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Original Research Article

Efficacy and maternal experience with manual breast pump versus electric breast pump in mothers of preterm infants: a prospective observational study

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ABSTRACT

Background: Mother's own milk is the optimal nutrition for preterm infants admitted in neonatal intensive care unit (NICU). Effective breast milk expression is essential to establish and maintain lactation. Although manual and electric breast pumps are widely used, evidence comparing their efficacy and maternal experience.

Methods: This prospective observational study was conducted over six months at Setu Newborn Care Centre, Ahmedabad. 100 mothers of preterm infants (<34 weeks' gestation) were enrolled and allocated into two groups based on the type of breast pump used: manual (n=50) and electric (n=50). Outcomes assessed included expressed milk volume on days 3, 7, 14, and 21, nipple injury, nipple pain (Numerical rating scale), maternal satisfaction, expression time, and neonatal outcomes.

Results: Baseline maternal and neonatal characteristics were comparable between groups. Milk volume increased significantly over time in both groups ($p<0.001$), with consistently higher mean volumes in the electric pump (EP) group; however, between-group differences were not statistically significant. Nipple injury was significantly less frequent in the EP group (12% vs. 34%; $p=0.009$). Mothers using EPs also reported better ease of use and lower pain scores, while galactagogue use was similar between groups.

Conclusions: Both manual and electric breast pumps effectively support milk expression in preterm infants' mother. While milk yield was comparable, electric breast pumps were associated with significantly lower nipple injury and greater maternal comfort, suggesting they may be the preferred option for improving maternal experience and sustaining lactation in the NICU setting.

Keywords: Mother's own milk, Manual breast pumps, Electric breast pumps, Preterm infants

INTRODUCTION

Breast milk is widely acknowledged as the gold standard of nutrition for all infants, offering a vast array of immunological components and health advantages that promote optimal growth and neurodevelopment.[1] For low birth weight and vulnerable infants admitted to a NICU, the feeding of mother's own milk is a critical clinical priority because it significantly lowers the risk of short- and long-term morbidities, including enteral feed intolerance, nosocomial infections, and necrotizing enterocolitis.[2,3] However, many high-risk neonates are unable to suck directly at the breast due to severe physiological immaturity or acute illness. In these complex clinical scenarios, mothers must express their milk to sustain ongoing lactation, avoid painful breast engorgement, and ensure the child receives human milk via gavage or alternative feeding modalities.[4]

To successfully establish and maintain an adequate milk volume over an extended period, pump-dependent mothers must rely heavily on mechanical or manual

expression technology.[4,5] In modern neonatal units, heavy-duty electric breast pumps are frequently regarded as the clinical standard for milk expression.[5,6] Concurrently, manual breast pumps serve as an important alternative, with some models designed to operate more physiologically by simulating the infant's natural compressive actions on the areola rather than relying strictly on simple vacuum suction.[6,7] Despite their widespread convenience, mechanical expression devices function as a double-edged sword, as their performance and safety profiles significantly impact maternal compliance and infant health outcomes.[8]

One of the most critical clinical barriers to sustained milk expression is the high incidence of persistent nipple pain, soreness, and visible cutaneous tissue damage.[9] Nipple trauma stands as a frequent primary driver of early, premature weaning, as it induces maternal psychological distress, compromises daily activities, and physically inhibits the oxytocin-driven milk ejection reflex.[8,9] Incorrect suction parameters, poorly fitting breast shields, or inefficient breast evacuation can cause structural damage to the breast tissue, manifesting as erythema, swelling, cracks, or open wounds that predispose the mother to secondary bacterial infections.[9,10] Selecting an expression methodology that balances maximum pumping efficiency with optimal maternal comfort and tissue safety is a critical care priority for neonatologists and lactation specialists alike.[8,10]

Furthermore, the mechanical efficiency of a breast pump directly dictates the temporal burden placed on the mother and the overall volume of milk obtained. Pumping is inherently time-consuming for new mothers, and while double EPing can save time compared to sequential methods, there remains a lack of clear consensus on whether electric suction patterns consistently provide superior overall milk volumes when compared directly to modern manual pumps (MPs).[6,11] Additionally, incomplete breast evacuation directly impacts the dynamic composition of the expressed milk.[6,12] Human milk changes markedly throughout an expression session, with fat concentrations rising substantially in the later fractions, known as hindmilk.[7,12] Because an infant's daily weight gain and nutritional programming depend entirely on the consistent delivery of these calorie-dense, fat-rich milk fractions, the performance characteristics of the chosen expression device directly influence downstream neonatal growth velocities.[12]

While several comparative trials have evaluated breast pump mechanics, current evidence regarding their absolute effectiveness presents conflicting conclusions, with clinical outcomes often varying based on specific device instructions, pump patterns, and study cohorts.[6,7,11] Furthermore, many historical claims regarding pump efficacy cannot be universally applied to all regional neonatal units, as maternal body habitus, local lactation infrastructures, and cultural concepts of mothercraft diverge significantly across different populations.[4,6] Therefore, this thesis is designed to conduct a precise, direct comparison between a manual breast pump and an electric breast pump within our clinical setting. By systematically measuring and evaluating four primary parameters-the time required for milk expression, the total amount of milk expressed, the incidence and severity of maternal nipple injury, and the subsequent weight gain of the child-this study aims to establish an evidence-based clinical paradigm to optimize neonatal nutritional care and enhance long-term growth trajectories.

METHODS

Study design was of prospective observational study. Duration of the study was of November 2025-April 2026. Study was conducted at Setu Newborn Care Centre, Ahmedabad.

Inclusion criteria

Preterm infants of <34 weeks of gestational age, mothers who initiated milk expression within the first (e.g., 24 to 48 hours) postpartum, mothers who exclusively used either manual expression/ MPing or an electric breast pump during their infant's hospital stay, infants admitted to the neonatal unit for a minimum duration of 21 days and infants who are hemodynamically stable were included in the study. Complete documentation in medical charts regarding milk volumes and expression frequencies available.

Exclusion criteria

Preterm infants of >34 weeks of gestational age, infants who are hemodynamically unstable, babies who are on Formula feeds, mothers who frequently crossed over or switched between manual and electric methods during the monitored timeline, infants with major congenital malformations, craniofacial anomalies (e.g., cleft lip and palate), or metabolic disorders that directly altered enteral feeding protocols and incomplete or missing clinical documentation regarding primary outcomes were excluded from the study.

Based on the documented primary mode of milk expression recorded in the lactation charts, the study population was divided into two distinct exposure cohorts:

Manual expression cohort (Group 1)

Mothers who utilized non-electric, hand-operated manual breast pumps to empty their breasts.

Electric breast pump cohort (Group 2)

Mothers who utilized personal-use electric breast pumps configured with standard vacuum cycles.

Statistical analysis

Data were analyzed using SPSS version 29 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean±standard deviation (SD), while categorical variables were summarized as frequencies and percentages. Baseline maternal and neonatal characteristics were compared between the electric and manual breast pump groups using the independent-samples t-test for continuous variables and the chi-square test or Fisher's exact test for categorical variables, as appropriate. Changes in lactation volume over time (Days 3, 7, 14, and 21) within each group were evaluated using repeated-measures analysis of variance (ANOVA), with Greenhouse–Geisser correction applied when the assumption of sphericity was violated.

Between-group comparisons of lactation volume and volume gain at each time point were performed using independent-samples t tests.

Maternal and neonatal outcomes, breastfeeding-related practices, nipple pain categories, and breast pump questionnaire responses were compared using chi-square or Fisher's exact tests.

Secondary outcomes, including neonatal weight gain, average expression time, and nipple pain scores, were analyzed using independent-samples t tests. P<0.05 was considered statistically significant.

RESULTS

All 100 patients divided in 50-50 each groups baseline characteristics were as per mentioned in Table 1 and 2, all the parameters were not shown any significant difference.

As shown in Table 3 at day 3, the mean lactation volume was 11.78±18.76 ml in the electric group and 15.00±13.27 ml in the manual group (p=0.324). On day 7, the volume increased to 143.00±124.97 ml in the electric group and 127.00±55.13 mL in the manual group (p=0.41). At day 14, the electric group recorded 268.50±168.18 ml, compared to 224.80±81.63 ml in the manual group (p=0.102). By day 21, the volumes were 364.10±161.94 ml and 326.20±88.78 ml in the electric and manual groups, respectively (p=0.15).

For incremental gain in lactation volume, the increase from day 3 to day 7 was 131.22±122.38 ml in the electric group and 112.00±51.42 ml in the manual group (p=0.308).

The gain from day 3 to day 14 was 256.72±167.11 ml in the electric group and 209.80±81.09 ml in the manual group (p=0.077). From day 3 to day 21, the gain was 352.32±161.91 ml in the electric group and 311.20±87.15 ml in the manual group (p=0.117). Overall, although the electric group showed consistently higher mean lactation volumes and gains across all time points, the differences between the two groups were not statistically significant.

As shown in Table 4 nipple injury was significantly more common in the manual group compared to the electric group (p=0.009). In the electric group, 6 (12.0%) participants reported nipple injury, whereas in the manual group, 17 (34.0%) reported injury. The majority in both groups had no nipple injury (88.0% vs 66.0%, respectively). Use of galactagogues was also comparable between the two groups. It was reported in 21 (42.0%) of the electric group and 19 (38.0%) of the manual group, with no statistically significant difference (p=0.683). Overall, the manual expression group showed a significantly higher incidence of nipple injury, while galactagogue use was similar between groups.

The responses for breast pump questionnaire items were compared between the MP and EP groups using Fisher's exact test as shown in Table 4.

For ease of use, a statistically significant difference was observed between the groups (p<0.001), with the EP group showing higher ratings in lower score categories compared to the MP group. For the amount of suction, there was no statistically significant difference between MP and EP groups (p=0.115).

For pain, a statistically significant difference was observed (p=0.007), with the EP group reporting comparatively lower pain scores. For flange attachment, a significant difference was also found between groups (p=0.013).

For the overall opinion, no statistically significant difference was observed between the groups (p=0.060).

Table 1: Baseline characteristics of patients, (n=100).

Variables	Electric, (n=50)	Manual, (n=50)	Total	P value
Maternal age (in years)	31.60±4.36	32.12±3.43	31.86±3.91	0.509
Previous live births				
0	39 (78.0)	38 (76.0)	77 (77.0)	0.201
≥1	11 (22.0)	12 (24.0)	23 (23.0)	
Type of delivery				
LSCS	50 (100.0)	50 (100.0)	100 (100.0)	>0.999

Table 2: Mean gestational age and birth weight of newborns.

Variables	Electric, (n=50)	Manual, (n=50)	P value
Gestational age (in weeks)	30.57±2.64	31.20±2.20	0.193
Birth weight (kg)	1.34±0.42	1.42±0.39	0.297

Table 3: Between-group comparison of lactation volume (mL) and change over time in electric and manual expression groups.

Variables (ml)	Electric, (n=50)	Manual, (n=50)	P value
Lactation volume day 3	11.78±18.76	15.00±13.27	0.324
Lactation volume day 7	143.00±124.97	127.00±55.13	0.41
Lactation volume day 14	268.50±168.18	224.80±81.63	0.102
Lactation volume day 21	364.10±161.94	326.20±88.78	0.15
Gain (day 7-3)	131.22±122.38	112.00±51.42	0.308
Gain (day 14-3)	256.72±167.11	209.80±81.09	0.077
Gain (day 21-3)	352.32±161.91	311.20±87.15	0.117

Table 4: Result of breast pump questionnaire.

Variables	Groups	Scores					P value
		1	2	3	4	5	
Ease of use	MP	3	16	23	8	-	<0.001
	EP	18	24	8	-	-	
Amount of suction	MP	13	18	7	9	3	0.115
	EP	15	20	12	3	-	
Pain	MP	5	16	15	14	1	0.007
	EP	13	20	15	2	-	
Flange attachment	MP	8	16	18	7	1	0.013
	EP	16	24	7	3	-	
Overall opinion	MP	9	15	23	3	-	0.06
	EP	14	23	11	2	-	

Table 5: Comparison of weight gain, average time taken to express milk per day and nipple pain score.

Outcomes	Electric, (n=50)	Manual, (n=50)	P value
Weight gain (g/day)	17.62±5.14	17.82±4.86	0.842
Average time taken for expression (min/day)	74.44±23.87	84.74±25.10	0.452
Nipple pain score	0.92±0.80	3.56±1.42	<0.001

As shown in Table 5 for weight gain (g/day), there was no statistically significant difference between the electric group (17.62±5.14) and the manual group (17.82±4.86), with a p=0.842. For average time taken for expression (min/day), no significant difference was observed between electric (74.44±23.87) and manual (84.74±25.10) groups (p=0.452).

However, for nipple pain score, a statistically significant difference was observed. The electric group reported significantly lower pain scores (0.92±0.80) compared to the manual group (3.56±1.42), with p<0.001.

DISCUSSION

The present study compared manual and electric breast pumps in mothers of preterm neonates with respect to milk volume expressed, time taken for expression, nipple pain, nipple injury, maternal satisfaction, and neonatal weight gain.

The mean gestational age was 30.57±2.64 weeks in the EP group and 31.20±2.20 weeks in the MP group, while mean birth weight was 1.34±0.42 kg and 1.42±0.39 kg respectively. Similar baseline characteristics have been reported by Dhanawat et al and Fewtrell et al where comparable maternal and neonatal profiles were maintained between intervention groups to ensure valid comparisons of lactation outcomes.[6,13]

The present study demonstrated a progressive increase in milk volume in both groups over time. Mean lactation volume increased from 11.78 ml on day 3 to 364.10 ml on day 21 in the EP group and from 15.00 ml to 326.20 mL in the MP group. Repeated-measures ANOVA showed a significant increase over time in both groups

(p<0.001). These findings are similar to those reported by Dhanawat et al who compared manual expression with pump expression among mothers of preterm infants and found no significant difference between the manual hand expression group and the MP expression group (733 (593-995) vs. 848.5 (571-1009), respectively, p=0.55) in expressed milk volume during the first week postpartum.[13] Fewtrell et al reported significant difference in overall milk production between manual and electric breast pumps among mothers of both term and preterm infants.[6] Mothers in the MP arm produced a significantly higher total milk volume over the 20-minute test block (112 ml (SD=69) manual vs. 76 ml (SD=44) electric, p=0.04) and demonstrated significantly faster milk flow rates. Similarly in Paul et al key findings were the pump method yielded significantly higher milk output than manual expression across all time points. In Phase I, mean output was nearly double with the pump (41.57 ml vs. 21.7 ml, p<0.001).[4] In Phase II, the pump remained superior though the gap narrowed as manual output improved by about 23% over time.

One of the most important findings of the present study was the significantly lower incidence of nipple injury among mothers using electric breast pumps. Nipple injury occurred in only 12% of mothers in the EP group compared with 34% in the MP group (p=0.009). The lower incidence of nipple injury in the EP group may be explained by more uniform suction pressure, better flange design, and reduced mechanical friction. Gridneva et al reported excellent maternal comfort and absence of significant nipple trauma with modern electric breast pumps utilizing two-phase expression technology.[11]

Our study found a highly significant reduction in nipple pain among mothers using electric breast pumps. Mean nipple pain scores were significantly lower in the electric group compared with the manual group (0.92±0.80 vs. 3.56±1.42; p<0.001). These findings are consistent with Chowdhry et al who demonstrated lower pain scores among mothers using electric breast pumps compared with alternative techniques for managing breastfeeding difficulties.[14] Similarly, Gridneva et al reported excellent maternal comfort with wearable EPing systems, with no participant reporting significant discomfort during pumping sessions.[11] Flaherman et al identified pain during pumping as one of the major reasons for maternal dissatisfaction and discontinuation of milk expression.[16] Therefore, the significantly lower pain scores observed in the present study may have important implications for long-term breastfeeding continuation.

The average daily time required for milk expression was similar between groups EP vs MP (74.44±23.87 minutes/day versus 84.74±25.10 minutes/day; p=0.452) showed no statistical significance. which was taken as average mean time for the day to express milk. These findings differ from those reported by Fewtrell et al who observed shorter pumping times among EP users, primarily due to the use of double pumping systems that allowed simultaneous expression from both breasts.[6] Gridneva et al similarly demonstrated improved efficiency with modern EPs utilizing double-pumping technology.[11]

Our study found no significant difference in neonatal weight gain between the electric and MP groups (17.62±5.14 g/day versus 17.82±4.86 g/day; p=0.842). This finding suggests that both methods were equally effective in providing adequate nutritional support for preterm infants. Our results are consistent with the systematic review by Gandino et al which concluded that expression method alone does not significantly influence neonatal growth outcomes when sufficient breast milk is provided.[12] Similarly, Dhanawat et al found comparable exclusive breast milk feeding rates among neonates whose mothers used manual or pump-assisted expression methods.[13]

Fewtrell et al reported greater comfort and satisfaction among mothers using technologically advanced breast pumps compared with conventional systems.[6] Bartels et al emphasized that maternal comfort, ease of operation, portability, and ergonomic design are major determinants of pump acceptability and continued use.[15] The findings of the present study support these observations and suggest that EPs provide a more comfortable pumping experience, which may improve compliance with recommended pumping schedules. Where in our study we found significant difference in ease of use (p≤0.001), flange attachment (p=0.013), and pain while expressing (p=0.007) between manual breast pump and electric breast pump. Our findings differ from Fewtrell et al preterm study which showed that the MP scored significantly better regarding maternal comfort, pleasure of use, and overall structural satisfaction (p<0.05).[6]

Limitations

This study was limited by its observational design, small sample size and single centre setting, which may limit generalizability and introduce selection bias. The 21 day follow up did not allow assessment of long term breastfeeding outcomes. Maternal factors, differences in pump models and pumping techniques may have influenced the results, while pain and satisfaction were assessed using subjective measures.

CONCLUSION

This study demonstrates that manual and electric breast pumps are equally effective at initiating and maintaining lactation in mothers of preterm neonates, with no significant differences observed in milk output, infant weight gain and anthropology, or pumping duration. However, EPs offered distinct clinical advantages, including significantly reduced rates of nipple pain and trauma, as well as superior scores for usability, flange attachment, and maternal satisfaction. Consequently, while both approaches are functionally equivalent for

milk production, EPs represent the preferred modality when minimizing maternal discomfort and enhancing the pumping experience are considered.

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