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Original Research Article

Assessment of expressed breast milk intake among preterm neonates admitted in a tertiary care neonatal intensive care unit

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ABSTRACT

Background: Breast milk is the optimal nutrition for infants, but despite increased NICU breast milk use, challenges in expressing and maintaining mother's own milk (MOM) persist. Mothers of NICU-admitted neonates often struggle to establish sufficient milk supply. The objectives is to improve expressed breast milk (EBM) intake in preterm neonates (<34 weeks) through lactation counselling, ensuring colostrum as the first feed within 6 hours, and providing hands-on training and support to mothers for effective breastfeeding practices.

Methods: This prospective interventional cohort study involved mothers of preterm neonates (<34 weeks) admitted to the NICU at MSRMCH. Participants were divided into two groups: Group 1 received antenatal and postnatal counselling, along with three daily EBM expression sessions led by a breastfeeding support team. Group 2 received routine care by non-lactation experts. EBM quantity from days 1 to 7 and colostrum intake were assessed and compared between the two groups, emphasizing techniques for breast milk expression through live demonstrations and video aids.

Results: The total EBM expressed over one week was analyzed across different gestational age groups, revealing significant differences between the groups. Group 1, which received intensive lactation support, produced an average of 549.93±111.75 ml, compared to 404.13±97.22 ml in Group 2, with significant difference (p=0.018). The proportion of preterm neonates receiving adequate EBM in Group 1 increased from 23.1% on day 1 to 78.2% by day 7. In contrast, Group 2 showed a lower improvement, with only 2.4% receiving adequate EBM on day 1 and 33.3% by day 7, indicating a significant difference (p<0.001). Notably, all mothers in the study expressed EBM within 6 hours postpartum.

Conclusions: Lactation counselling by a trained breastfeeding team significantly improved EBM quantity and intake in the intervention group. Encouraging and supporting mothers during expression enhanced their breastfeeding skills and ensured better neonatal outcomes.

Keywords: Expressed breast milk, Preterm neonates, Tertiary care centre, Neonatal intensive care unit

INTRODUCTION

Breast milk is the ideal nutrition for infants, providing essential nutrients for growth, disease prevention, and health promotion. It offers significant benefits for preterm neonates, reducing morbidities such as sepsis, enterocolitis, and bronchopulmonary dysplasia, and improving neurodevelopmental outcomes.[1] However, breastfeeding challenges are amplified for mothers of preterm infants, particularly due to the separation, stress, and health issues following delivery.[2] Expressing breast milk (EBM) is essential but difficult, as preterm infants may struggle to breastfeed initially, requiring early and frequent milk expression.[3]

Preterm birth, which accounts for 10.6% of global births, presents unique complications.[4] Mothers often face delayed lactogenesis and lower milk supply due to factors such as premature delivery, medical complications, and limited skin-to-skin contact.[5] Early initiation of EBM expression, ideally within six hours postpartum, can enhance milk production and improve outcomes.[6] However, barriers like maternal fatigue, socioeconomic challenges and inadequate support complicate regular milk expression.[7] NICUs must allocate resources to support mothers through counselling, practical skill-building, and breastfeeding aids.[8]

Given these complexities, this study aims to assess EBM intake among preterm neonates (<34 weeks) in a tertiary NICU with structured lactation counselling. The primary objective is to evaluate the amount of EBM expressed during the early neonatal period. Secondary objectives include ensuring colostrum intake within six hours of birth and empowering mothers with practical breastfeeding skills through live training and support. Effective counselling, combined with consistent guidance, will help mothers navigate the difficulties of milk expression and improve neonatal health outcomes.

METHODS

This prospective interventional cohort study involved mother-preterm infant dyads admitted to the NICU at MS Ramaiah Medical College and Hospitals from February 2021 to August 2022. The study aimed to assess the expressed breast milk (EBM) intake among preterm neonates (<34 weeks) with structured lactation counselling. A sample size of 120 mother-infant pairs was calculated, considering a 20% potential loss to follow-up, based on a reported 50% increase in EBM volume. Preterm infants and mothers meeting the inclusion criteria were recruited, excluding those with major malformations, surgical conditions, or substance abuse, as well as infants admitted after 24 hours of life or those whose mothers had HIV.

Following ethical guidelines, informed written consent was obtained from all mothers. The study population was randomly divided into two groups. Group 1 received antenatal and postnatal lactation counselling and support from a trained breastfeeding team consisting of neonatologists, pediatricians, staff nurses, and lactation counsellors. Group 2 received routine care, with counselling provided by non-lactation experts. In Group 1, mothers were supported three times a day during EBM expression. Counselling included teaching manual and breast pump milk expression techniques, supported by video and live demonstrations. Mothers were encouraged to express milk six to eight times daily, including nighttime sessions, for about 15 minutes each time.

Data collection involved recording the quantity of EBM expressed from day 1 to day 7 using syringes, and this data was compared between the two groups. Additionally, the number of preterm neonates receiving adequate EBM, as advised by the NICU team, was tracked. Intake of colostrum as the first feed within 6 hours of life was also ensured for all participants.

Data was entered into Excel and analyzed using MedCalc version 19.0. Continuous variables were expressed as mean±standard deviation, and categorical data as percentages. The independent t-test was used for statistical analysis, with a significance threshold of $p<0.05$. Regular team meetings were held to ensure effective compliance, and challenges faced by preterm mothers during expression were addressed.

RESULTS

In our study, a significant proportion of mothers (71%) were graduates, reflecting higher educational attainment, while 55% were primigravida, suggesting a balanced distribution of first-time and experienced mothers (Table 1). Normal vaginal delivery was more common (56.7%) than cesarean sections (43.3%). Most deliveries occurred inborn (95%), indicating efficient institutional care (Table 2). Key maternal risk factors included preterm premature rupture of membranes (19.2%) and preeclampsia (17.5%), with other conditions such as urinary tract infections (15%) and chorioamnionitis (10%) contributing to risk (Figure 1).

The comparison of expressed breast milk (EBM) between Group 1 (78 mothers) and Group 2 (42 mothers) shows a consistent and significant difference across all seven days, with Group 1 producing higher quantities. On Day 7, Group 1 expressed an average of 146.86 ml (SD 18.80), compared to 117.10 ml (SD 21.11) in Group 2, with a total weekly output of 549.93 ml versus 404.13 mL, respectively ($p<0.001$) (Table 3). Similarly, more preterm neonates in Group 1 received adequate EBM daily, with 78.2% receiving adequate EBM by Day 7, compared to only 33.3% in Group 2 ($p<0.001$). These findings highlight the critical need for effective lactation support to improve EBM supply and neonatal nutrition, especially in at-risk groups (Table 4).

Among preterm neonates born at gestational age <28 weeks, Group 1 (29 mothers) consistently expressed a higher quantity of EBM than Group 2 (17 mothers) throughout the first week, with significant differences observed each day. By Day 7, Group 1 expressed a mean of 134.65 ml (SD 16.59) compared to 99.76 ml (SD 14.71) in Group 2, with a total weekly output of 469.25 mL versus 340.88 ml ($p <0.001$) (Table 5). Additionally, 100% of neonates in Group 1 received adequate EBM by Day 7, compared to only 17.6% in Group 2 ($p <0.001$). These findings emphasize the importance of early and effective lactation interventions to ensure sufficient EBM intake in extremely preterm neonates, enhancing their nutritional outcomes (Table 6).

Table 1: Characteristics of the study subjects.

Subjects (n=120)		Frequency (N)	Percentage (%)
Education of mother	School	6	5.0%
	PU/Diploma	29	24.0%
	Graduate	85	71.0%
Parity	Primigravida	66	55.0%
	Multigravida	54	45.0%
Mode of delivery	Normal vaginal delivery	68	56.7%
	Cesarean Section	52	43.3%
Place of delivery	Inborn	114	95.0%
	Outborn	6	5.0%

Table 2: Comparison of quantity of EBM between the groups.

Subjects (n=120)		Group 1 (n=78)		Group 2 (n=42)		P value
Day	**Frequency of expression per day**	**Mean**	**SD**	**Mean**	**SD**	
1	4	14.28	8.49	8.54	6.22	<0.001
2	5	33.56	16.92	20.22	12.06	<0.001
3	6	57.98	18.59	39.34	17.86	<0.001
4	7	80.65	20.47	58.79	20.85	<0.001
5	8	104.17	22.11	77.65	23.91	<0.001
6	9	125.27	19.84	96.45	21.08	<0.001
7	9	146.86	18.80	117.10	21.11	<0.001
Total amount in a week (in ml)		549.93	111.75	404.13	97.22	<0.001

Table 3: Comparison of number of preterm neonates received adequate EBM between the groups.

Subjects (n=120)	Group 1 (n=78)		Group 2 (n=42)		P value
	N	**%**	**N**	**%**	
Day 1	18	23.1%	1	2.4%	<0.001
Day 2	36	46.2%	5	11.9%	<0.001
Day 3	41	52.6%	6	14.3%	<0.001
Day 4	48	61.5%	5	11.9%	<0.001
Day 5	51	65.4%	9	21.4%	<0.001
Day 6	59	75.6%	11	26.2%	<0.001
Day 7	61	78.2%	14	33.3%	<0.001

Table 4: Comparison of quantity of EBM between the groups among population of gestational age <28 weeks.

Subjects (n=46)	Group 1 (n=29)		Group 2 (n=17)		P value
	Mean	**SD**	**Mean**	**SD**	
Day 1	9.41	1.70	5.94	0.75	<0.001
Day 2	22.93	4.14	14.76	2.81	<0.001
Day 3	44.86	6.74	28.70	4.75	<0.001
Day 4	66.51	10.21	45.47	7.40	<0.001
Day 5	87.93	11.97	61.41	10.84	<0.001
Day 6	111.65	14.21	81.17	12.42	<0.001
Day 7	134.65	16.59	99.76	14.71	<0.001
Total amount in a week (in ml)	469.25	56.02	340.88	48.58	<0.001

Table 5: Comparison of number of preterm neonates received adequate EBM between the groups among population of gestational age <28 weeks.

Subjects (n=46)	Group 1 (n=29)		Group 2 (n=17)		P value
	N	%	N	%	
Day 1	6	20.7%	0	0.0%	<0.001
Day 2	16	55.2%	1	5.9%	<0.001
Day 3	21	72.4%	1	5.9%	<0.001
Day 4	25	86.2%	0	0.0%	<0.001
Day 5	25	86.2%	2	11.8%	<0.001
Day 6	28	96.6%	1	5.9%	<0.001
Day 7	29	100.0%	3	17.6%	<0.001

Table 6: Comparison of quantity of EBM between the groups among population of gestational age 28-32 weeks.

Subjects (n=49)	Group 1 (n=30)		Group 2 (n=19)		P value
	Mean	SD	Mean	SD	
Day 1	11.00	2.08	7.00	1.20	<0.001
Day 2	28.40	6.48	16.57	2.47	<0.001
Day 3	55.67	7.42	36.21	5.70	<0.001
Day 4	80.06	9.26	57.10	6.65	<0.001
Day 5	106.43	14.69	80.21	9.19	<0.001
Day 6	128.70	13.29	102.15	11.22	<0.001
Day 7	151.06	13.18	126.31	9.17	<0.001
Total amount in a week (in ml)	561.50	61.01	424.66	44.02	<0.001

Even in the population of preterm neonates born between 28-32 weeks of gestational age, Group 1 (30 mothers) exhibited a significantly higher quantity of EBM expression compared to Group 2 (19 mothers) across all seven days. By Day 7, Group 1 achieved a mean expression of 151.06 ml (SD 13.18), surpassing Group 2's 126.31 ml (SD 9.17), with a total weekly yield of 561.50 ml versus 424.66 ml (p<0.001) (Table 7).

Furthermore, the proportion of neonates receiving adequate EBM was notably higher in Group 1, with 83.3% adequately fed by Day 7 compared to 42.1% in Group 2 (p<0.001). These findings highlight the need for sustained lactation support in mothers of preterm infants to optimize milk production and ensure adequate neonatal nutrition in this critical gestational window (Table 8).

Again, in preterm neonates born at 32-34 weeks of gestational age, Group 1 (16 mothers) demonstrated consistently higher EBM expression compared to Group 2 (9 mothers). By Day 7, Group 1 achieved a mean of 172.50 ml (SD 5.34), significantly surpassing Group 2's 147.00 ml (SD 26.47), with a total weekly output of 773.00 ml versus 586.75 ml (p=0.003) (Table 9).

Although Group 1 showed a higher proportion of neonates receiving adequate EBM on Day 1 (37.5% vs. 11.1%; p=0.001), no significant differences were observed in later days. These findings suggest that mothers of neonates in this gestational window can achieve higher milk output with support, though maintaining adequate EBM intake for these neonates remains a challenge over time, requiring sustained lactation efforts and monitoring (Table 10).

Table 7: Comparison of number of preterm neonates received adequate EBM between the groups among population of gestational age 28-32 weeks.

Subjects (n=49)	Group 1 (n=30)		Group 2 (n=19)		P value
	N	%	N	%	
Day 1	4	13.3%	0	0.0%	0.001
Day 2	14	46.7%	1	5.3%	0.002
Day 3	13	43.3%	1	5.3%	0.003
Day 4	16	53.3%	2	10.5%	0.002
Day 5	20	66.7%	4	21.1%	0.001
Day 6	23	76.7%	7	36.8%	0.003
Day 7	25	83.3%	8	42.1%	0.001

Table 8: Comparison of quantity of EBM between the groups among population of gestational age 32-34 weeks.

Subjects (n=25)	Group 1 (n=16)		Group 2 (n=9)		P value
	Mean	SD	Mean	SD	
Day 1	28.02	8.19	17.75	10.64	0.015
Day 2	62.60	12.49	40.50	16.78	0.008
Day 3	89.38	15.32	69.37	22.18	0.019
Day 4	116.70	15.45	95.71	25.75	0.031
Day 5	140.20	11.64	123.20	33.51	0.043
Day 6	157.50	8.45	134.25	27.70	0.006
Day 7	172.50	5.34	147.00	26.47	0.001
Total amount in a week (in ml)	773.00	64.85	586.75	153.43	0.003

Table 9: Comparison of number of preterm neonates received adequate EBM between the groups among population of gestational age 32-34 weeks.

Subjects (n=25)	Group 1 (n=16)		Group 2 (n=9)		P value
	N	%	N	%	
Day 1	6	37.5%	1	11.1%	0.001
Day 2	5	31.3%	3	33.3%	0.785
Day 3	6	37.5%	4	44.4%	0.679
Day 4	6	37.5%	3	33.3%	0.821
Day 5	5	31.3%	3	33.3%	0.875
Day 6	6	37.5%	3	33.3%	0.821
Day 7	6	37.5%	3	33.3%	0.821

DISCUSSION

Donor human milk has been shown to enhance feeding tolerance and offer protection against necrotizing enterocolitis (NEC) compared to formula feeding. As a result, human milk (HM) is recommended for all neonates, including preterm infants.

Guidelines from organizations such as the European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN), the American Academy of Pediatrics (AAP) and the Milan EMBA/ESPGHAN/AAP Joint Meeting Consensus emphasize that mother's own milk (MOM) is the preferred choice for preterm infants.[9-12] This recommendation highlights the critical role of HM in improving neonatal outcomes by reducing the risks of infections and improving neurodevelopment.

Impact of counselling and support on EBM quantity

In our study, the intervention group receiving structured antenatal and postnatal counselling showed a significantly higher volume of expressed breast milk (EBM) compared to the routine care group. From day 1 to day 7, the quantity of EBM and the number of preterm infants achieving adequate EBM increased notably in the intervention group. This reinforces the importance of expert lactation counselling and hands-on support during milk expression. Similar findings were reported by Paula M. Sisk et al who demonstrated that early counselling and support increased the likelihood of timely EBM expression without exacerbating maternal stress.[13] Spatz et al also emphasized the importance of strategies like kangaroo mother care, non-nutritive sucking, and ongoing follow-up to enhance breastfeeding outcomes in neonates.[14]

Comparison of EBM outcomes across studies

Our study revealed that 23.1% of preterm infants in the intervention group received adequate EBM on day 1, increasing to 78.2% by day 7 ($p<0.001$). In comparison, only 2.4% of preterm infants in the routine care group received adequate EBM on day 1, rising to 33.3% by day 7.

These results align with findings from Ramya Nadipineni et al who demonstrated that antenatal counselling improved EBM provision from 24% to 80% on day 1, with a further increase to 73% by day 7.[15] Similarly, studies by Anup Thakur et al and Qi Zhou et al reported significant improvements in EBM intake following antenatal counselling and telephonic reminders, with statistical significance ($p<0.01$) favoring the intervention group.[16,17]

Importance of early milk expression

Our study observed that all mothers expressed breast milk within six hours of delivery, a critical factor influencing successful lactation. Research indicates that early milk expression correlates with higher EBM production and improved neonatal outcomes. Nadipineni et al demonstrated a reduction in the median age of first EBM expression from 2.5 days to 1.16 days, while Alexandre et al reported a significant decrease from 37.6 hours to 30.7 hours with structured interventions.[15,18] Other studies, including those by Fugate et al and Murphy et al highlighted that early milk expression positively impacts the proportion of infants receiving exclusive MOM at 28 days and discharge.[19,20]

Addressing challenges in NICU breastfeeding practices

Although breastfeeding offers numerous benefits, it is not always prioritized as a therapeutic intervention in NICUs. Sisk PM et al pointed out that healthcare professionals and families may lack awareness regarding the importance of breast milk and lactation technologies.[13] To address these challenges, our study employed continuous counselling by a dedicated breastfeeding support team. The team held regular meetings to discuss challenges faced by mothers, provided hands-on guidance, and offered emotional support to ensure successful breastfeeding practices.

Implications for practice

The findings of our study emphasize the importance of antenatal and postnatal counselling in enhancing EBM expression among preterm neonates. Structured lactation support, early milk expression, and continuous guidance significantly improved the volume of EBM and the number of preterm infants receiving adequate EBM. Our results align with similar studies, reinforcing the value of expert counselling and early intervention. Consistent messaging from NICU staff, development of breastfeeding policies, and the implementation of lactation technologies are essential to optimize breast milk use for preterm infants. By addressing the challenges faced by mothers and providing comprehensive support, NICUs can improve neonatal outcomes and promote exclusive breastfeeding practices.

Limitations

The limitations are the time taken for intake of full feeds in both the groups were not studied and complications in the neonatal period in intervention group and routine group could not be studied as our study included only early neonatal period in preterm babies.

CONCLUSION

This study demonstrates that counselling by trained lactation experts in the intervention group significantly improved EBM volume among preterm neonates (<34 weeks) during the early neonatal period. The intervention also increased the number of preterm infants receiving adequate EBM as recommended by the NICU team. Encouragement, supervision, and assistance during expression enhanced mothers' breastfeeding skills. All participating mothers in both groups expressed milk within the first six hours, ensuring colostrum as the first feed for all neonates, highlighting the value of antenatal counselling. Breast milk remains a crucial, evidence-based strategy to reduce morbidity and mortality in preterm infants. Notably, the intervention group showed sustained improvement in breast milk expression over time.

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