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Rates and Determinants of Home Nasogastric Tube Feeding in Infants Born Very Preterm

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Objective To examine rates and determinants of home nasogastric (NG)-tube feeding at hospital discharge in a cohort of very preterm infants within the Canadian Neonatal Network (CNN).

Study design This was a population-based cohort study of infants born <33 weeks of gestation and admitted to neonatal intensive care units (NICUs) participating in the CNN between January 1, 2010, and December 31, 2018. We excluded infants who had major congenital anomalies, required gastrostomy-tube, or were discharged to non-CNN facilities. Multivariable logistic regression analysis was used to identify independent determinants of home NG-tube feeding at hospital discharge.

Results Among the 13 232 infants born very preterm during the study period, 333 (2.5%) were discharged home to receive NG-tube feeding. Rates of home NG-tube feeding varied across Canadian NICUs, from 0% to 12%. Determinants of home NG-tube feeding were gestational age (aOR 0.94 per each gestational week increase, 95% CI 0.88-0.99); duration of mechanical ventilation (aOR 1.02 per each day increase, 95% CI 1.01-1.02); high illness severity at birth (aOR 1.32, 95% CI 1.01-1.74); small for gestational age (aOR 2.06, 95% CI 1.52-2.78); male sex (aOR 0.61, 95% CI 0.49-0.77); severe brain injury (aOR 1.60, 95% CI 1.10-2.32); and bronchopulmonary dysplasia (aOR 2.22, 95% CI 1.67-2.94).

Conclusions Rates of home NG-tube feeding varied widely between Canadian NICUs. Higher gestational age and male sex reduced the odds of discharge home to receive NG-tube feeding; and in contrast small for gestational age, severe brain injury, prolonged duration on mechanical ventilation and bronchopulmonary dysplasia increased the odds. *(J Pediatr 2022;246:26-33)*.

Because preterm infants have decreased suckling strength and immature oral coordination skills, feeding via tube has become the standard of care for infants born <32 weeks of gestation.[1] Transition from tube to oral feeding usually starts between 32 and 34 weeks of gestation.[2] Achieving full oral feeding is a major factor in determining timing of hospital discharge.[3] Some preterm infants fail to complete the transition and are discharged to receive home tube feeding. Traditionally, a surgical gastrostomy (G)-tube was placed; however, G-tube placement is associated with complications and carries operative risks.[4] Home nasogastric (NG)-tube feeding has gained popularity, with studies describing lower rates of tube-related complications and readmission compared with infants receiving G-tubes.[5,6] Home NG-tube feeding can promote growth and reduce the length of hospital stay, parental anxiety, and health care costs.[6-8] Furthermore, it facilitates the transition of preterm infants to a less stressful environment, thus, reducing their exposure to the negative stimuli often associated with a prolonged neonatal intensive care unit (NICU) stay.[7]

Home NG-tube feeding is designed to address the feeding difficulties experienced by preterm infants at the time of hospital discharge.[8] These difficulties may result from incoordination of sucking, swallowing, and breathing, oral

BPD	Bronchopulmonary dysplasia
CNN	Canadian Neonatal Network
G-tube	Gastrostomy tube
IVH	Intraventricular hemorrhage
NEC	Necrotizing enterocolitis
NG-tube	Nasogastric tube
NICU	Neonatal intensive care unit
PVL	Periventricular leukomalacia
SGA	Small for gestational age
SNAP-II	Score for Neonatal Acute Physiology version II

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Organizational support for the Canadian Neonatal Network and the Canadian Preterm Birth Network was provided by the Maternal-infant Care Research Centre (MiCare) at Mount Sinai Hospital in Toronto, Ontario, Canada. MiCare is supported by the Canadian Institutes of Health Research (CTP 87518) and Mount Sinai Hospital. The authors declare no conflicts of interest.

Part of the manuscript was presented as poster in AAP District VIII Section on Neonatal-Perinatal Medicine 44th Annual Conference 2021 (virtual).

https://doi.org/10.1016/j.jpeds.2022.03.012

fatigue, or physiologic instability during feeding.[9,10] There is an association between feeding difficulties and suboptimal growth, delayed neurodevelopment, and increased family stress.[11-13] Home NG-tube feedings support nutrient intake and growth while the infant's neurodevelopment and feeding skills mature and their endurance improves. Several strategies to promote sucking skills are available for preterm infants showing early signs of feeding difficulties and for those at risk for significant oral feeding delay.[14,15] A feeding and swallowing assessment is indicated for fragile feeders, to determine the safety of oral feeding and integrity of the swallow and to provide strategies to improve sucking skills, coordination, and endurance. Identifying the determinants of home tube feeding can help the health care team recognize at-risk infants sooner and proceed with early referral to aerodigestive programs, plan for early discharge of infants that otherwise are ready to go home, and provide appropriate family counseling.

The objectives of this study were to identify the rates of home NG-tube and G-tube feedings in infants discharged from Canadian NICUs and examine factors that may predict delayed acquisition of oral feeding skills in preterm infants born <33 weeks of gestation.

Methods

We conducted a multicenter, population-based retrospective cohort study using data from the Canadian Neonatal Network (CNN) that maintains a national database of admissions from tertiary-level NICUs in Canada. Trained research assistants at each participating NICU abstracted data following a manual of standardized operational definitions.[16] Data collection and transmission from each participating NICU were approved by each hospital's local Research Ethics Board or Quality Improvement Committee. Specific approval for this study was obtained from the University of Calgary Conjoint Health Research Ethics Board and from the Executive Committee of the CNN.

Infants born <33 weeks of gestational age; admitted to participating NICUs between January 1, 2010, and December 31, 2018; and discharged home were included in the analysis. During the study years, the numbers of units participating in the CNN increased from 25 in 2010 to 31 in 2018. Only infants with available data about type of feeding received at the time of discharge home were eligible for the study. Infants who had major congenital anomalies, did not survive to discharge, required a G-tube, or were transferred to non-CNN facilities were excluded from the analysis.

Outcomes and Study Variables

The primary outcome was the rate of home NG-tube feeding in preterm infants born <33 weeks of gestation in Canadian NICUs. The feeding method at day of discharge home was dichotomized as home NG-tube feeding or oral feeding. We also aimed to examine and the institutional variation in the rates of NG- and G-tube feeding among Canadian NICUs. The secondary outcome was to identify the determinants of the method of feeding on the day of discharge home in this population.

Determinants of Home NG-Tube Feeding

The following characteristics of the mothers and neonates were compared between the 2 feeding method groups: maternal age, gestational age, birth weight, gravida, parity, gestational diabetes, maternal hypertension, multiple gestations, antenatal steroid use, sex, small for gestational age (SGA) status (defined as birth weight <10th percentile for the given gestational age and sex),[17] outborn status, days of ventilation, days of oxygen use, days noninvasive ventilation including nasal positive airway pressure, nasal intermittent positive pressure, and high flow nasal cannula, duration of hospital stay, severe intraventricular hemorrhage (IVH) defined as grade ≥3 according to Papile classification, bronchopulmonary dysplasia (BPD) defined as use of oxygen and/or invasive or noninvasive ventilatory support and/or high flow air at 36 weeks of postmenstrual age, culture-proven late onset sepsis defined as any positive blood and/or cerebrospinal fluid culture after 2 days of age, necrotizing enterocolitis (NEC) stage 2 or higher, periventricular leukomalacia (PVL), brain injury was defined as IVH grade ≥3 or PVL, and Score for Neonatal Acute Physiology version II (SNAP-II). Study variables were defined according to the CNN Abstractor's Manual.[16] Gestational age was defined as the best estimate based on obstetric history, obstetric examination, and first prenatal ultrasound examination. Antenatal steroid use was classified as none, partial course, or complete course (defined as receipt of 2 doses of Betamethasone 24 hours prior to birth). SNAP-II, a validated scoring system of illness severity during the first 12 hours after NICU admission, was dichotomized to score <20 or score ≥20.[18] Outborn was defined as being born anywhere other than the admitting tertiary-level NICU.

Statistical Analyses

The study population was summarized descriptively. The rate of the primary outcome, home NG-tube feeding, was calculated for the study population. Cochran-Armitage test was used to trend the rate of home NG-tube feeding over the study period.[19,20] To examine the potential determinants of the primary outcome, maternal and infant characteristics were compared between the 2 feeding method groups, oral feeding and home NG-tube feeding, using the χ^2 test for categorical variables and the Students t test or Wilcoxon rank-sum test, as appropriate, for continuous variables. To further identify the independent determinants of home NG-tube feeding at discharge, we applied a multivariable logistic regression model with a generalized estimating equation approach

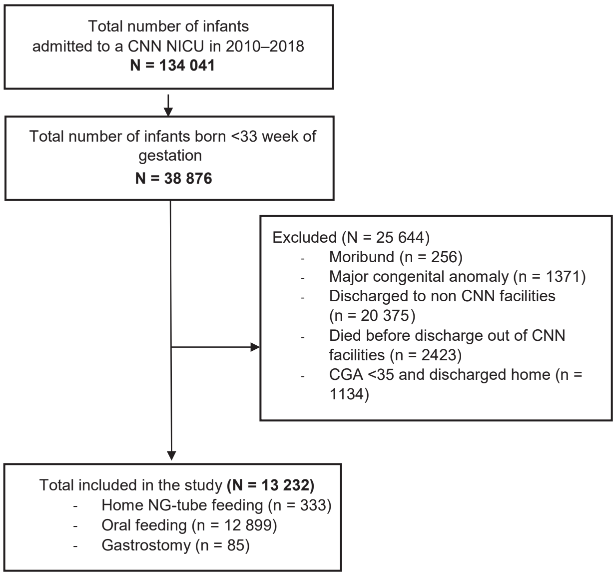


Figure 1. Flow chart of study population. *CGA*, corrected gestational age.

to account for the clustering of infants within sites. The covariates included in this model were the potential determinants identified in the univariate analysis as being associated with the primary outcome. Birth weight was not included in the model because of significant collinearity with gestational age. The data management and all statistical analyses were performed using Statistical Analysis System software: SAS 9.4 (SAS Institute). A 2-sided *P* value of <.05 was considered statistically significant.

Results

Of the total 134 041 neonates admitted to CNN NICUs during the study period, 13 317 infants were born between 22 and 32 weeks of gestation and were included in the study. Of those, 333 (2.5%) were discharged home to receive NG-tube feeding and 85 (0.6%) were discharged home receiving G-tube feeding. The rate of home NG-tube feeding in preterm infants born <28 weeks of gestation was significantly higher (4.8%) than infants born at 28-32 weeks of gestation (1.5%). The rates of home G-tube feeding in preterm infants born <28 and at 28-32 weeks gestation were 1.3% and 0.3%, respectively. Figure 1 shows the flow chart of the study participants. The rates of home NG-tube feeding at discharge varied across Canadian NICUs, from 0% to 12% with a mean of 2.5% (Figure 2). The rate of home NG-tube feeding in Canada (all CNN sites combined) increased significantly from 2010 to 2018 (Cochran-Armitage trend test $P < .01$) and the rate of G-tube feeding remained static (Cochrane-Armitage trend test $P = .18$) (Figure 3). Infants on home NG-tube feeding were discharged from hospital 5.2 weeks (SD 2.8 weeks) later than their counterparts who went home on oral feeding.

The maternal and infant baseline characteristics of the 2 feeding groups are summarized in Table I. Rates of home NG-tube feeding at discharge decreased significantly with increasing gestational age at birth. Results from the multivariable analysis for determinants of home NG-tube feeding at discharge are summarized in Table II. This analysis showed that infants born at lower gestational ages had significantly higher odds to discharge home on NG-tube feeding. SGA, SNAP-II score ≥20, severe brain injury, and longer duration of mechanical ventilation were all associated with home NG-tube feeding. BPD was the strongest predictor of home NG-tube feeding in very preterm infants. In contrast, male sex was associated with lower odds of home NG-tube feeding.

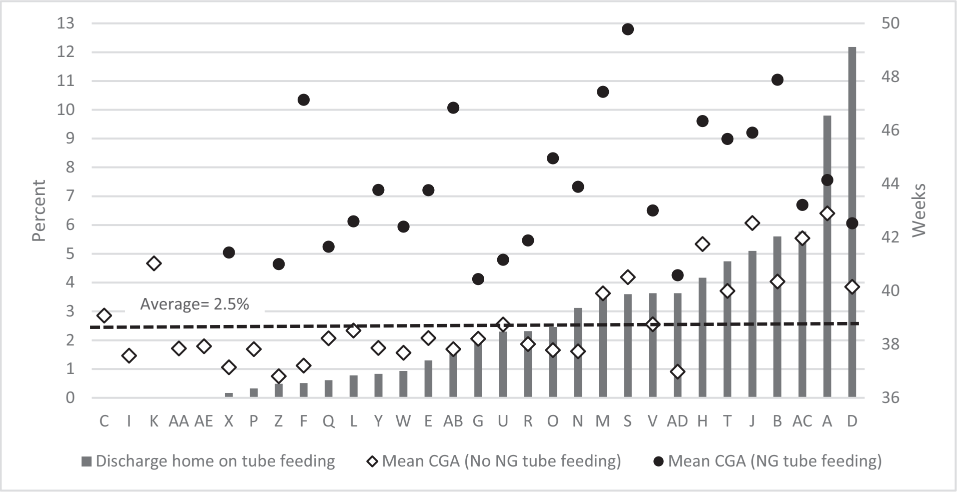
Table III (available at www.jpeds.com) summarizes the baseline characteristics and neonatal outcomes of infants receiving home NG-tube vs G-tube feeding. Infants who were discharged home to receive G-tube feeding had NEC, spontaneous intestinal perforation, laparotomy, severe brain injury, and BPD more often than counterparts receiving home NG-tube feeding. Furthermore, infants receiving home G-tube feeding had significantly longer hospital stay.

Results from the multivariable analysis for determinants of home G-tube feeding at discharge are summarized in Table IV (available at www.jpeds.com). SGA, BPD, severe brain injury, and NEC were associated with higher odds of home G-tube feeding. Table V (available at www.jpeds.com) summarizes the neonatal characteristics and outcomes between centers with high rates (upper quartile) vs low rates (lower quartile) of home NG-tube feeding. Infants who were born in centers with low rates of home NG-tube feeding were more likely to be more mature than counterparts in centers with high rates.

Discussion

In this large, population-based cohort of very preterm neonates born <33 weeks of gestation, 2.5% required NG-tube feeding at the time of hospital discharge, and the rates of home NG-tube feeding varied markedly among Canadian NICUs. The determinants of home NG-tube feeding at hospital discharge were younger gestational age, SGA status, SNAP-II score ≥20, duration of mechanical ventilation, severe brain injury, and BPD.

Our study revealed wide variation in the rates of home NG-tube feeding among NICUs, which ranged from 0% to 12% with a mean of 2.5%. Data on the rate of home NG-tube feeding in the literature is scarce, combining preterm and medically complex term neonates and focusing largely on oral feeding difficulties after



Letters along the x-axis represent individual sites. CGA, corrected gestational age. The mean rate of home NG-tube feeding was 2.5%.

Figure 2. Rates of home NG-tube feeding and mean corrected gestational age at hospital discharge by site.

introducing solids at 4-6 months of age. In the Children's Hospital Neonatal Database cohort of 40 910 newborn infants born between 2010 and 2014 and cared for in 27 regional NICUs, the rate of nonoral enteral feedings at discharge to home was 11.4%.[21] The non-oral enteral feedings in this cohort included those using NG-tubes and G-tubes. In another cohort from a single, medically complex level IV tertiary NICU, White et al reported that 21% of 1223 newborn infants who survived between 2013 and 2015 were discharged to receive home NG-tube or nasojejunal-tube.[22] Both of these studies included term neonates with medically complex conditions and other types of tube feeding, which may explain the higher rates of home tube

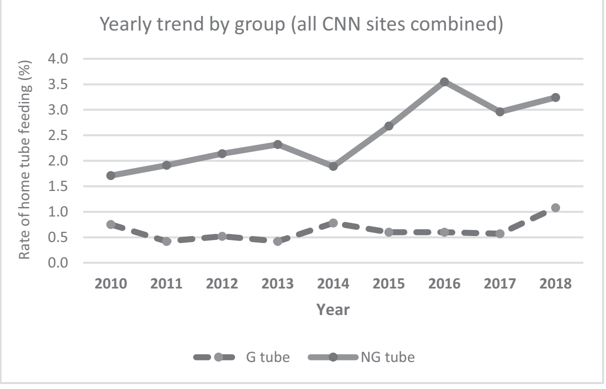


Figure 3. Yearly rate of home NG-tube and G-tube feeding between 2010 and 2018 in preterm infants born <33 weeks of gestation in Canada.

feeding compared with the rate for our cohort. The need for NG-tube feeding represents the severe form of oral-pharyngeal sensorimotor delay and feeding difficulties at time of hospital discharge only. The rates of feeding difficulties appear to be higher when other challenges are included in the first year of life. Sanchez et al reported that 38% of children born before 30 weeks of gestation had feeding difficulties at 12 months corrected age.[11] These difficulties were observed with specific food textures (purees, solids, easily dissolvable foods) related to oral-pharyngeal sensorimotor delay. Continued feeding difficulties after weaning to oral feeding in preterm infants discharged receiving home NG-feeding are anticipated.

The significant variation in the rates of home NG-tube feeding among Canadian NICUs may be explained by the differences in clinical practices between units and the availability of home-nutrition or aerodigestive programs that can provide appropriate follow-up post discharge. Furthermore, tertiary NICUs caring for cardiac and surgical infants may have higher rates of home NG-tube feeding at discharge compared with other regional tertiary NICUs.[11,22] Our findings indicate an increasing trend in home NG-tube in Canadian NICUs over the study period. However, there appears to be a large variation between sites because of variability in practice or perhaps difference in the patient population at centers that have higher rates. Establishing postdischarge feeding programs in some institutions with high rates of home NG-tube feeding may have encouraged health care providers to discharge more infants to receive NG-tube feeds.

In our study, the rate of home NG-tube feeding decreased with increasing gestational age at birth. This finding is in agreement with the literature.[23] Pahsini et al reported that

Table I. Maternal and infant characteristics of oral feeding and home NG-tube feeding in infants born at <33 weeks of gestation

Characteristics	Oral feeding (n = 12 899)	Home NG-tube feeding (n = 333)	P value
Maternal age, mean (SD), y	30.5 (5.8)	31.2 (5.5)	.05
Maternal diabetes (GDM/DM), no (%)	1706 (14)	46 (14)	.75
Maternal hypertension, no (%)	2443 (20)	73 (22)	.20
Multiple pregnancy, no (%)	3969 (31)	87 (26)	.07
Antenatal steroids, no (%)	11 098 (88)	297 (92)	.049
Outborn, no (%)	1272 (10)	31 (9)	.74
Gestational age, mean (SD), wk	29.0 (2.5)	27.0 (2.6)	<.001
Gestational age category:			<.001
<26 wk, no (%)	1572 (12)	118 (35)	
26-28 wk, no (%)	3499 (27)	120 (36)	
29-32 wk, no (%)	7828 (61)	95 (29)	
Birth weight, mean (SD), g	1320 (445)	970 (399)	<.001
SGA (<10th percentile), no (%)	1231 (10)	63 (19)	<.001
Male sex, no (%)	7131 (55)	145 (44)	<.001
Apgar score at 5 min <7, no (%)	3561 (28)	151 (46)	<.001
SNAP-II score ≥20, no (%)	1557 (12)	107 (32)	<.001
Patent ductus arteriosus requiring surgical ligation, no (%)	443 (3)	51 (15)	<.001
Any NEC stage ≥2, no (%)	452 (4)	22 (7)	.003
Surgical NEC, no (%)	107 (1)	11 (3)	<.01
Spontaneous intestinal perforation, no (%)	124 (1)	3 (1)	.12
Laparotomy, no (%)	323 (3)	29 (9)	<.01
Retinopathy of prematurity stage ≥3, no (%)	795 (10)	68 (26)	<.01
Duration of central venous catheter, median (IQR)	8 (0, 16)	20 (10, 37)	<.01
Duration of parenteral nutrition, median (IQR)	10 (6, 19)	23 (12, 39)	<.01
Any breastmilk feeding at discharge home, no (%)	8488 (66)	209 (630)	.25
Exclusive formula feeding at discharge home, no (%)	4056 (31)	110 (33)	.54
Culture-proven late-onset sepsis, no (%)	1658 (13)	73 (22)	<.001
Severe brain injury (IVH/PVL), no (%)	514 (5)	38 (12)	<.001
Corrected age at discharge, mean (SD), wk	38.5 (3.2)	44.3 (5.2)	<.001
Length of hospital stay, median (IQR), d	56 (38, 86)	116 (89, 145)	<.001
Level and duration of respiratory support			
Duration of mechanical ventilation, median (IQR), d	0 (0, 6)	20 (2, 42)	<.001
Duration of noninvasive ventilation (includes nCPAP, NIPPV, HFNC), median (IQR), d	9 (2, 37)	44 (26, 64)	<.001
Duration of oxygen supplementation, median (IQR), d	3 (0, 34)	66 (21, 117)	<.001
Receipt of oxygen at 36 wk of gestation, no (%)	2187 (17)	173 (52)	<.001
Any respiratory support at 36 wk of gestation, no (%)	2972 (23)	219 (66)	<.001
O_2 receipt at discharge home, no (%)	1181 (9)	116 (35)	<.001
Anthropometry			
Weight at discharge home, mean (SD), g	2838 (697)	3737 (964)	<.01
Weight z score at discharge, mean (SD)	−0.03 (0.97)	1.22 (1.34)	<.01
Head circumference at discharge, mean (SD), cm	33.7 (2.1)	35.5 (2.4)	<.01
Head circumference z score at discharge, mean (SD)	−0.01 (1.00)	0.83 (1.17)	<.01

DM, diabetes mellitus; *GDM*, gestational diabetes mellitus; *HFNC*, high flow nasal cannula; *nCPAP*, nasal continuous positive airway pressure; *NIPPV*, noninvasive ventilation.

severe prematurity was the primary cause of home tube dependency in 83% of infants born <29 weeks of gestation compared with 22% of infants born at 29-36 weeks of gestation.[23] Similarly, White et al reported a significant increase in the odds of assisted home feeding at discharge with every week's decrease in gestational age.[22] Reasons for the gestational age-related differences could be multifactorial. Infants born at an earlier gestational age usually achieve independent oral feeding later than those born at a later gestational age.[23,24] Van Nostrand et al found preterm infants born <29 weeks of gestation to be ≥7 days delayed in achieving independent oral feeding compared with preterm infants born at 29 weeks of gestation and later.[25] Postnatal oral-pharyngeal maturation in preterm infants can be affected by early life experiences, including environmental and nociceptive stimuli to the digestive and airway tract given to support enteral nutrition and ventilation.[26] The younger the gestational age, the longer these stimuli are required, and therefore the higher the risk for feeding milestone delays. Furthermore, younger gestational age is associated with significant increases in neonatal morbidities, such as severe IVH and PVL and respiratory complications, all of which are associated with significant delay in achieving feeding milestones.[26]

In our cohort, infants born SGA were at higher risk for home NG-tube feeding compared with appropriate for gestational age infants. Migraine et al, also showed that birth weight <−1 SD in preterm infants born <33 weeks of gestation was associated with abnormal eating behaviors at 2 years of age (aOR 2.88, 95% CI 1.47-5.67).[27] This

Table II. Multivariable analysis for determinants of home NG-tube feeding at discharge

Variables	Unadjusted OR (95% CI)	aOR* (95% CI)
Gestational age, wk	0.75 (0.72, 0.78)	0.94 (0.88, 0.99)
SGA	2.22 (1.68, 2.94)	2.06 (1.52, 2.78)
Male sex	0.63 (0.50, 0.78)	0.61 (0.49, 0.77)
SNAP-II score ≥20	3.45 (2.73, 4.37)	1.32 (1.01, 1.74)
Patent ductus arteriosus requiring surgical ligation	5.08 (3.72, 6.95)	1.39 (0.97, 1.98)
Necrotizing enterocolitis stage ≥2	1.95 (1.25, 3.30)	1.02 (0.64, 1.62)
Severe brain injury (severe IVH/PVL)	2.78 (1.96, 3.95)	1.60 (1.10, 2.32)
Mechanical ventilation, d†	1.04 (1.03, 1.04)	1.02 (1.01, 1.02)
O_2 receipt at 36 wk corrected age	5.30 (4.25, 6.60)	2.22 (1.67, 2.94)

*Adjusted for all other factors included in the model.
†OR is for every 1-day increase.

association could be explained by the fact that fetal volume and neuronal density of hypothalamic centers can be affected by fetal nutritional determinants.[26]

This lower risk associated with male sex is in contrast to that seen with other neonatal morbidities of preterm infants, where male infants are more likely to be affected. However, Migraine et al reported worse drive-to-eat scores in female infants born <33 weeks of gestation (aOR 1.76, 95% CI 1.08, 2.88).[27] Sex differences in the physiology of eating have been frequently described in animals and humans, including in children as young as 2 years old.[28,29] These differences appear to be related to hypothalamic-pituitary-gonadal axis function. Although a sex difference in eating physiology and morbidity may explain the association, the possibility of statistical interaction or residual confounding cannot be ruled out given the increased mortality in male preterm infants.[30]

Our study identified several determinants of home tube feeding related to level of sickness at birth and neonatal morbidities. Higher SNAP-II scores, BPD, and severe brain injury were associated with increased risk of home NG-tube feeding. Severe illness might affect neurologic maturation for SSB coordination. Furthermore, higher SNAP-II scores are associated with neonatal morbidities that are themselves frequently associated with feeding difficulties.[31,32] Infants with BPD were twice as likely to go home receiving NG-tube feeding in our study. The association between BPD and feeding difficulties in preterm infants has been reported.[33-35] A recent study Brun et al identified BPD as the most important single predictor for delayed achievement of full oral feeding, followed by oxygen and nasal positive airway pressure duration.[35] It is not clear whether this association reflects a complication of long-term invasive and noninvasive respiratory support, a delay in the introduction and progression of oral feeds, or fatigue during feeding as a sequela of BPD; or whether it is simply due to residual confounding of other factors, such as gestational age. Severe brain injury is a known risk factor for delayed feeding maturation and use of assisted feeding methods.[25] Coordination of SSB is a highly organized process that requires several regions of the brain to work in tandem. Damage to any of these areas could explain the delayed development of oral feeding skills in infants with brain injury.

Our study showed an association between home NG-tube feeding and longer duration of hospital stay. This may be a result of health care providers trying to wean infants from NG-tube feedings before discharge. Infants discharged receiving NG-tube feeding are more likely to have other comorbidities or require respiratory support that prevent them from being discharged. Our study indicates that discharge to receive home NG-tube feeding in Canada may be a “last resort” rather than an approach for facilitating home discharge with community support. The average corrected gestational age for sending infants home to receive NG-tube feeds would have been significantly shorter had the NICUs utilized the proactive approach to facilitate early discharge. Schuler et al reported safety and parental satisfaction in a prospective cohort study of 119 preterm infants discharged from a tertiary NICU receiving NG-tube feeding at an average gestational age of 35.4 weeks, compared with 44.3 weeks in our cohort.[36] Early discharge is beneficial for the emotional and psychological states of the parents and provides an ultimate form of family integrated care and reduces health care costs.[37,38] A quasi-randomized trial evaluated outcomes after early hospital discharge receiving home NG-tube feeding.[39,40] This study included 88 infants born >30 weeks of gestation and showed a lower incidence of respiratory infection.[40]

The major strength of our study is that it included a large, population-representative data set and a multicenter cohort. In addition, the processes of data collection and data entry validation were rigorous, and we studied a very specific preterm population at high risk for feeding difficulties. We must also acknowledge some limitations of our study. First, because we studied a retrospective cohort, we may have missed variables with important implications for discharge home on tube feeding, including social determinants of health and the availability of parents to feed their infants in the NICU. Second, we excluded infants with G-tube feeding, as the reasons for placing a G-tube can differ from those for placing an NG-tube. Third, we excluded infants discharged to non-CNN facilities because hospital discharge data were not available. Fourth, we did not evaluate the long-term feeding, nutritional, or neurodevelopmental outcomes of infants discharged home receiving NG-tube feeding as this was outside the scope of this study.

Identifying infants at risk for severe oral-pharyngeal sensorimotor delay may help health care providers anticipate the possible need for NG-tube feeding, plan early and optimal management strategies to improve oral feeding skills, and provide appropriate family counseling. ■

The authors thank all site investigators and data abstractors of the Canadian Neonatal Network (CNN) and the Canadian Preterm Birth Network (CPTBN). We thank Dr Sarfaraz Momin from the Department of Pediatrics at the University of Calgary in Calgary, Alberta, and Heather McDonald Kinkaid, PhD, of the Maternal-infant Care Research Center (MiCare) at Mount Sinai Hospital in Toronto, Ontario, for editorial support in preparing this manuscript; and other MiCare staff, for organizational support of CNN and CPTBN.

Submitted for publication Dec 23, 2021; last revision received Feb 15, 2022; accepted Mar 1, 2022.

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Data Statement

Data sharing statement available at www.jpeds.com.

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Table III. Baseline characteristics and neonatal outcomes of infants on home NG-tube vs G-tube feeding

Characteristics	Home NG-tube feeding (n = 333)	Home G-tube feeding (n = 85)	*P* value
Gestational age, mean (SD), wk	27.0 (2.6)	26.8 (2.7)	.62
Birth weight, mean (SD), g	970 (399)	935 (391)	.48
SGA (<10th percentile), no (%)	63 (19)	18 (21)	.64
Antenatal steroids, no (%)	297 (92)	70 (86)	.15
Male sex, no (%)	145 (44)	43 (51)	.25
SNAP-II score ≥20, no (%)	107 (32)	33 (39)	.25
Patent ductus arteriosus requiring surgical ligation, no (%)	51 (15)	14 (16)	.79
NEC stage ≥2, no (%)	22 (7)	16 (19)	<.01
Surgical NEC, no (%)	11 (3)	7 (8)	.05
Spontaneous intestinal perforation, no (%)	3 (1)	6 (7)	<.01
Laparotomy, no (%)	29 (9)	27 (32)	<.01
Culture-proven late-onset sepsis, no (%)	73 (22)	39 (46)	<.01
Severe brain injury (IVH/PVL), no (%)	38 (12)	19 (23)	<.01
Retinopathy of prematurity stage ≥3, no (%)	68 (26)	23 (32)	.32
Days on mechanical ventilation, median (IQR), d	20 (2, 42)	45 (22, 70)	<.01
Duration of central venous catheter, median (IQR), d	20 (10, 37)	40 (20, 71)	<.01
Duration of parenteral nutrition, median (IQR), d	23 (12, 39)	37 (23, 70)	<.01
O_2 receipt at 36 wk of gestation, no (%)	173 (52)	61 (72)	<.01
Corrected age at discharge, mean (SD), wk	44.3 (5.2)	56.2 (10.1)	<.01
Length of hospital stay, median (IQR), d	116 (89, 145)	200 (147, 245)	<.01
Weight at discharge home, mean (SD), g	3737 (964)	5457 (1529)	<.01
Weight z score at discharge home, mean (SD)	1.22 (1.34)	3.62 (2.13)	<.01
Head circumference at discharge home, mean (SD), cm	35.5 (2.4)	38.9 (3.2)	<.01
Head circumference z score at discharge home, mean (SD)	0.83 (1.17)	2.50 (1.53)	<.01

Table IV. Multivariable analysis for determinants of home G-tube feeding

Variables	Unadjusted OR (95%CI)	aOR* (95% CI)
Gestational age, wk	0.73 (0.68, 0.80)	1.19 (1.05, 1.35)
SGA	2.55 (1.51, 4.30)	2.02 (1.12, 3.63)
Male sex	0.83 (0.54, 1.27)	0.66 (0.42, 1.06)
SNAP-II score ≥20	4.61 (2.97, 7.15)	1.11 (0.65, 1.89)
Patent ductus arteriosus requiring surgical ligation	5.54 (3.10, 9.91)	0.91 (0.46, 1.79)
NEC stage ≥2	6.38 (3.68, 11.08)	2.90 (1.58, 5.35)
Severe brain injury (severe IVH/PVL)	6.18 (3.68, 10.39)	3.23 (1.80, 5.80)
Mechanical ventilation, d†	1.05 (1.04, 1.06)	1.04 (1.03, 1.05)
O_2 receipt at 36 wk corrected age	12.45 (7.75, 20.03)	4.71 (2.49, 8.90)

*Adjusted for all other factors included in the model.
†OR is for every 1-day increase.

Table V. Baseline characteristics and neonatal outcomes of infants admitted to NICUs with the highest rates (upper quartile) vs the lowest rates of home NG-tube feeding

Characteristics	Infants admitted to NICUs with low rates of home NG-tube feeding (lower quartile) (n = 2271)	Infants admitted to NICUs with high rates of home NG-tube feeding (upper quartile) (n = 1876)	*P* value
Gestational age, mean (SD), wk	29.3 (2.4)	27.6 (2.6)	<.01
Birth weight, mean (SD), g	1363 (423)	1102 (416)	<.01
SGA (<10th percentile), no (%)	217 (10%)	220 (12%)	.02
Male sex, no (%)	1236 (54%)	1036 (55%)	.59
SNAP-II score ≥20, no (%)	128 (6%)	455 (24%)	<.01
Patent ductus arteriosus requiring surgical ligation, no (%)	61 (3%)	152 (8%)	<.01
NEC stage ≥2, no (%)	39 (2%)	118 (6%)	<.01
Spontaneous intestinal perforation, no (%)	10 (1%)	29 (2%)	<.01
Laparotomy, no (%)	34 (2%)	87 (5%)	<.01
Culture-proven late-onset sepsis, no (%)	258 (11%)	373 (20%)	<.01
Severe brain injury (IVH/PVL), no (%)	58 (3%)	128 (7%)	<.01
O_2 receipt at 36 wk corrected age, no (%)	177 (8%)	476 (25%)	<.01
Retinopathy of prematurity stage ≥3, no (%)	72 (5%)	190 (15%)	<.01
Mechanical ventilation, median (IQR), d	0 (0, 4)	4 (0, 24)	<.01