Title: The influence of Social Determinants of Health on Feeding Outcomes in a Level IV NICU

Authors: Daubert, M; Hernandez, J; Sarkisian, V; Joshi, Menkiti O; S; Quiñones Cardona, V

Introduction: Social Determinants of Health (SDoH) influence health outcomes and remain key drivers of health disparities. High area of deprivation index (ADI) has been implicated in neonatal mortality, sepsis, and intraventricular hemorrhage. Feeding techniques (Oral versus Tube) and support at time of discharge impacts overall length of stay and parenting burden post discharge. Understanding the influence of SDoH on short-term feeding outcomes is essential for promoting positive health outcomes in this vulnerable population. This study aims to elucidate the relationship between neonatal feeding outcomes, specifically discharge home on tube versus oral feeds, and ADI in infants admitted to a level IV NICU.

Methods: This was a retrospective cohort study in an urban, academic level IV NICU between November 2019 and April 2023. Infants who survived to discharge were included and groups were divided into those discharged on oral versus tube feeds (i.e., gastrostomy and naso/orogastric tube). Maternal and neonatal demographics, comorbidities, feeding and in-hospital outcomes data were abstracted from the Children's Hospitals Neonatal Consortium database as well as electronic medical records. ADI was obtained by cross referencing maternal address to the Neighborhood Atlas of the Center for Health Disparities Research at the University of Wisconsin School of Medicine and Public Health. Groups were compared utilizing SPSS. Chi squared test was performed for nominal data and Mann U Whitney test for continuous data. Multivariate logistic regression analysis was performed to adjust for covariates such as birthweight, gestational age, invasive mechanical ventilation (IMV), congenital heart disease (CHD), genetic/ metabolic conditions and discharge on bronchopulmonary disease (BPD) medications.

Results: A total of 513 patients were included in the cohort, 417 (81.2%) infants were discharged on oral feeds and 96 (18.7%) on tube feeds. Of those discharged on tube feeds, 87 (90.6%) were gastrostomy tubes and nine (9.3%) naso/orogastric tubes. There was no difference in median ADI between groups (Oral 76 [53-91] vs Tube 69.5 [44.5-89] p=0.266). Infants in the tube fed group were more premature, had lower birth weight, and had higher prevalence of CHD, genetic/metabolic disorders, culture positive sepsis, PDA, confirmed aspiration, history of abdominal surgery, tracheostomy, and history of IMV than the orally fed group (Table 1). There were no differences between groups in sex, race/ethnicity, maternal language preference or type of insurance (Table 1). The tube fed group had a longer median duration of respiratory support and length of stay, and older corrected gestational age at discharge. Tube fed group were more frequently discharged on diuretics, inhaled BPD medications, oxygen, and pulmonary hypertension medications than the orally fed group (Table

1). Despite the increased prevalence in IMV in the tube fed group, there was no difference in the duration of IMV between groups (Table 1).

Logistic regression analysis (Table 2) showed that infants with IMV (OR 1.04, 95%CI [1.015-1.069], p=0.002), a diagnosis of genetic/metabolic condition (OR 4.46, 95%CI [1.374-14.51], p=0.013), confirmed aspiration (OR 35.78, 95%CI [7.172-178.464], p= <0.001), and discharged on BPD medications (OR 3.857 95%CI [1.252-11.88], p=0.019) had higher odds of being discharged on tube feeds.

Conclusion:

In this cohort study, area of deprivation index was not associated with short term neonatal feeding outcomes. The presence of a metabolic or genetic diagnosis, confirmed aspiration of feeds, IMV, and need for BPD medications at discharge were associated with higher odds of tube feeds at discharge. The high prevalence of gastrostomy tubes over nasogastric tubes at time of discharge demands review of practice and opportunities for quality improvement efforts.

Table 1. Patient Characteristics

Characteristic	Total	IQR or %	Oral Feeds	IQR or %	Tube Feeds	IQR or %	p value
Total	513	100.0	417	81.3	96	18.7	
Tube Feed Type							
Naso/orogastric					9	9.4	
Gastrostomy					87	90.6	
Sex							0.412
Female	216	42.1	172	41.2	44	45.8	
Race/Ethnicity							0.159
White, non-Hispanic	52	10.1	46	11.0	6	6.3	
Black, non-Hispanic	261	50.9	208	49.9	53	55.2	
Hispanic, any-race	164	32.0	130	31.2	34	35.4	
Unknown	36	7.0	33	7.9	3	3.1	
Racial Subgroups							0.157
White	61	11.9	52	12.5	9	9.4	
Black	160	31.2	121	29.0	39	40.6	
Asian	8	1.6	5	1.2	3	3.1	
Native Hawaiian/Pacific Islander	1	0.2	1	0.2	0	0.0	
Native American	1	0.2	1	0.2	0	0.0	
Other	246	48.0	204	48.9	42	43.8	
Unknown	36	7.0	33	7.9	3	3.1	
Latinx/Hispanic Subgroups							0.569
Hispanic	166	32.4	132	31.7	34	35.4	
Non-Hispanic	309	60.2	252	60.4	57	59.4	
Unknown	38	7.4	33	7.9	5	5.2	
Maternal Preferred Language							0.852

English Preference	436	85.0	355	85.1	81	84.4	
Non-Eng. Preference	77	15.0	62	14.9	15	15.6	
Preferred Language Subgroups							0.843
English	436	85.0	355	85.1	81	84.4	
Spanish	61	11.9	49	11.8	12	12.5	
Portuguese	5	1.0	4	1.0	1	1.0	
Chinese (Mandarin, Cantonese, etc.)	2	0.4	2	0.5	0	0.0	
Haitian Creole	3	0.6	3	0.7	0	0.0	
Other	6	1.2	4	1.0	2	2.1	
Type of Insurance							0.472
Public	365	71.2	294	70.5	71	74.0	
Private	36	7.0	29	7.0	7	7.3	
Both	51	9.9	40	9.6	11	11.5	
None	61	11.9	54	12.9	7	7.3	
Prenatal Care Received							0.798
Yes, Adequate	382	74.5	312	74.8	70	72.9	
Yes, Limited	90	17.5	71	17.0	19	19.8	
No	41	8.0	34	8.2	7	7.3	
Area Deprivation Index							0.266
Median	75		76	53-91	69.5	44.5-89	
Birth Characteristics							
Weight, Grams, Median	2450		2554	1587-3203	1760	946-2772	<0.001
Gestational Age, Weeks, Median	36.6		37	32.4-39	34.1	27-37.3	0.001
Delivery Method							0.708

Vaginal Delivery	237	46.2	191	45.8	46	47.9	
Cesarean Delivery	276	53.8	226	54.2	50	52.1	
APGAR 1 minute, Median	7		7	4-8	6	3-8	<0.001
APGAR 5 minute, Median	9		9	4-9	8	5-8	0.407
Infant Diagnoses							
Aspiration, Clinical Diagnosis	134	26.1	76	18.2	58	60.4	<0.001
Aspiration, Confirmed by Video Swallow Study	41	8.0	9	2.2	32	33.3	<0.001
Bronchopulmonary Dysplasia	98	19.1	65	15.6	33	34.4	<0.001
Congenital Diaphragmatic Hernia	2	0.4	1	0.2	1	1.0	0.256
Congenital Heart Defect	138	26.9	96	23.0	42	43.8	<0.001
Delayed/Slow Feeding	207	40.4	145	34.8	62	64.6	<0.001
Genetic/Metabolic Disorder	39	7.6	24	5.8	15	15.6	0.001
Gastrointestinal Obstruction	14	2.7	11	2.6	3	3.1	0.792
Hypoxic-Ischemic Encephalopathy	41	8.0	33	7.9	8	8.3	0.891
Intrauterine Drug Exposure/NOWS	75	14.6	61	14.6	14	14.6	0.991
Infant of a Diabetic Mother	49	9.6	38	9.1	11	11.5	0.481
Large for Gestational Age	31	6.0	28	6.7	3	3.1	0.183
Necrotizing Enterocolitis	33	6.4	25	6.0	8	8.3	0.400
Other Cardiac Disorder	61	11.9	50	12.0	11	11.5	0.885
Patent Ductus Arteriosus	61	11.9	42	10.1	19	19.8	0.008
Prematurity	198	38.6	151	36.2	47	49.0	0.021
Respiratory Distress Syndrome	91	17.7	77	18.5	14	14.6	0.369
Sepsis, culture positive	29	5.7	16	3.8	13	13.5	<0.001
Sepsis, culture negative	44	8.6	36	8.6	8	8.3	0.925
Seizure	22	4.3	15	3.6	7	7.3	0.107
Small for Gestational Age	74	14.4	59	14.1	15	15.6	0.710
Spontaneous Intestinal Perforation	8	1.6	7	1.7	1	1.0	0.650
Interventions							
Abdominal Surgery (exc. gastrostomy)	96	18.7	69	16.5	27	28.1	0.009
Dur. all resp. support, days, median	1.3		0.6	0-10.7	28.4	1.4-75	<0.001
Invasive Mechanical Ventilation (IMV)	181	35.3	114	27.3	67	69.8	<0.001
Duration IMV, days, median	1.6		1.2	0.1-6.4	3.9	0.1-25	0.165
Tracheostomy	12	2.3	0	0.0	12	12.5	<0.001
Discharge Characteristics							

Corrected Gestational Age, Median	41		40	39-42.5	49	45-53	<0.001
Length of Stay, Days, Median	23		15	7-38	76	45-138	<0.001
Discharge Medications							
Anti-seizure	10	1.9	6	1.4	4	4.2	0.081
Diuretics	61	11.9	32	7.7	29	30.2	<0.001
H2 Antagonists	13	2.5	8	1.9	5	5.2	0.064
Inhaled BPD	98	19.1	56	13.4	42	43.8	<0.001
Oxygen	81	15.8	54	12.9	27	28.1	<0.001
Promotility Agents	5	1.0	3	0.7	2	2.1	0.220
Proton Pump Inhibitors	33	6.4	18	4.3	15	15.6	<0.001
Pulmonary Hypertension	8	1.6	2	0.5	6	6.3	<0.001

Table 2: Covariates influencing feeding outcomes

Variables	**Odds ratio**	**Confidence interval**	**p-value**
Birth weight	1.000	0.999-1.001	0.694
Gestational age	1.055	0.872-1.276	0.580
Invasive mechanical ventilation	1.049	1.017-1.082	0.002
Bronchopulmonary dysplasia	0.547	0.136-2.206	0.397
Congenital Heart disease	2.656	1.173-6.014	0.019
Genetic/metabolic	4.288	1.208-15.225	0.024
Confirmed aspiration	35.777	7.172-178.464	<0.001
Discharged on inhaled BPD medications	4.692	1.242-17.720	0.023
Discharged on oxygen	1.510	0.458-4.976	0.498