflex scores would increase significantly from before to after the intervention.

MATERIALS AND METHODS

Study design and setting

A nonrandomized, one-group pre-test post-test (quasi-experimental) interventional design was used; no control or comparison group was included, and this design feature is stated explicitly here in accordance with transparent reporting standards for nonrandomized evaluations (TREND). The study was carried out over four months at Yash Maternity Hospital, Visnagar, and at selected community centres in Visnagar town and Kansa village, Gujarat, India, following approval from the Institutional Ethics Committee of Nootan College of Physiotherapy (approval no. NCP/IEC/144 - 14/26) and permission from the administrative authorities of the participating hospital and community centres.

Participants

Thirty breastfeeding mothers were enrolled by convenience sampling. Eligible participants were primiparous or multiparous women aged 20-35 years, exclusively breastfeeding an infant aged 1-6 months, reporting a baseline Perceived Stress Scale (PSS-10) score above 13, and willing to provide written informed consent. Women with a severe medical illness or diagnosed psychiatric disorder likely to affect breastfeeding, or who were taking medication known to influence lactation, were excluded. The sample size of 30 was determined pragmatically on the basis of the four-month study period and participant availability at the study sites, consistent with similarly designed pilot evaluations of relaxation-based lactation interventions in the reviewed literature (Keith *et al*., 2012; Ak *et al*., 2017).

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki (as revised) and the ethical guidelines of the Indian Council of Medical Research (ICMR). Written informed consent was obtained from every participant after the purpose, procedures, expected benefits, potential discomforts and voluntary nature of participation had been explained in the local language. Participants were informed that they could withdraw at any stage without any effect on their clinical care, and confidentiality of individual data was maintained throughout by coding participant records.

Intervention

Diaphragmatic breathing was selected as the intervention on the theoretical basis that slow, abdominally-directed breathing promotes a shift from sympathetic to parasympathetic autonomic predominance, thereby lowering circulating cortisol and disinhibiting oxytocin release, the hormone responsible for the milk let-down reflex (Uvnas-Moberg *et al*., 2020; Ohmura *et al*., 2023). Each participant received individual, investigator-led instruction and a supervised demonstration before independent practice began. Participants adopted a comfortable sitting, semi-Fowler's, or supine position, placed one hand on the chest and one on the abdomen, inhaled slowly through the nose over approximately four seconds while allowing the abdomen (not the chest) to rise, and exhaled slowly through the mouth over approximately six seconds while the abdomen fell. Each session comprised approximately ten breath cycles lasting about ten minutes, performed twice daily for seven consecutive days. Adherence was supported through periodic telephone contact by the investigator, who also addressed participant queries throughout the intervention period; no adverse events were reported.

Outcome measures

Perceived stress, the primary outcome, was measured using the 10-item Perceived Stress Scale (PSS-10), a widely used and validated self-report instrument scored from 0 to 40, with higher scores indicating greater perceived stress; scores were additionally categorised as low (0-13), moderate (14-26) or high (27-40) (Cohen *et al*., 1983; Cohen, 1994). The secondary outcome, self-reported milk let-down reflex, was assessed using a structured Milk Let-Down Reflex Questionnaire (MLDRQ) capturing the mother's subjective perception of let-down occurrence and adequacy during breastfeeding. Both instruments were administered by the investigator immediately before the first breathing session (baseline) and again on completion of the seven-day intervention (post-intervention), under comparable conditions.

Statistical analysis

Data were entered in Microsoft Excel and summarised as means, standard deviations, frequencies and percentages. Paired pre-post comparisons for PSS-10 and MLDRQ scores were performed using the paired t-test; because the distribution of difference scores departed from normality on Shapiro-Wilk testing, results were confirmed using the Wilcoxon signed-rank test. Effect sizes were calculated as Cohen's d. The association between the magnitude of change in PSS-10 score and the magnitude of change in MLDRQ score was examined using Pearson and Spearman correlation coefficients. A p-value below 0.05 was considered statistically significant for all analyses.

RESULTS AND DISCUSSION

All 30 enrolled participants completed the seven-day diaphragmatic breathing programme and both assessment points, yielding a 100% completion and follow-up rate with no missing outcome data. The mean age of participants was 29.4 years (SD 1.96; range 26-34 years); 76.7% were aged 26-30 years. Sixty percent of the sample had undergone caesarean delivery and 73.3% were primiparous. No participant reported any coexisting medical condition. Sample characteristics are summarised in Table 1. At baseline, the mean PSS-10 score was 31.07 (SD 4.04), and 86.7% of participants fell into the high-stress category (0% low, 13.3% moderate, 86.7% high), indicating that psychological stress was pronounced across the sample before intervention. The mean baseline MLDRQ score was 6.70 (SD 0.60), reflecting a comparatively weak self-reported let-down response consistent with the elevated baseline stress levels. Following the seven-day intervention, the mean PSS-10 score decreased to 24.47 (SD 4.42), a mean reduction of 6.60 points (95% CI 6.17-7.03), $t(29) = 31.09$, $p < 0.001$, Cohen's $d = 5.68$, confirmed by Wilcoxon signed-rank test ($p < 0.001$). The proportion of mothers in the high-stress category fell from 86.7% to 26.7%, while the moderate-stress category rose from 13.3% to 73.3%; no participant scored in the low-stress category at either assessment. Over the same period, the mean MLDRQ score increased from 6.70 (SD 0.60) to 11.30 (SD 1.02), a mean improvement of 4.60 points (95% CI 4.20-5.00), $t(29) = 23.55$, $p < 0.001$, Cohen's $d = 4.30$, likewise confirmed by Wilcoxon signed-rank test ($p < 0.001$). These pre-post comparisons are summarised in Table 2.

Table 1. Demographic and obstetric characteristics of participants (N = 30).

Characteristic	Category	n	%
Age (years)	26-30	23	76.7
	31 and above	7	23.3
Type of delivery	Normal (vaginal)	12	40.0
	Caesarean section	18	60.0
Parity	Primipara	22	73.3
	Multipara	8	26.7
Associated medical condition	None reported	30	100.0

Table 2. Comparison of pre- and post-intervention Perceived Stress Scale (PSS-10) and Milk Let-Down Reflex Questionnaire (MLDRQ) scores (paired t-test, N = 30).

Outcome	Pre-intervention Mean (SD)	Post-intervention Mean (SD)	Mean difference (95% CI)	t (df)	p-value	Cohen's d
PSS-10 score	31.07 (4.04)	24.47 (4.42)	6.60 (6.17-7.03)	31.09 (29)	<0.001	5.68
MLDRQ score	6.70 (0.60)	11.30 (1.02)	4.60 (4.20-5.00)	23.55 (29)	<0.001	4.30

Table 3. Correlation between change in perceived stress and change in milk let-down reflex (N = 30).

Variables correlated	Test	r / rho	p-value	Interpretation
Reduction in PSS-10 vs. improvement in MLDRQ	Pearson correlation	-0.105	0.580	Negligible, not significant
Reduction in PSS-10 vs. improvement in MLDRQ	Spearman correlation	-0.075	0.695	Negligible, not significant

Change scores were computed for each participant as the reduction in PSS-10 score and the improvement in MLDRQ score from pre- to post-intervention. The correlation between these two change scores was negligible and not statistically significant (Pearson r = -0.105, p = 0.580; Spearman rho = -0.075, p = 0.695), as summarised in Table 3, indicating that although both outcomes improved significantly at the group level, the extent of stress reduction experienced by an individual mother was not associated with the extent of her improvement in let-down reflex within this sample. This nonrandomized pre-post evaluation found that a brief, seven-day diaphragmatic breathing programme was associated with a large and statistically significant reduction in perceived stress and a large and statistically significant improvement in self-reported milk let-down reflex among breastfeeding mothers, although the two changes were not correlated at the individual level. The high baseline stress observed in this sample (86.7% in the high-stress category) is consistent with the well-documented vulnerability of women in the early postpartum period, when physical recovery, sleep loss and the demands of newborn care converge (Lau, 2001; Nagel *et al*., 2022). The concurrently low baseline MLDRQ score is compatible with the established physiological pathway by which psychological stress, acting through sympathetic activation and elevated cortisol, blunts oxytocin-mediated milk ejection (Wahyuni *et al*., 2021; Matyas *et al*., 2024). The magnitude of stress reduction observed here compares favourably with reductions reported in systematic reviews of diaphragmatic breathing in general adult populations (Hopper *et al*., 2019; Ma *et al*., 2017); this may partly reflect the unusually high baseline stress of the present postpartum sample, which allowed greater room for improvement, as well as the structured, twice-daily practice schedule used over the intervention period. The improvement in let-down reflex parallels findings from other relaxation-based lactation interventions, including relaxation therapy, guided imagery and music-based relaxation, which have similarly been associated with improved breastfeeding-related outcomes through their effects on the oxytocin-prolactin axis (Feher *et al*., 1989; Keith *et al*., 2012; Ak *et al*., 2017; Mohd Shukri *et al*., 2019). Mechanistically, diaphragmatic breathing is thought to promote a shift from sympathetic to parasympathetic autonomic predominance, lowering cortisol and thereby disinhibiting oxytocin release (Uvnas-Moberg *et al*., 2020; Brown & Gerbarg, 2013), which offers a plausible pathway linking the two outcomes at the physiological level even though they were not correlated across individuals in this sample.

The absence of a significant individual-level correlation between change in stress and change in let-down reflex is a notable finding that should not be interpreted as evidence against a physiological relationship between the two variables. The let-down reflex is multiply determined, being influenced by infant latch and feeding frequency, maternal fatigue and pain, and prior breastfeeding experience, of which maternal stress is only one contributing factor. Both outcome measures also relied on subjective self-report, which may correlate imperfectly with the underlying physiological processes, and the modest sample size limited statistical power to detect a weak association even if one exists in the wider population. Taken together, these findings suggest that diaphragmatic breathing may improve maternal stress and let-down reflex through partly independent or indirect mechanisms rather than through a simple, tightly coupled cause-and-effect pathway. From a clinical perspective, these findings support the consideration of diaphragmatic breathing as a supportive, non-pharmacological component of postpartum and lactation care, particularly for mothers at elevated risk of stress-related breastfeeding difficulty, including primiparous women and those recovering from caesarean delivery. Because the technique is simple, inexpensive and requires only brief initial instruction, it is readily implementable even in resource-limited maternity and community-health settings.

This study has several limitations that should be considered when interpreting the results. The one-group pre-post design, without a control or comparison group, means that observed changes cannot be attributed to diaphragmatic breathing alone and may partly reflect natural postpartum recovery, increasing maternal confidence, regression to the mean given the unusually high baseline stress, or the additional attention received from the research team. The relatively small, single-region convenience sample of 30 mothers' limits generalizability and reduces statistical power to detect correlations. Both outcome measures were subjective self-reports rather than objective physiological or biochemical indices, and the seven-day follow-up period is too short to establish whether the observed benefits are sustained.

CONCLUSION

A seven-day diaphragmatic breathing programme was associated with statistically significant reductions in perceived stress and statistically significant improvements in self-reported milk let-down reflex among breastfeeding mothers, despite the absence of a significant correlation between the two changes at the individual level. As a simple, safe and cost-free technique, diaphragmatic breathing merits consideration as an adjunct within routine postpartum and lactation support programmes, and warrants further evaluation using randomized controlled designs, larger and more diverse samples, longer follow-up, and objective physiological outcome measures.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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