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ORIGINAL ARTICLE

# Comparative analysis of mother's own milk, donor human milk and mix of both: Impact on growth.

**Muhammad Akhtar[1], Athar Razzaq[2], Farhan Sabir[3], Muhammad Sarfraz Ahmad[4]**

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**ABSTRACT… Objective:** To compare the impact of mother's own milk (MOM), donor milk (DM), and mixed milk (MM) on key growth parameters in preterm neonates. **Study Design:** Randomized Controlled Trial. **Setting:** The Neonatal Intensive Care Unit (NICU) at Recep Tayyip Erdogan Hospital, Muzaffargarh, Punjab, Pakistan. **Period:** During 1st August 2024 to 30th January 2025. **Methods:** Ninety preterm neonates (28–32 weeks gestation, 800–2000 grams birth weight) were randomized to receive MOM, DM, or MM. Detailed demographic, anthropometric, and clinical data were collected at admission, and at discharge. Data were analyzed using IBM-SPSS v26.0, with appropriate statistical tests, and significance was set at $p<0.05$. **Results:** Among 90 enrolled preterm neonates, 53 (58.9%) were male, and 37 (41.1%) female. The median postnatal age was 12.0 (IQR 10.0–14.0) days, and gestational age was 30.0 (28.0–30.0) weeks. Baseline weight, length, and head circumference were 1200 g (1000–1300), 38.0 cm (36.0–40.0), and 29.0 cm (28.0–30.0), respectively. At discharge, median weight was 1500 g (1300–1725) in the MOM group, 1450 g (1157–1525) in the DM group, and 1350 g (1200–1600) in the MM group ($p=0.122$). Median length was 42.5 cm (41.0–46.0), 43.0 cm (41.0–45.0), and 42.0 cm (40.0–43.0), respectively ($p=0.171$). Head circumference medians were 31.0 cm (30.0–32.0) in MOM and MM, and 31.0 cm (30.0–31.0) in DM ($p=0.546$). **Conclusion:** This study supports the use of donor milk and mixed feeding strategies as safe and effective alternatives to exclusive maternal milk feeding, particularly when supported by appropriate fortification and clinical protocols.

**Key words:** Donor Milk, Head Circumference, Length, Mother's Own Milk, Preterm, Weight.

## INTRODUCTION

Advancements in neonatal nursing, medical interventions, and nutritional care have significantly improved the survival rates of vulnerable newborns, particularly preterm infants.[1] Despite these medical achievements, neonatal mortality remains a global challenge, and postnatal growth restriction continues to be a frequent complication among extremely preterm infants.[2,3] This vulnerability, combined with unique physiological and metabolic challenges, increases their nutritional requirements and underscores the critical need for optimal early nutrition.[4,5]

Breast milk is universally recommended as the ideal source of nutrition for all newborns, especially for preterm infants, due to its unique composition of nutrients, immunological factors, and growth-promoting properties.[6] When mother's own milk (MOM) is unavailable or contraindicated, donor human milk (DM) is the preferred alternative.[7] It is important to note that unfortified DM typically contains lower macronutrient content compared to MOM, largely because most donor milk comes from mothers of term infants and is collected later in lactation when nutrient concentrations have declined.[8,9] DM obtained from mothers who delivered preterm often contains higher levels of protein, sodium, and chloride compared to DM from term mothers, making it more suitable for meeting the specific needs of preterm infants.[8] Some studies have shown that infants fed with DM alone may experience slower weight gain than those fed with infant formula.[10,11] Early initiation of feeding with fortified DM or fortified MOM has been associated with improved weight gain and head circumference growth in very low birth weight (VLBW) infants.[12]

1. MBBS, FCPS (Pediatric Medicine), Fellow Neonatology, RTEH / Indus Hospital, Muzafargarh, Pakistan.
2. MBBS, FCPS (Pediatric Medicine), FCPS (Neonatology), Consultant Neonatology, RTEH / Indus Hospital, Muzafargarh, Pakistan.
3. MBBS, FCPS (Pediatric Medicine), Fellow Neonatology, RTEH / Indus Hospital, Muzafargarh, Pakistan.
4. MBBS, FCPS (Pediatric Medicine), Fellow Neonatology, RTEH / Indus Hospital, Muzafargarh, Pakistan.

**Correspondence Address:**
Dr. Muhammad Akhtar
Department of Neonatology
RTEH / Indus Hospital, Muzafargarh, Pakistan.
akhtarsanghi574@gmail.com

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While considerable research has compared DM and MOM to infant formula, there is a relative lack of studies directly comparing the effects of DM versus MOM, and their mix on growth and developmental outcomes in preterm neonates. This gap in evidence limits our ability to make precise recommendations regarding optimal feeding practices in this population. This study was done to compare the impact of MOM, DM, and mixed milk (MM) on key growth parameters in preterm neonates. By directly evaluating these feeding strategies, the study aims to provide evidence-based guidance for nutritional management in this vulnerable population.

## METHODS

This randomized controlled trial was conducted in the Neonatal Intensive Care Unit (NICU) at Recep Tayyip Erdogan Hospital, Muzaffargarh, Punjab, Pakistan, during 1st August 2024 to 30th January 2025. The study was carried out following approval from the institutional ethics committee (IHHN-IRB-2024_05_015, dated: 29th July 2024). The sample size was calculated based on the methodology reported by Montjaux-Régis et al.[13], using daily weight gain as the primary outcome variable. The calculation used a mean daily weight gain of 12.3 grams (SD 3.9) for one group and 18 grams (SD 7.0) for the other, with a significance level ($\alpha$) of 0.05 and power ($1-\beta$) of 0.8. After adjusting for a potential attrition rate of 15%, the estimated sample size required was 90 participants (30 in each group). Preterm neonates admitted to the NICU during the study period were considered for inclusion if they were born at a gestational age 28-32 weeks, and had birth weight between 800-2000 grams. Neonates were excluded if they had significant congenital anomalies, dysmorphism, necrotizing enterocolitis stage IIa or higher before enrollment, congenital heart disease other than patent ductus arteriosus, or gastrointestinal conditions requiring surgical intervention. Neonates whose parents or guardians declined consent, were also excluded from the study.

Following written informed consent from parents or guardians, eligible neonates were enrolled and randomized into three groups according to the type of milk received. The first group was exclusively fed MOM, the second group received only DM, and the third group was provided with both MOM and DM (MM group). The investigator was responsible for assigning neonates to the groups and for the collection and allocation of donor milk, which was obtained from mothers who had surplus milk, irrespective of their own infant's gestational age at delivery.

At the time of enrollment, detailed demographic and clinical information were obtained. A clinical examination was conducted upon admission. Anthropometric measurements like length (measured with a non-stretch tape while the infant was supine), head circumference (measured at the largest occipitofrontal circumference), and weight (measured using a calibrated digital infant scale) were recorded at admission, daily during the hospital stay, and at discharge, and were plotted on standard growth charts. Throughout the study, all neonates received medical care as per institutional protocols. Requirement for intubation, mechanical ventilation, and the development of complications were documented. Data were collected using a standardized proforma.

Statistical analysis was performed using IBM-SPSS version 26.0. Categorical data such as gender, mode of delivery, resuscitation requirements, outcomes, and complications were reported as frequencies and percentages. Continuous variables, including age, birth weight, length, gestational age, duration of respiratory support, and NICU stay, were summarized as means and standard deviation (SD), or median and interquartile range (IQR). Group comparisons for categorical variables were made using the Chi-square or Fisher's exact test, while continuous variables were compared using the analysis of variance or Kruskal-Wallis test, as appropriate. P-value less than 0.05 was considered statistically significant.

## RESULTS

In a total of 90 preterm neonates enrolled, 53 (58.9%) were males, and 37 (41.1%) females. The median post-natal age and gestational age were 12.0 (10.0-14.0) days, and 30.0 (28.0-30.0) weeks, respectively. The baseline median weight, length, and head circumference were 1200.00 (1000.00-1300.00) grams, 38.00 (36.00-40.00) cm, and 29.0 (28.0-30.0) cm, respectively. The gender distribution (p=0.955), post-natal age (p=0.117), and gestational age (p=0.292) were statistically similar among groups. Baseline evaluation of weight (p=0.562), length (p0.243), and head circumference (p=0.858) did not show sginificant differences among groups. Table-1 is showing comparison of baseline characteristics of preterm neonates among study groups.

The median duration of feeding in MOM, DM, and MM groups were 12.00 (10.00-12.25) days, 12.00 (11.50-13.00) days, and 12.00 (10.00-15.00) days, respectively (p=0.108). Feeding intolerance was reported in MOM, DM, and MM groups among 4 (13.3%), 1 (3.3%), and 5 (16.7%) neonates (p=0.232). At discharge, the median weight was highest among the MOM group at 1500.00 grams (1300.00–1725.00), followed by the DM group at 1450.00 grams (1157.00–1525.00), and lowest in the mixed milk (MM) group at 1350.00 grams (1200.00–1600.00), but these differences did not reach statistical significance (p=0.122). The median length at discharge was 42.50 cm (41.00–46.00) in the MOM group, 43.00 cm (41.00–45.00) in the DM group, and 42.00 cm (40.00–43.00) in the MM group (p=0.171), with p=0.171. Head circumference in MOM and MM groups had a median of 31.00 cm (30.00–32.00), while the DM group, it was 31.00 cm (30.00–31.00), and showed no statistically significant differences (p=0.546). The incidence of intraventricular hemorrhage (p=0.600), bronchopulmonary dysplasia (p=0.770), and retinopathy of prematurity (p=0.600), sepsis (p=0.200), or hospital-acquired infections (p=0.200) did not vary significantly among groups. The median duration of NICU stay was statistically similar across groups, at 35.00 days (30.00–39.25) in the MOM group, 35.00 days (34.75–36.00) in the DM group, and 39.50 days (32.00–40.00) in the MM group (p=0.200). No mortality was reported in any of the groups. Table-1 is showing comparison of final outcomes evaluation across groups.

## DISCUSSION

The present study found no statistically significant differences in postnatal growth, as measured by weight, length, and head circumference, among preterm neonates fed MOM, DM, or MM during their NICU stay. Alizadeh and colleagues[14] conducted a trial involving 90 preterm neonates randomized into groups based on the proportion of donor milk in their diets.

| | | MOM (n=30) | DM (n=30) | MM (n=30) | P-Value |
|---|---|---|---|---|---|
| Gender | Male | 18 (60.0%) | 17 (56.7%) | 18 (60.0%) | 0.955** |
| | Female | 12 (40.0%) | 13 (43.3%) | 12 (40.0%) | |
| Post-natal age (days) ^ | | 12.00 (10.00-12.25 | 12.00 (11.50-12.25) | 12.00 (10.00-15.00) | 0.117# |
| Gestational age (weeks) ^ | | 30.00 (28.00-31.25) | 30.00 (28.00-31.00) | 30.00 (28.00-30.00) | 0.292# |
| Weight (grams) ^ | | 1200.00 (1075.00-1425.00) | 1200.00 (1000.00-1300.00) | 1200 (1000.00-1300.00) | 0.562# |
| Length (cm) ^ | | 37.50 (36.00-41.00) | 38.00 (36.00-40.00) | 37.50 (35.75-38.25) | 0.243# |
| Head circumference (cm) ^ | | 29.00 (27.75-30.00) | 29.00 (28.00-29.00) | 29.00 (28.00-30.00) | 0.855# |
| Mode of delivery | Cesarean section | 18 (60.0%) | 16 (53.3%) | 16 (53.3%) | 0.835** |
| | Vaginal delivery | 12 (40.0%) | 14 (46.7%) | 14 (46.7%) | |
| Maternal age (years) ^ | | 25.00 (22.75-25.00) | 25.00 (24.75-26.00) | 24.50 (20.00-26.00) | 0.068# |
| Maternal hypertension | | 1 (3.3%) | 2 (6.7%) | 3 (10.0%) | 0.585* |
| Maternal diabetes | | 1 (3.3%) | - | 2 (6.7%) | 0.355* |

**Table-I. Comparison of baseline characteristics of neonates with different feeding strategies (N=90)**

MOM: Mother's own milk; DM: Donor's milk, MM: Mixed milk; #Kruskal-Wallis test applied; *Fisher's exact test applied; **Chi-square test applied; ^Values shown as median and interquartile range

| Outcomes | MOM (n=30) | DM (n=30) | MM (n=30) | P-Value |
|---|---|---|---|---|
| Weight (grams) | 1500.00 (1300.00-1725.00) | 1450.00 (1157.00-1525.00) | 1350.00 (1200.00-1600.00) | 0.122# |
| Length (cm) | 4250 (41.00-46.00) | 43.00 (41.00-45.00) | 42.00 (40.00-43.00) | 0.171# |
| Head circumference (cm) | 31.00 (30.00-32.00) | 31.00 (30.00-31.00) | 31.00 (30.00-32.00) | 0.546# |
| Intraventricular hemorrhage | 1 (3.3%) | 1 (3.3%) | - | 0.600* |
| Bronchopulomonary dysplasia | 1 (3.3%) | 1 (3.3%) | 2 (6.7%) | 0.770* |
| Retinopathy of prematurity | - | 1 (3.3%) | 1 (3.3%) | 0.600* |
| Sepsis | - | 3 (10.0%) | 3 (10.0%) | 0.200* |
| Hospital acquired infections | - | 3 (10.0%) | 3 (10.0%) | 0.200* |
| NICU stay (days) | 35.00 (30.00-39.25) | 35.00 (34.75-36.00) | 39.50 (32.00-40.00) | 0.200# |

**Table-II. Comparison of anthropometric parameters and clinical outcomes among neonates with different feeding strategies (N=90)**

MOM: Mother's own milk; DM: Donor's milk, MM: Mixed milk; #Kruskal-Wallis test applied; *Fisher's exact test applied; ^ Values shown as median and interquartile range

The reported weight gain receiving predominantly DM and MOM did not reach statistical significance, consistent with the present study where the three feeding groups demonstrated similar growth outcomes at discharge. Further supporting these findings, Lund et al.[15], investigated growth and clinical outcomes in extremely preterm infants exposed to varying proportions of MOM and DM. That study also found that an increased MOM intake was associated with improved weight gain and head circumference z-score change, although the association with other clinical outcomes diminished after adjustment for confounders.[15] No association was observed between DM intake and improved growth or morbidity, echoing the present study's results, which demonstrated non-inferiority of DM and MM compared to MOM alone for anthropometric parameters. These consistencies reinforce the growing consensus that appropriately fortified DM is an effective alternative when MOM is not available. Gialeli et al.[16], highlighted that preterm donor milk (PDM) used to supplement MOM led to higher protein intake and better short-term growth outcomes compared to term donor milk (TDM) supplementation. In Gialeli et al study, donor milk was separated based on maternal gestational age at donation, revealed higher discharge weights and improved head circumference growth when PDM was used.[16] The lack of detailed stratification by donor milk type in the present study may have contributed to the absence of significant group differences.

Umasekar et al.[17], observed that exclusive MOM feeding, when achieved early, enhances the likelihood of ongoing exclusive MOM intake at discharge, but growth velocity and complications did not differ between MOM and DM groups in their studies. These results underscore the importance of comprehensive lactation support programs in the NICU, including targeted interventions to promote early and sustained breastmilk expression. Timely establishment of full enteral feeds with MOM not only supports nutritional adequacy but also may improve long-term breastfeeding success.[17,18] The present findings are in agreement with the study by Karoobi et al.[19], which showed no significant differences in length of hospital stay, growth rate, or incidence of ROP and BPD among very low birth weight infants exclusively fed either MOM or DM. Similar trends are evident in the work of Sparks et al.[20], where growth velocity and neonatal complications did not differ by proportion of DM intake, even in a cohort with a high prevalence of HIV-positive mothers. These results may indicate that donor milk, when managed under rigorous safety and fortification protocols, does not appear to compromise short-term morbidity or mortality compared to MOM.

A further important finding of this study is the lack of significant difference in length of NICU stay among the three groups, with median durations of 35.00 days in the MOM and DM groups, and 39.50 days in the MM group. This observation is in line with data from Karoobi et al.[19], who also reported no difference in length of stay among VLBW infants fed MOM or DM. The clinical utility of DM is further highlighted by findings from Sparks et al.[20], in which a higher proportion of donor milk intake did not impair growth rates or prolong hospitalization, suggesting that DM facilitates early enteral nutrition without negatively impacting recovery or discharge readiness.

The clinical implications of these findings are substantial. Given the challenges of initiating and sustaining lactation in mothers of preterm infants, coupled with cultural and systemic barriers to breastfeeding in certain regions, DM represents a safe and effective nutritional alternative.[21,22] The absence of significant differences in growth and major clinical outcomes across feeding groups provides reassurance to clinicians and families that the use of DM and MM does not confer increased risk of adverse neonatal outcomes.[23,24] This could be particularly relevant for resource-limited settings.

The relatively small sample size, although powered for detecting differences, may have limited the detection of rare complications or small differences in growth outcomes. Future studies should aim for multicenter recruitment to enhance generalizability and statistical power. The lack of detailed compositional analysis of donor milk, including the inability to stratify by preterm versus term donor milk, could have obscured important subgroup differences. Prospective studies incorporating routine analysis of donor milk composition and fortification practices, as well as the inclusion of long-term neurodevelopmental follow-up, would help to clarify any subtle or delayed effects of feeding strategy. Microbiome analysis was also not performed.

## CONCLUSION

This study supports the use of donor milk and mixed feeding strategies as safe and effective alternatives to exclusive maternal milk feeding, particularly when supported by appropriate fortification and clinical protocols.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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| AUTHORSHIP AND CONTRIBUTION DECLARATION | |
|---|---|
| 1 | **Muhammad Akhtar:** Data collection, data analysis. |
| 2 | **Athar Razzaq:** Conception, critical revision. |
| 3 | **Farhan Sabir:** Methodology, proof reading. |
| 4 | **Muhammad Sarfraz Ahmad:** Literature review. |