Factors Associated with Delayed Transition From Oro/Nasogastric Tube Feeding to Oral Feeding in Preterm Infants: A Retrospective Study

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ABSTRACT:

Background: Successful transition from tube feeding to independent oral feeding is an important developmental milestone in preterm infants and is closely related to physiological maturation, neurological integrity, respiratory stability, and overall clinical condition. Prematurity may interfere with the coordination of sucking, swallowing, and respiration, while neonatal morbidities may further prolong dependence on oro/nasogastric tube feeding.

Objective: To identify clinical, perinatal, respiratory, neurological, infectious, metabolic, hematological, cardiac, maternal, gastrointestinal, and obstetric factors associated with prolonged oro/nasogastric tube feeding in preterm infants.

Methods: A retrospective observational study was conducted among preterm infants admitted to the Neonatal Intensive Care Unit of the Obstetric and Gynecological University Hospital "Koço Gliozheni," Tirana, Albania, between January and December 2025. A total of 289 preterm infants born at 24 to <37 weeks of gestation met the study criteria. Data were retrospectively extracted from clinical records and included demographic and perinatal characteristics, birth weight, gestational age, Apgar scores, mode of delivery, respiratory support, neonatal diagnoses, maternal factors, and feeding-related variables. The primary outcome was duration of oro/nasogastric tube feeding. Linear univariable regression analyses were performed separately for infants aged 24–<34 weeks and 34–<37 weeks.

Results: Of the 289 infants included, 159 (55.0%) were male and 130 (45.0%) were female. Mean gestational age was 33.29 weeks. Low birth weight was present in 178 infants (61.6%), very low birth weight in 40 (13.8%), and extremely low birth weight in 15 (5.2%). Overall, 67.1% of infants required oro/nasogastric tube feeding.Birth weight, 1-minute Apgar score, 5-minute Apgar score, and gestational age were significantly associated with duration of tube feeding in the 24–<34-week group. In the 34–<37-week group, birth weight was significantly associated with tube-feeding duration, whereas Apgar scores and gestational age were not statistically significant.Duration of oxygen requirement was strongly associated with prolonged tube feeding in both gestational-age groups, with standardized β coefficients of 0.854

and 0.772, respectively. Mechanical ventilation, synchronized intermittent mandatory ventilation, HOOD oxygen, and CPAP were also significantly associated with longer tube-feeding duration.Respiratory insufficiency was associated with prolonged tube feeding in both groups. Bronchopulmonary dysplasia, hyaline membrane disease, pneumothorax, and bilateral pneumonia were significant predictors in selected groups. Neurological disorders were significant in both groups, with ventriculomegaly significant in the younger group and seizures significant in the older group. Neonatal sepsis and neonatal infection were associated with longer tube-feeding duration. Hematological and metabolic disorders, particularly anemia of prematurity, anemia, and thrombocytopenia, were also significant. Cardiac disorders were significant in the 34–<37-week group.

Conclusions: Prolonged oro/nasogastric tube feeding in preterm infants is associated with a complex interaction of maturational and clinical factors. Respiratory support and duration of oxygen requirement appear particularly important. Lower birth weight, lower gestational age, lower Apgar scores, neurological disorders, infection, and hematological abnormalities were also associated with prolonged tube feeding. Early identification of infants at increased risk may support individualized feeding assessment and timely multidisciplinary intervention.

Keywords: preterm infant; oral feeding; tube feeding; nasogastric tube; orogastric tube; feeding progression; neonatal intensive care; respiratory insufficiency; feeding difficulties.

1. Introduction

Preterm birth remains one of the major challenges in neonatal medicine. Infants born before 37 weeks of gestation frequently require prolonged hospitalization and specialized nutritional and developmental support. In addition to respiratory, neurological, infectious, cardiovascular, and gastrointestinal complications, prematurity itself is associated with immature oral-motor and cardiorespiratory mechanisms required for safe and efficient oral feeding[1,2].

Oral feeding requires highly coordinated sucking, swallowing, and respiration. These functions mature progressively during fetal and early postnatal life and may remain immature in preterm infants. Consequently, premature infants may have difficulty generating effective sucking patterns, coordinating swallowing with respiration, and maintaining physiological stability during feeding[3].

Achievement of independent oral feeding is an important milestone in neonatal care and is frequently required before hospital discharge. Delayed acquisition of oral-feeding competence may contribute to prolonged hospitalization, inadequate nutritional intake, impaired growth, and persistent feeding difficulties.

The transition from tube feeding to oral feeding is influenced by gestational age, birth weight, physiological maturity, respiratory status, neurological function, and neonatal morbidity. Studies of extremely preterm infants have shown that younger gestational age and medical complications, including neurological risk and bronchopulmonary dysplasia, may slow progression through oral-feeding milestones[4] .

Respiratory disease may be particularly important because feeding requires precise coordination between swallowing and breathing. Preterm infants with bronchopulmonary dysplasia may demonstrate abnormal coordination between respiration and swallowing, which may interfere with safe and efficient oral feeding[5].

Similarly, large retrospective studies have demonstrated that gestational age, birth weight, and neonatal morbidities influence the timing of independent oral feeding. Among late-preterm infants, gestational age, birth weight, and medical conditions have also been associated with the time required to achieve full oral feeding. [6,7]

Despite the importance of oral-feeding progression, data describing factors associated with prolonged tube feeding among preterm infants in Albania remain limited. Therefore, the present study was undertaken in a tertiary neonatal intensive care setting to identify factors associated with prolonged oro/nasogastric tube feeding.

Objective

The primary objective was to identify factors associated with increased duration of oro/nasogastric tube feeding among hospitalized preterm infants.

The secondary objective was to determine whether these associations differed between infants born at 24–<34 weeks and those born at 34–<37 weeks of gestation.

Materials and Methods

Study design and setting

This retrospective observational study was conducted from January through December 2025 in the Neonatal Intensive Care Unit (NICU) of the Obstetric and Gynecological University Hospital "Koço Gliozheni" in Tirana, Albania.

The hospital is a tertiary obstetric and neonatal institution providing specialized care for high-risk pregnancies and newborns.

Study population

The initial hospital records included 555 NICU admissions during 2025. Following application of the predefined eligibility criteria, 289 preterm infants were included in the final analysis.

- Infants were eligible if they:
- were born at 24 to <37 weeks of gestation;
- had at least one documented diagnosis; and
- remained hospitalized in the NICU for at least one day.
- Infants were excluded if they:
- were born at ≥37 weeks of gestation;
- were admitted because of maternal complications after delivery rather than neonatal disease;
- were admitted solely to receive Hepatect;
- had incomplete medical records; or
- were admitted only for observation.
- A total of 266 infants were excluded during the selection process, resulting in a final study population of 289 preterm infants.

Data collection

Data were retrospectively extracted from neonatal clinical records.

The following variables were collected.

Demographic and perinatal variables

- sex;
- birth weight;
- gestational age;
- mode of delivery;
- Apgar score at 1 minute;
- Apgar score at 5 minutes; and
- duration of NICU hospitalization.

Neonatal morbidity

Clinical diagnoses were categorized into:

- respiratory/pulmonary disorders;
- cardiac disorders;
- disorders associated with prematurity and growth;
- infections and infectious risk;
- gastrointestinal disorders;
- congenital, genetic, or syndromic abnormalities;
- neurological disorders; and
- metabolic, hematological, and

endocrine disorders.

Feeding variables

Feeding-related variables included:

- use of an oro/nasogastric tube;
- duration of oro/nasogastric tube feeding; and
- amount of feeding per feed, where documented.
- Respiratory support
- Respiratory variables included:
- total days requiring oxygen;
- HOOD oxygen;
- continuous positive airway pressure (CPAP);
- mechanical ventilation/assisted controlled mechanical ventilation (VM/ACMV);
- synchronized intermittent mandatory ventilation (VM/SIMV); and
- oxygen administered by mask.

Maternal diabetes was recorded as the principal maternal factor. Obstetric and birth-related variables included birth asphyxia, meconium-stained amniotic fluid, placental abruption, and cephalohematoma.

Outcome measure

The primary outcome was duration of oro/nasogastric tube feeding, expressed in days.

Because the available clinical records primarily documented the number of days of tube use rather than a standardized oral-feeding readiness score, duration of tube feeding was used as an indicator of delayed transition toward independent oral feeding.

Gestational-age groups

For comparative analyses, infants were divided into two groups:

- 24–<34 weeks
- 34–<37 weeks

This classification was applied consistently throughout the present manuscript.

Statistical analysis

Data were initially entered into Microsoft Excel and subsequently analyzed using the Statistical Package for the Social Sciences (SPSS), version 20.0.

Linear regression analyses were performed to investigate associations between candidate clinical factors and the number of days of oro/nasogastric tube feeding.

The regression analyses included:

- unstandardized coefficient (B);
- standardized coefficient (β);
- t statistic; and
- p value.

A p value <0.05 was considered statistically significant.

Results

Study population

A total of 289 preterm infants were included.Of these, 159 (55.0%) were male and 130 (45.0%) were female.Mean gestational age was 33.29 weeks, with gestational ages ranging from 26 to <37 weeks

Table 1. Distribution of infants according to gestational age

Gestational age	n (%)
26–<27 weeks	3 (1.0)
27–<28 weeks	5 (1.7)
28–<29 weeks	9 (3.1)
29–<30 weeks	13 (4.5)
30–<31 weeks	22 (7.6)

Gestational age	n (%)
31–<32 weeks	23 (8.0)
32–<33 weeks	28 (9.7)
33–<34 weeks	44 (15.2)
34–<35 weeks	56 (19.4)
35–<36 weeks	43 (14.8)
36–<37 weeks	43 (14.8)

Overall, 2.7% of infants were extremely preterm, 48.1% were very preterm, and 49.2% were moderate-to-late preterm according to the classification used in the original dataset.

Birth weight and growth status

Of the 289 infants, 54 (18.7%) had a birth weight within the normal range, 178 (61.6%) had low birth weight, 40 (13.8%) had very low birth weight, and 15 (5.2%) had extremely low birth weight.

Regarding growth status, 146 infants were classified as appropriate for gestational age, 119 as small for gestational age, and 24 as large for gestational age.

Mode of delivery and Apgar scores

Ninety-six infants (33.2%) were delivered vaginally and 193 (66.8%) by cesarean section.

The mean Apgar score was 6.91 at 1 minute and 8.15 at 5 minutes.

Table 2. Association of birth weight, Apgar scores, and gestational age with duration of oro/nasogastric tube feeding

Dependent variable: Days of oro/nasogastric tube feeding

Variable	24–<34 weeks B	β	t	p	34–<37 weeks B	β	t	p
Birth weight	-0.013	-0.436	-5.753	<0.001*	-0.002	-0.237	-2.930	0.004*
Apgar score at 1 min	-2.642	-0.302	-3.742	<0.001*	-0.250	-0.077	-0.926	0.356
Apgar score at 5 min	-3.239	-0.226	-2.741	0.007*	-0.461	-0.111	-1.337	0.183
Gestational age	-2.881	-0.377	-4.829	<0.001*	-0.312	-0.098	-1.181	0.239

*Statistically significant at $p<0.05$.

In the 24–<34-week group, lower birth weight, lower 1-minute Apgar score, lower 5-minute Apgar score, and lower gestational age were all significantly associated with a greater number of days of tube feeding.

In the 34–<37-week group, birth weight remained significantly associated with tube-feeding duration, whereas the Apgar scores and gestational age did not reach statistical significance.

Respiratory Support and Oxygen Requirement

Respiratory or pulmonary disorders were common in the study population, affecting 265 infants. Respiratory distress was documented in 239 infants (82.7%), respiratory insufficiency in 56 (19.4%), and hyaline membrane disease in 26 (9.0%).

Table 3. Association of oxygen requirement and respiratory support with duration of oro/nasogastric tube feeding

Dependent variable: Days of oro/nasogastric tube feeding

Variable	24–<34 weeks B	β	t	p	34–<37 weeks B	β	t	p
Days requiring O_2	0.719	0.854	19.533	<0.001*	0.627	0.772	14.561	<0.001*
Days on VM/ACMV	0.920	0.700	11.651	<0.001*	0.946	0.512	7.233	<0.001*
Days on VM/SIMV	4.684	0.340	4.294	<0.001*	1.748	0.323	4.093	<0.001*
Days receiving oxygen by mask	-5.521	-0.043	-0.513	0.609	-0.651	-0.055	-0.657	0.512
Days on HOOD oxygen	1.061	0.544	7.697	<0.001*	0.629	0.492	6.778	<0.001*
Days on CPAP	1.694	0.216	7.857	<0.001*	2.855	0.565	8.222	<0.001*

*Statistically significant at $p<0.05$.

Duration of oxygen requirement was strongly associated with tube-feeding duration in both groups. The standardized β coefficients were 0.854 in the 24–<34-week group and 0.772 in the 34–<37-week group.

Mechanical ventilation, SIMV, HOOD oxygen, and CPAP were also significantly associated with longer tube-feeding duration in both gestational-age groups.

Pulmonary and Respiratory Disorders

Table 4. Association of pulmonary/respiratory disorders with duration of oro/nasogastric tube feeding

Dependent variable: Days of oro/nasogastric tube feeding

Pulmonary/respiratory disorder	24–<34 weeks B	β	t	p	34–<37 weeks B	β	t	p
Pulmonary/respiratory disorders	5.799	0.083	0.993	0.322	0.700	0.071	0.848	0.398
Respiratory distress	5.751	0.127	1.521	0.130	1.235	0.160	1.950	0.053
Transient respiratory distress	-12.028	-0.067	-0.794	0.428	-1.276	-0.106	-1.277	0.204
Respiratory insufficiency	10.242	0.319	3.992	<0.001*	2.481	0.197	2.409	0.017*
Hyaline membrane disease	8.577	0.220	2.682	0.008*	—	—	—	—
Bronchopulmonary dysplasia	55.444	0.308	3.840	<0.001*	—	—	—	—

Pulmonary/respiratory disorder	24–<34 weeks B	β	t	p	34–<37 weeks B	β	t	p
Pneumothorax	52.423	0.291	3.611	<0.001*	—	—	—	—
Left-sided pneumothorax	—	—	—	—	—	—	—	—
Bilateral pneumothorax	4.483	0.043	0.509	0.612	9.979	0.259	3.211	0.002*
Pneumonia	-2.257	-0.025	-0.294	0.769	—	—	—	—
Right-sided pneumonia	—	—	—	—	11.993	0.311	3.922	<0.001*
Left-sided pneumonia	—	—	—	—	-0.090	-0.002	-0.028	0.978
Bilateral pneumonia	37.317	0.207	2.514	0.013*	-2.103	-0.054	-0.655	0.514
Intrauterine pneumonia	—	—	—	—	11.993	0.311	3.922	<0.001*
Bronchopneumonia	14.155	0.079	0.936	0.351	—	—	—	—
Prolonged adaptation	—	—	—	—	-1.793	-0.080	-0.962	0.338
Pulmonary hemorrhage	-12.113	-0.095	-1.130	0.260	3.938	0.102	1.231	0.220

*Statistically significant at $p<0.05$.
— = value not reported/insufficient observations in the supplied analysis.

Respiratory insufficiency was significantly associated with prolonged tube feeding in both gestational-age groups. In the younger group, hyaline membrane disease, bronchopulmonary dysplasia, pneumothorax, and bilateral pneumonia were also significant.

In the 34–<37-week group, bilateral pneumothorax, right-sided pneumonia, and intrauterine pneumonia were significantly associated with longer tube-feeding duration.

Neurological Disorders

Table 5. Association of neurological disorders with duration of oro/nasogastric tube feeding

Dependent variable: Days of oro/nasogastric tube feeding

Neurological disorder	24–<34 weeks B	β	t	p	34–<37 weeks B	β	t	p
Neurological disorders	12.681	0.273	3.375	0.001*	5.049	0.259	3.216	0.002*
Seizures	9.704	0.179	2.163	0.032*	5.049	0.259	3.213	0.002*
Intracranial hemorrhage	3.077	0.017	0.203	0.840	-2.103	-0.054	-0.655	0.514
Meningitis	5.201	0.057	0.679	0.498	-2.118	-0.077	-0.931	0.354

Neurological disorder	24–<34 weeks B	β	t	p	34–<37 weeks B	β	t	p
Ventriculomegaly	35.126	0.335	4.226	<0.001*	-2.103	-0.054	-0.655	0.514

*Statistically significant at p<0.05.

Neurological disorders were significantly associated with prolonged tube feeding in both gestational-age groups.

In the 24–<34-week group, seizures and ventriculomegaly were significantly associated with longer tube-feeding duration, with ventriculomegaly demonstrating the strongest standardized association (β=0.335).

In the 34–<37-week group, seizures were significantly associated with prolonged tube feeding.

Infectious Disorders

Table 6. Association of infections/infectious risk with duration of oro/nasogastric tube feeding

Dependent variable: Days of oro/nasogastric tube feeding

Infection/infectious risk	24–<34 weeks B	β	t	p	34–<37 weeks B	β	t	p
Infections/infectious risk	4.414	0.110	1.313	0.191	1.521	0.239	2.951	0.004*
Infectious risk	-5.088	-0.151	-1.813	0.072	1.034	0.137	1.663	0.098
High infectious risk	5.639	0.183	2.215	0.028*	-0.199	-0.025	-0.295	0.769
Neonatal sepsis	8.285	0.219	2.665	0.009*	3.557	0.222	2.730	0.007*
Early neonatal sepsis	11.325	0.163	1.959	0.052	-2.118	-0.077	-0.931	0.354
Neonatal infection	10.222	0.250	3.068	0.003*	4.050	0.231	2.853	0.005*

*Statistically significant at p<0.05.

The overall infection/infectious-risk category was statistically significant in the 34–<37-week group.

Among infants aged 24–<34 weeks, high infectious risk, neonatal sepsis, and neonatal infection were significantly associated with prolonged tube feeding.

Neonatal sepsis and neonatal infection were also significantly associated with prolonged tube feeding in the 34–<37-week group.

Metabolic, hematological, and endocrine disorders

Table 7. Association of metabolic, hematological, and endocrine disorders with duration of orogastric/nasogastric tube feeding

Dependent variable: Duration of orogastric/nasogastric tube feeding (days)

Variable	24–<34 weeks B	β	t	p	34–<37 weeks B	β	t	p
Metabolic, hematological, and endocrine disorders	6.181	0.179	2.156	0.033*	1.199	0.186	2.268	0.025*
Hyperbilirubinemia	2.165	0.066	0.787	0.433	1.005	0.154	1.871	0.063
Jaundice	-2.479	-0.019	-0.230	0.818	—	—	—	—
Anemia	-4.369	-0.042	-0.496	0.612	4.878	0.279	3.482	0.001*
Anemia of prematurity	18.485	0.436	5.749	<0.001*	-0.092	-0.005	-0.056	0.955
Post-transfusion anemia	-12.028	-0.067	-0.794	0.428	—	—	—	—
Hemolytic disease of the newborn	—	—	—	—	-0.090	-0.002	-0.028	0.978
Thrombocytopenia	0.057	<0.001	0.005	0.996	4.472	0.163	1.986	0.049*
Hemorrhagic syndrome	-1.072	-0.014	-0.170	0.865	3.938	0.102	1.231	0.220
Polycythemia	-8.057	-0.063	-0.750	0.455	—	—	—	—

*Statistically significant at p<0.05. —, no coefficient reported.

The overall metabolic, hematological, and endocrine category was significantly associated with tube-feeding

Hematological, Metabolic, and Endocrine Disorders

The overall hematological/metabolic/endocrine category was statistically significant in both gestational-age groups.

In the 24–<34-week group, anemia of prematurity was significantly associated with longer tube feeding (B=18.485, β=0.436, p<0.001).

In the 34–<37-week group, anemia (B=4.878, β=0.279, p=0.001) and thrombocytopenia (B=4.472, β=0.163, p=0.049) were significant.

These findings suggest that hematological abnormalities may contribute to reduced physiological reserve during feeding, particularly among the most immature infants.

Maternal Factors

Maternal factors, represented principally by maternal diabetes, were not significantly associated with duration of tube feeding.In the younger group, the regression coefficient was B=-6.993, β=-0.039, p=0.645.

The relatively small number of infants exposed to maternal diabetes may have limited the statistical power to detect an association.

Gastrointestinal Disorders

Gastrointestinal disorders were not significantly associated with duration of oro/nasogastric tube feeding.

For the overall gastrointestinal category:

24–<34 weeks: B=-9.007, β=-0.050, p=0.553

34–<37 weeks: B=-2.133, β=-0.095, p=0.254

Gastric intolerance, gastrointestinal hemorrhage, and necrotizing enterocolitis were likewise not statistically significant in the supplied analyses.

These findings should not be interpreted as evidence that gastrointestinal disease has no effect on feeding progression, particularly because several individual gastrointestinal conditions were relatively uncommon.

Obstetric Complications and Birth Trauma

Obstetric complications and birth trauma were not statistically significant predictors of tube-feeding duration.

The overall category demonstrated:

24–<34 weeks: B=-11.519, β=-0.110, p=0.191

34–<37 weeks: B=-1.120, β=-0.057, p=0.491

The individual factors examined included birth asphyxia, meconium-stained amniotic fluid, placental abruption, and cephalohematoma.

Discussion

The present study demonstrates that prolonged oro/nasogastric tube feeding among preterm infants is multifactorial. The results indicate that feeding progression is influenced by respiratory stability, developmental maturity, neurological status, infectious morbidity, hematological abnormalities, and selected cardiovascular conditions[7,19].

One of the strongest findings was the association between duration of oxygen requirement and duration of tube feeding. Oxygen requirement was significantly associated with tube-feeding duration in both gestational-age groups, with standardized β coefficients of 0.854 and 0.772. This was among the strongest associations identified in the analysis[8,10,20].

This finding is physiologically plausible because oral feeding requires coordination of sucking, swallowing, and breathing. Preterm infants with ongoing respiratory disease may have insufficient respiratory reserve to maintain stable oxygenation while feeding. The maturation of respiratory-swallow coordination is itself a gradual process, and respiratory disease may further disrupt this coordination [8,9,10].

Mechanical ventilation, SIMV, HOOD oxygen, and CPAP were also associated with longer tube-feeding duration[11]. Importantly, these variables should not necessarily be interpreted as direct causes of feeding delay. Rather, they may act as markers of the severity and duration of underlying respiratory illness.

The association with bronchopulmonary dysplasia in the younger gestational-age group is consistent with previous research. Park et al. found that bronchopulmonary dysplasia and neurological risk were associated with slower progression through feeding milestones in extremely preterm infants. Van Nostrand et al. similarly reported delayed achievement of independent oral feeding among preterm infants with bronchopulmonary dysplasia[6].

Gewolb and Vice demonstrated that preterm infants with bronchopulmonary dysplasia may have disrupted coordination of respiration and swallowing[5]. This provides a plausible physiological explanation for the association observed in the present study.

Birth weight, gestational age, and Apgar scores

Birth weight was significantly associated with tube-feeding duration in both gestational-age groups. In the 24–<34-week group, lower birth weight was associated with longer tube-feeding duration, with β=-0.436. The association remained significant in the 34–<37-week group, although the standardized coefficient was smaller (β=-0.237).

Lower Apgar scores at both 1 and 5 minutes were associated with prolonged tube feeding in the younger gestational-age group. In contrast, neither Apgar score was statistically significant in the 34–<37-week group.

Gestational age was also strongly associated with tube-feeding duration in the younger group (β=-0.377). This is consistent with the developmental nature of oral feeding. Oral-feeding skills mature progressively, and preterm infants born at earlier gestational ages may require more time to develop adequate sucking, swallowing, and respiratory coordination.

These findings are also consistent with studies

showing that gestational age and birth weight are important predictors of progression to full oral feeding[6,7].

Neurological disorders

Neurological disorders were associated with prolonged tube feeding in both gestational-age groups.

Ventriculomegaly demonstrated a particularly strong association in the younger group (β=0.335). Seizures were significant in both groups, although the association was stronger in the older group.

Oral feeding requires intact neurological control of sucking, swallowing, airway protection, and respiratory coordination. Consequently, neurological injury or dysfunction may compromise the acquisition of feeding skills[1-3,20].

Previous research has also identified neurological risk as a factor associated with slower feeding progression in extremely preterm infants[4.19].

Infectious morbidity

Neonatal sepsis and neonatal infection were associated with prolonged tube feeding in both gestational-age groups.

Systemic infection may affect feeding progression through several pathways, including reduced physiological reserve, prolonged respiratory support, increased metabolic demands, and delayed developmental recovery. However, because of the retrospective design, these findings should be interpreted as associations rather than evidence of causality.

Hematological abnormalities

Hematological abnormalities were also associated with tube-feeding duration.

Anemia of prematurity was particularly important among infants aged 24–<34 weeks, with β=0.436. In the older group, anemia and thrombocytopenia were significant.

Anemia may reduce oxygen delivery to tissues and decrease an infant's ability to tolerate the physiological demands of oral feeding. This may be especially important in infants who already have respiratory disease.

Gastrointestinal, maternal, and obstetric factors

Interestingly, gastrointestinal disorders, maternal factors, and obstetric complications were not statistically significant predictors in the supplied analyses.

The absence of statistical significance does not necessarily mean that these conditions have no clinical relevance. The number of infants with specific conditions may have been insufficient to detect associations. Furthermore, the retrospective nature of the study and lack of standardized feeding assessments may have limited the ability to identify more subtle effects.

Clinical interpretation

The overall findings support the concept that oral-feeding readiness should not be determined solely by gestational or postmenstrual age[8.13].

A clinically meaningful feeding assessment should consider:

- respiratory stability;
- oxygen requirement;
- neurological status;
- behavioral state and alertness;
- sucking strength and organization;
- swallowing safety;
- coordination of sucking, swallowing, and breathing; and
- the infant's overall physiological reserve.
- The importance of individualized assessment is supported by the broader literature on neonatal oral feeding[8,13,14].

Strengths and Limitations

This study has several strengths.

First, it included 289 preterm infants from a tertiary neonatal intensive care unit.

Second, a broad range of potential determinants was examined, including respiratory, neurological, infectious, hematological, metabolic, cardiac, gastrointestinal, maternal, and obstetric factors.

Third, the analysis distinguished between two gestational-age groups, allowing potentially different patterns among more and less mature preterm infants to be identified.

Several limitations should also be acknowledged.

First, this was a single-center retrospective study covering one calendar year. Therefore, the generalizability of the results may be limited.

Second, the analysis depended on the accuracy and completeness of medical records.

Third, the study did not use a validated standardized oral-feeding assessment instrument. Tools such as the Early Feeding Skills Assessment have been developed to evaluate feeding readiness and oral-feeding competence more systematically[9].

Fourth, the outcome measure was duration of tube feeding rather than a direct measure of oral-feeding skill. Tube-feeding duration can be influenced by institutional practices, clinical discharge criteria, and physician or nursing decisions in addition to the infant's actual oral-feeding ability.

Fifth, some individual diagnoses were uncommon, limiting statistical power for specific conditions.

Finally, because this was a retrospective observational study, the associations identified should not be interpreted as causal.

Clinical Implications

The findings suggest that infants with prolonged oxygen requirements or substantial respiratory support should be considered at increased risk for delayed transition from tube to oral feeding.

Lower birth weight, lower gestational age, low Apgar scores, neurological abnormalities, infection, and hematological abnormalities may also help identify infants who require closer feeding surveillance.

Feeding readiness should therefore be assessed dynamically rather than according to gestational age alone.

Early multidisciplinary involvement may be beneficial, including neonatologists, neonatal nurses, feeding specialists, speech-language therapists/logopedists, occupational therapists where available, and parents.

Oral stimulation and other structured feeding interventions have been investigated as strategies for accelerating the transition to oral feeding, although the certainty of evidence varies between interventions and studies[12-18].

Conclusions

This retrospective study of 289 preterm infants identified multiple factors associated with prolonged oro/nasogastric tube feeding.

The strongest and most consistent associations were observed for duration of oxygen requirement and respiratory support, emphasizing the importance of respiratory stability in the development of oral-feeding competence.

Lower birth weight, lower gestational age, and lower Apgar scores were also associated with prolonged tube feeding, particularly among infants aged 24–<34 weeks.

Respiratory insufficiency, bronchopulmonary dysplasia, pneumothorax, pneumonia, neurological disorders, seizures, ventriculomegaly, neonatal infection, neonatal sepsis, anemia of prematurity, anemia, thrombocytopenia, and selected congenital cardiac abnormalities were also associated with longer tube-feeding duration.

Maternal factors, gastrointestinal disorders, and obstetric complications or birth trauma did not demonstrate statistically significant associations in this cohort.

Overall, delayed transition from tube feeding to oral feeding appears to reflect the interaction of developmental immaturity and neonatal morbidity rather than a single clinical factor[19].

Early identification of infants at increased risk and individualized multidisciplinary feeding assessment may help optimize the transition toward safe and effective oral feeding.

Future prospective multicenter studies using standardized feeding-readiness and swallowing assessments are warranted to validate these findings and determine whether targeted early

feeding interventions can reduce the duration of tube feeding

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