Variations in the Nutritional Content of Human Milk

Pediatric Nutrition
CONTINUING EDUCATION FOR CLINICIANS

Presented by
Brian Stansfield, MD

ANNENBERG CENTER FOR HEALTH SCIENCES
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Mead Johnson Nutrition.

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Dr. Stansfield on service. Photo courtesy of Brian Stansfield, MD.

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Brian Stansfield, MD

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Learning Objectives

- Discern what is known or not known about the nutritional composition of human milk
- State general nutritional expectations associated with mother's own milk and donor milk
- Apply critical assessment to the planned feeding strategy for a preterm infant

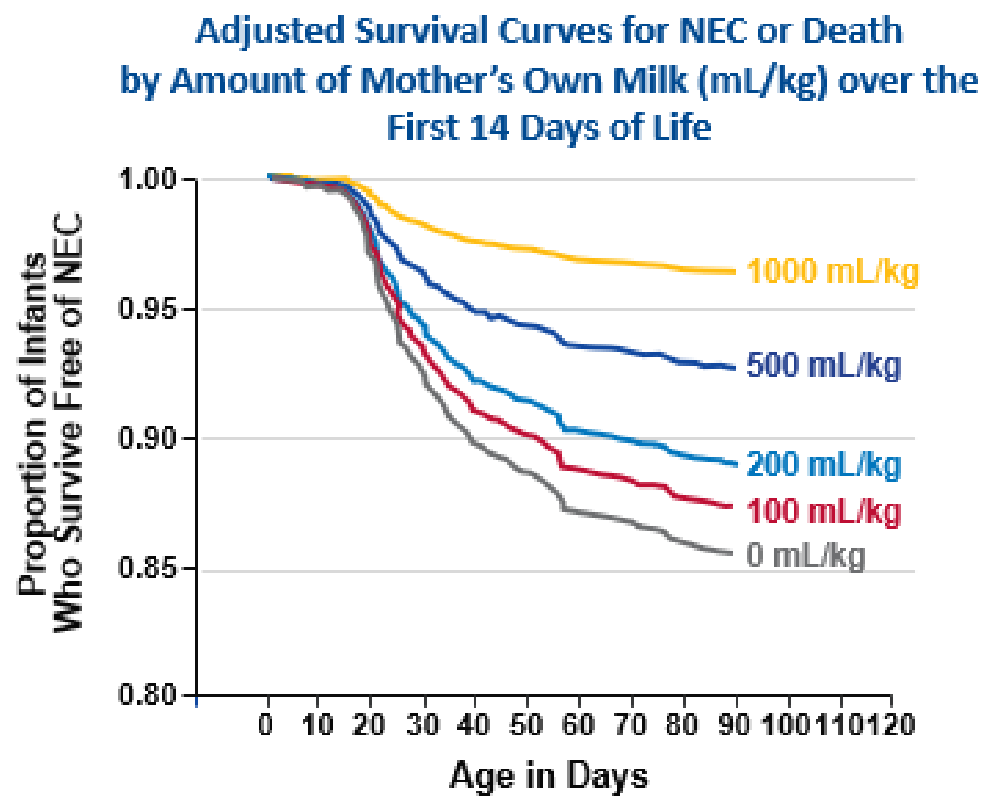
Human Milk for Preterm Infants

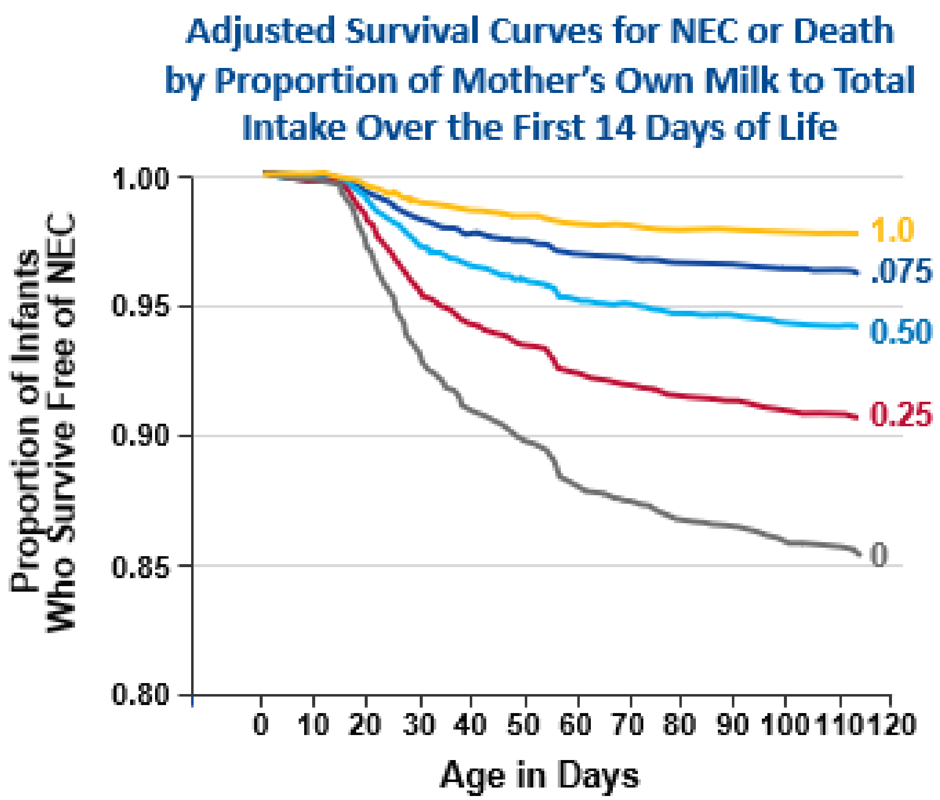
Exclusive Human Milk Feeding for the First 6 Months of Life: a "Public Health Imperative" [1]

Maternal, infant, and public health organizations recommend **exclusive breastfeeding** or **use of human milk** for virtually all infants—including preterm infants—for the first 6 months of life [1]–[6]

[1]. Meek JY et al. *Pediatrics*. 2022;150(1):e2022057988. [2]. World Health Organization (WHO). WHO Recommendations on Maternal and Newborn Care for a Positive Postnatal Experience. March 30, 2022. Accessed February 9, 2023. https://www.who.int/publications/i/item/9789240045989. [3]. American College of Obstetricians and Gynecologists (ACOG) Committee on Obstetric Practice; Breastfeeding Expert Work Group. *Obstet Gynecol*. 2016;127(2):e86-e92. [4]. US Department of Agriculture (USDA). Dietary Guidelines for Americans, 2020-2025. December 2020. Accessed February 9, 2023. www.DietaryGuidelines.gov. [5]. US Department of Health & Human Services. The Surgeon General's Call to Action to Support Breastfeeding. Office of the Surgeon General; 2011. [6]. Agostoni C et al. *J Pediatr Gastroenterol Nutr*. 2009;49(1):112-125. 7. Lessen R, Kavanagh K. *J Acad Nutr Diet*. 2015;115(3):444-449. 8. Spatz DL, Edwards TM. *Adv Neonatal Care*. 2016;16(4):254.

Human Milk and Risk of NEC or Death in Preterm Infants

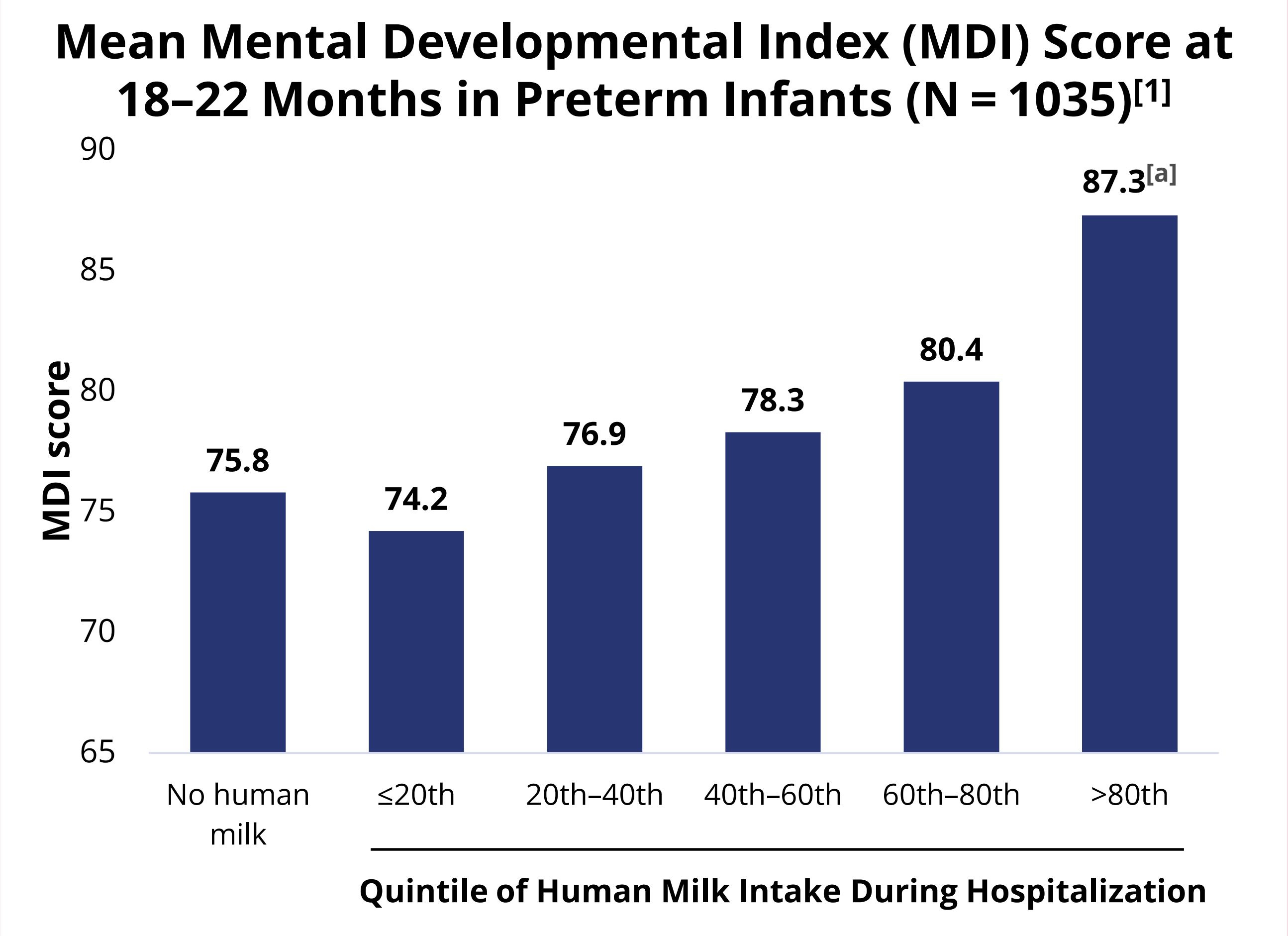




NEC, necrotizing enterocolitis.

Meinzen-Derr J et al. *J Perinatol*. 2009;29(1):57-62. Adapted from figure 1 and 2.

Human Milk and Neurodevelopment in Preterm Infants



At 22 months of age, higher levels of human milk intake during hospitalization was associated with better neurodevelopmental outcomes.[1]

In cohort studies, the neurodevelopmental benefits of human milk for hospitalized preterm infants persisted for up to **8 years of age**.[2],[3]

a. *P* < .01 vs no human milk

[1]. Vohr BR et al. *Pediatrics*. 2006;118(1):e115-e123. [2]. Horwood LJ et al. *Arch Dis Child Fetal Neonatal Ed*. 2001;84(1):F23-F27. [3]. Belfort MB et al. *JAMA Netw Open*. 2022;5(7):e2221608.

Human Milk and the Unique Nutritional Needs of Preterm Infants

Despite clear advantages of human milk for preterm infants, several challenges remain: [1],[2]

- Rapid growth rate of preterm infants (twice the rate of term infants) and high metabolic demands
- Suboptimal gestational nutrient accretion and deficient nutrient stores
- Weight-appropriate human milk feeding volumes insufficient to meet nutritional needs
- Variability of human milk composition

[1]. Hay WW, Jr. *Pediatr Gastroenterol Hepatol Nutr*. 2018;21(4):234-247. [2]. Kleinman RE, Greer FR, eds. *Pediatric Nutrition, 8th ed*. American Academy of Pediatrics; 2020.

Adequate Growth and Preterm Infant Outcomes

Preterm Infant Growth Benefits: Preventing Morbidity

Preterm infants with growth faltering are at elevated risk for…

- Late-onset sepsis [1]
- Necrotizing enterocolitis [1]
- Bronchopulmonary dysplasia [1]
- Retinopathy of prematurity [2]

[1]. Guellec I et al. *J Pediatr*. 2016;175:93-99.e1. [2]. Hellström A et al. *Acta Paediatr*. 2010;99(4):502-508.

Supporting Growth and Development Through Nutrition

The **American Academy of Pediatrics** recommends that preterm nutrition should "provide nutrients **to approximate the rate of growth and composition of weight gain for a normal fetus** of the same postmenstrual age and to maintain normal concentrations of blood and tissue nutrients."[1]

Benefits of achieving recommended growth rates in preterm infants: [1]–[3]

- Improved short- and long-term neurodevelopmental outcomes
- Reduced rate of school difficulties (ie, need for special educational accommodations, lower than average grades)
- Improved short- and long-term body composition scores

[1]. Kleinman RE, Greer FR, eds. *Pediatric Nutrition, 8th ed*. American Academy of Pediatrics; 2020. [2]. Guellec I et al. *J Pediatr.* 2016;175:93-99.e1. [3]. Ramel S et al. *J Pediatr.* 2016;173:108-115.

Preterm Infant Growth Benefits: Neurodevelopment

From 1 week of age to term, for every **z-score improvement** in...

Cognitive testing at **18 months** corrected age showed...

	Weight gain [1]	**BMI** [1]	**Head growth** [1]
MDI score	⇧2.4	⇧1.7	⇧1.4
PDI score	⇧2.7	⇧2.5	⇧2.5

Neurodevelopmental benefits of postnatal growth in preterm infants carry through **childhood** [2],[3] and into **early adulthood** [4]

MDI, Mental Developmental Index; PDI, Psychomotor Development Index.

[1]. Belfort MB et al. *Pediatrics*. 2011;128(4):e899-e906. [2]. Claas MJ et al. *Early Hum Dev*. 2011;87(7):495-507. [3]. Isaacs EB et al. *J Pediatr.* 2009;155(2):229-234. [4]. Sammallahti S et al. *J Pediatr.* 2014;165(6):1109-1115.e3.

Risk Factors for Preterm Infant Growth Faltering

- Lower birth weight or younger gestational age
- Male sex
- Comorbidities and their treatments (eg, mechanical ventilation, steroids, diuretics, and catecholamines, all of which are catabolic)
- Intrauterine growth restriction
- Insufficient nutritional intake

Modifiable risk factor for preventing growth faltering

Composition of Human Milk

Factors Influencing Human Milk Composition

Maternal [1]–[3]	**Perinatal** [1],[3]	**Environmental** [4]
• Prepregnancy BMI • Age • Race/ethnicity • Parity • Geographic location • Diet • Genetics	• Milk volume • Lactation stage • Mode of delivery • Infant gestational age • Infant sex	• Pasteurization or heat treatment • Storage temperature • Thawing procedures • Pooling practices

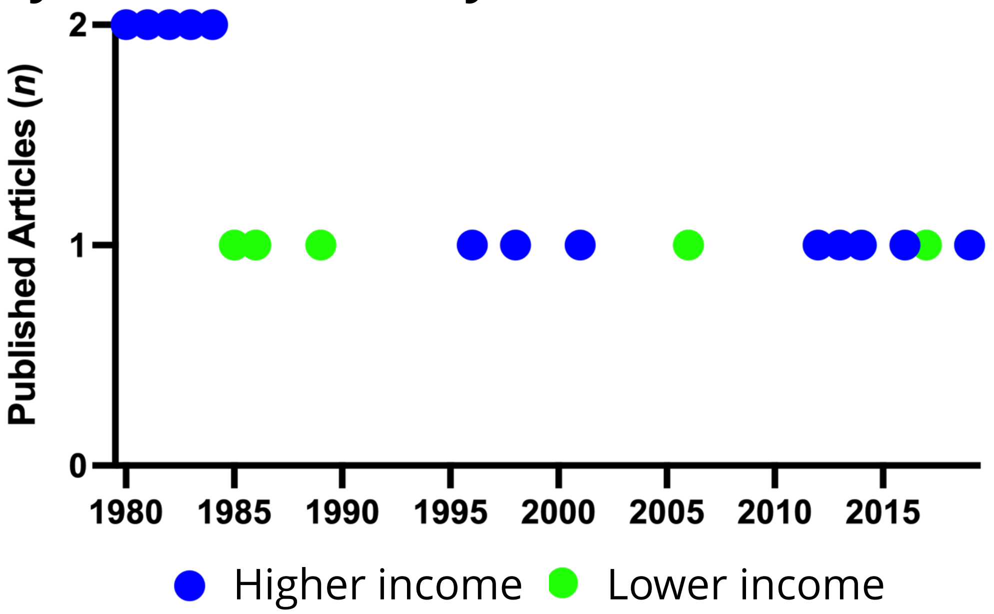
[1]. Han SM et al. *J Nutr.* 2021;151(6):1383-1393. [2]. McGuire MK et al. *Am J Clin Nutr.* 2017;105(5):1086-1100. [3]. Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719-1728. [4]. Kleinman RE, Greer FR, eds. *Pediatric Nutrition, 8th ed*. American Academy of Pediatrics; 2020.

Preterm Human Milk Composition: Challenges and Limitations of the Literature

In a review of 27 articles with original data on composition of preterm milk, several literature deficits were identified:

- All US studies (n = 7) published prior to 1984
- Underrepresentation of Black women
- Underrepresentation of deliveries <28 weeks gestation

Studies of Preterm Milk Composition by Date and Country Income Status



Prospective, Longitudinal Study of Preterm Human Milk Composition: Design and Baseline Demographics

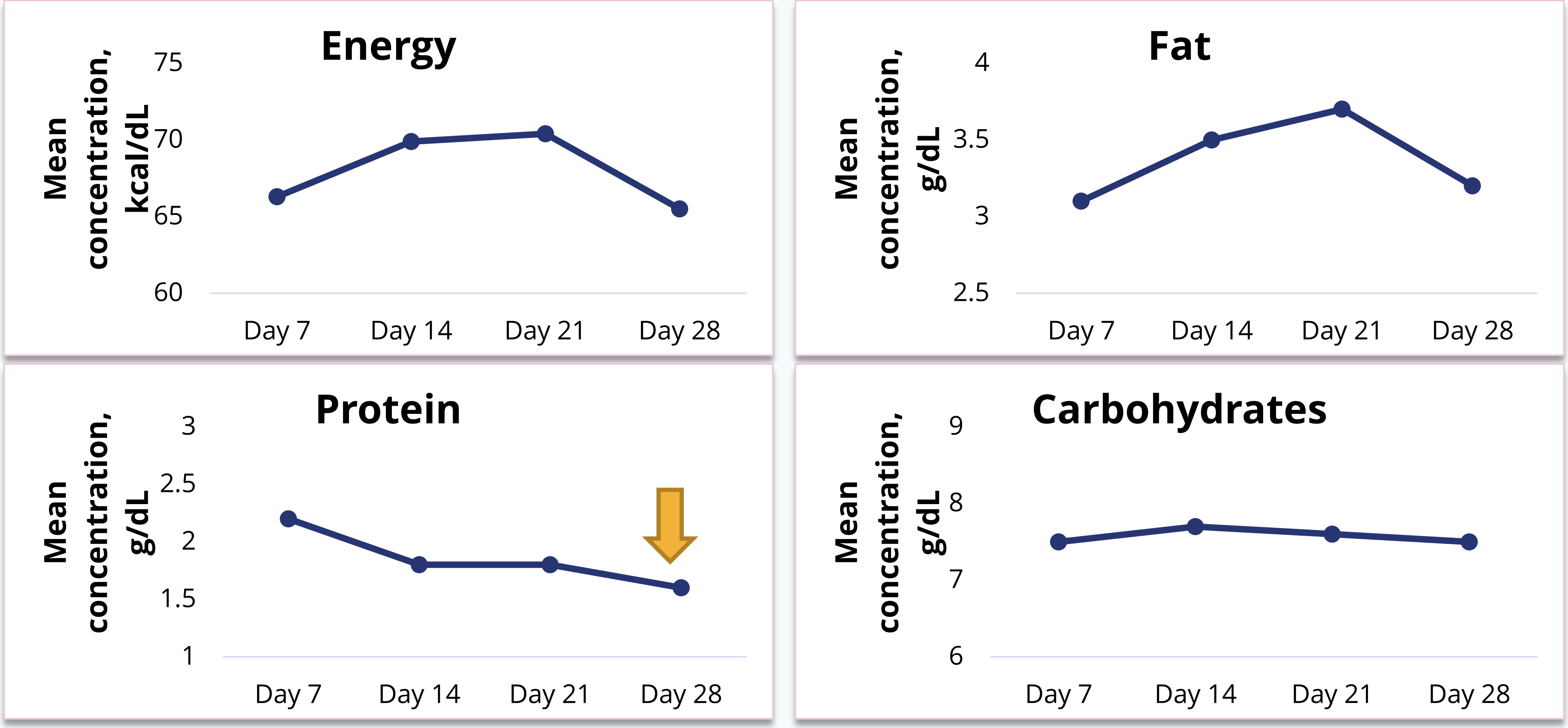
- Women who delivered ≤33 weeks gestation (N = 38)
- Pooled 24-hour milk samples from days 7, 14, 21, and 28
- Assessed macro- and micronutrient composition

	Mean ± SD or N (%)	Range
Maternal age, y	27 ± 5.1	18–37
EGA, wk	28.2 ± 2.8	22.9–33.0
EGA <28 wk	16 (42)	
Infant birth weight, g	1098 ± 347.3	545–2130
Male infant sex	20 (53)	
Race		
Black	25 (66)	
White	13 (34)	

EGA, estimated gestational age; SD, standard deviation.

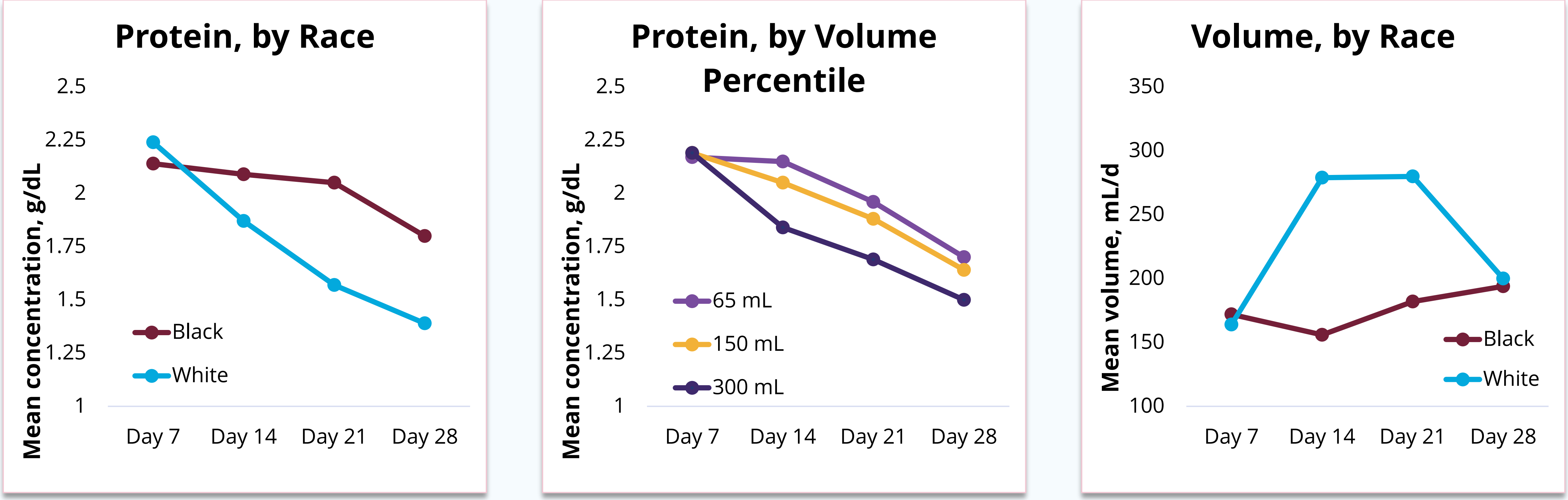
Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719-1728.

Prospective, Longitudinal Study of Preterm Human Milk Composition: Macronutrients by Lactation Stage



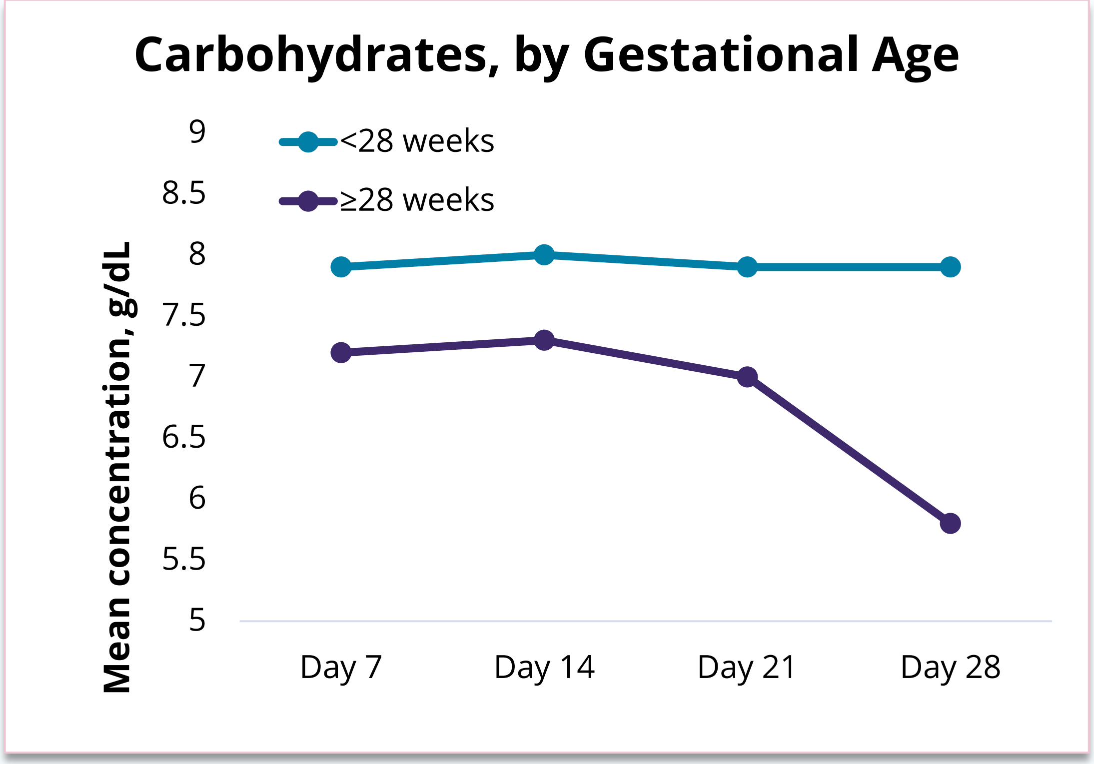
Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719-1728. Adapted from figure 2.

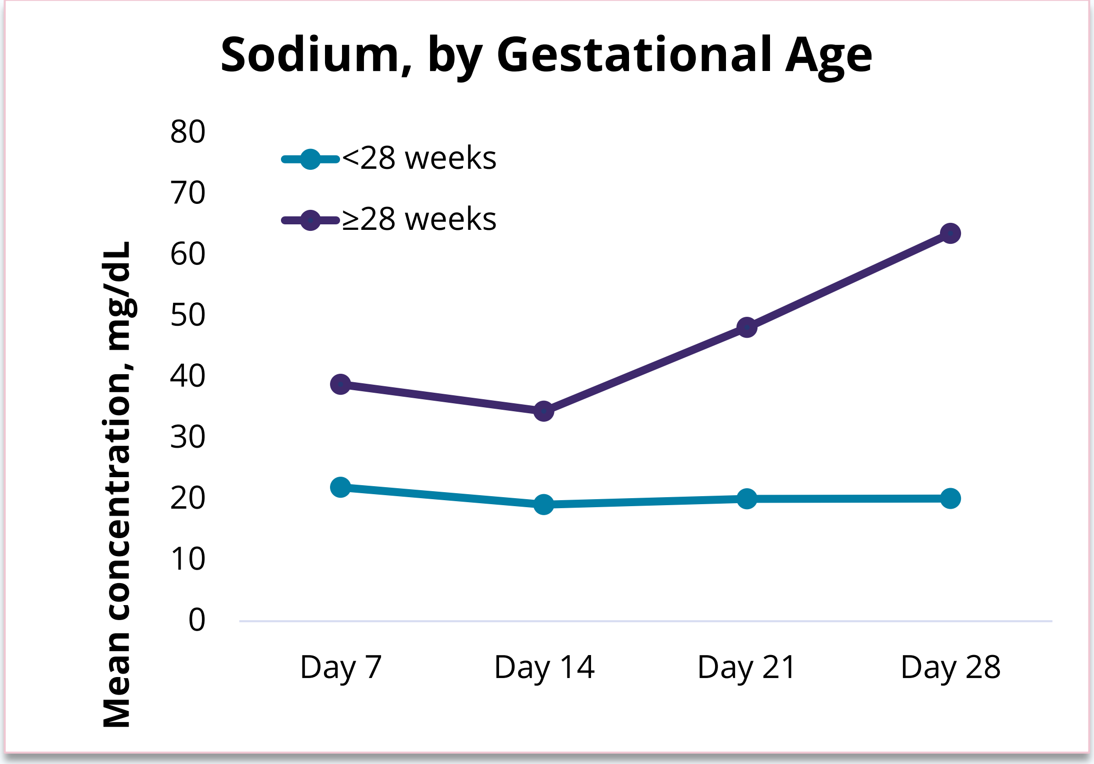
Prospective, Longitudinal Study of Preterm Human Milk Composition: Race, Protein, and Volume



Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719-1728. Adapted from figure 2.

Prospective, Longitudinal Study of Preterm Human Milk Composition: Gestational Age





Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719-1728.

Variation in Mother's Own Milk Composition for Term vs Preterm Infants

Nutrient	Preterm milk [1] (per 100 mL)	Term milk [3] (per 100 mL)
Energy, kcal	66–70	65–70
Protein, g	1.6–2.2	0.9–1.2
Carbohydrate, g	7.5–7.7	6.7–7.8
Fat, g	3.1–3.7	3.2–3.6
Sodium, mg	29–36	15–26
Potassium, mg	50–64	40–55
Chloride, mg	58–70	40–50
Calcium, mg	21–24	20–25
Phosphorus, mg	13–15	12–16
Iron, mg	0.09 [2]	0.03–0.09
Zinc, mg	0.3–0.5	0.1–0.3

[1]. Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719-1728. [2]. Koletzko B et al, eds. In: Koletzko B et al, eds. *Nutritional Care of Preterm Infants. Scientific Basis and Practical Guidelines, 2nd ed.* Karger; 2021:430-449. [3]. Kim SY, Yi DY. *Clin Exp Pediatr.* 2020;63(8):301-309.

Prospective, Longitudinal Study of Preterm Human Milk Composition: Key Takeaways

- Preterm human milk is **dynamic** in the first month of lactation
  - Relatively stable nutrients: energy, fat, carbohydrates
  - Dynamic nutrients: protein (⇩), sodium (⇩⇧; volume dependent), zinc (⇩)

- Other factors that influence the composition of preterm human milk:
  - **Maternal race/ethnicity** (protein content)
  - **Gestational age** (carbohydrate and sodium content)

What About Donor Milk?

- Guidelines recommend the use of donor milk when mother's own milk is unavailable, **particularly in the first few days of life** [1]–[3]
- Donor milk characteristics: [3]
  - Primarily expressed by mothers of **term infants**
  - Primarily collected in **later stages** of lactation
  - Represents "excess" milk supply
  - **Pooled** from multiple mothers
  - **Pasteurized** to destroy microbes

[1]. AAP Committee on Nutrition et al. *Pediatrics.* 2017;139(1):e20163440. [2]. Arslanoglu S et al. *J Pediatr Gastroenterol Nutr.* 2013;57(4):535-542. [3]. Koletzko B et al, eds. In: Koletzko B et al, eds. *Nutritional Care of Preterm Infants. Scientific Basis and Practical Guidelines, 2nd ed*. Karger; 2021.

Differences in Growth With Mother's Own Milk vs Donor Milk

- Donor milk is recommended based on evidence for **reduced risk of necrotizing enterocolitis** vs formula [1],[2]

- Recent studies comparing mother's own milk with donor human milk have shown **conflicting effects on short-term growth** [2]
  - Insufficient nutritional concentrations and inadequate donor human milk fortification practices may explain discrepancies

- Its effects on **long-term outcomes**, including growth and neurodevelopment, are uncertain [2]

[1]. Quigley M et al. *Cochrane Database Syst Rev.* 2019;7(7):CD002971. [2]. Koletzko B et al, eds. *Nutritional Care of Preterm Infants. Scientific Basis and Practical Guidelines, 2nd ed*. Karger; 2021.

Donor Milk Pasteurization: Effects on Milk Composition

Changes in bioactive components [1]–[3]

- Complete loss of certain **enzymes** and maternal **cell populations (eg, neutrophils, stem cells)**
- Reduced activity level or concentration of other **enzymes**, **cytokines**, **growth factors**, **immunoglobulins**, and **hormones**

Changes in macronutrient composition [4]

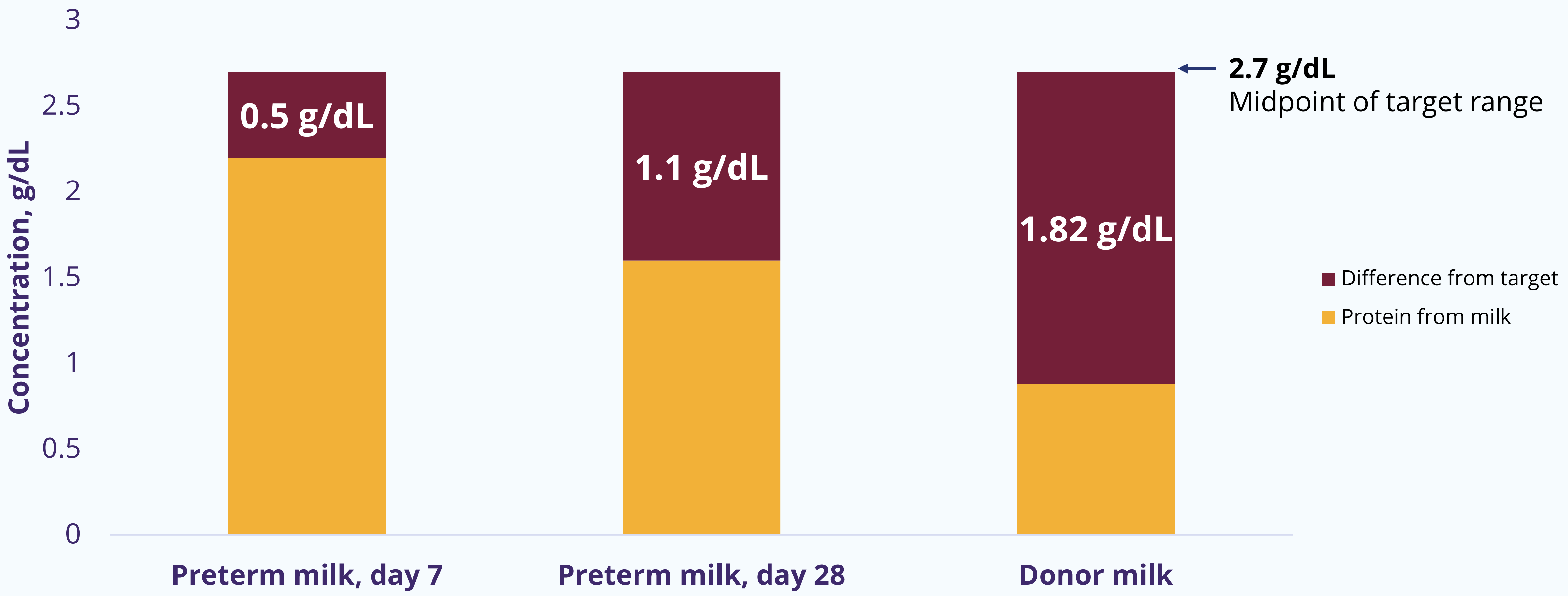
- Reduced **caloric density**
- Reduced levels of **lipids** and **long-chain polyunsaturated fatty acids**

Changes in micronutrient composition [1]

- Reduced **ascorbic acid** and **vitamin B6**

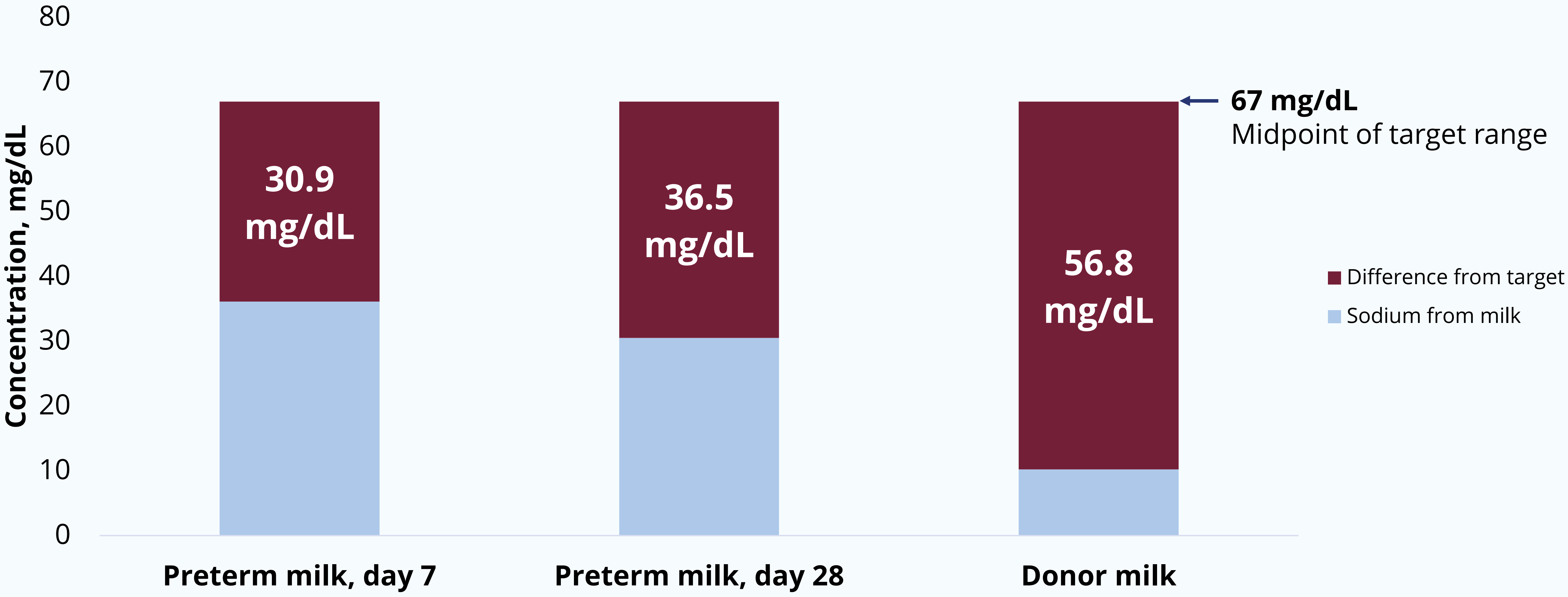
[1]. Peila C et al. *Nutrients*. 2016 Aug 2;8(8):477. [2]. Hård AL et al. *Acta Paediatr.* 2019;108(6):998-1007. [3]. Kleinman RE, Greer FR, eds. *Pediatric Nutrition, 8th ed*. American Academy of Pediatrics; 2020. [4]. Koletzko B et al, eds. In: Koletzko B et al, eds. *Nutritional Care of Preterm Infants. Scientific Basis and Practical Guidelines, 2nd ed*. Karger; 2021.

Differences in Protein Between Preterm Mother's Own Milk [1] and Donor Milk [2]



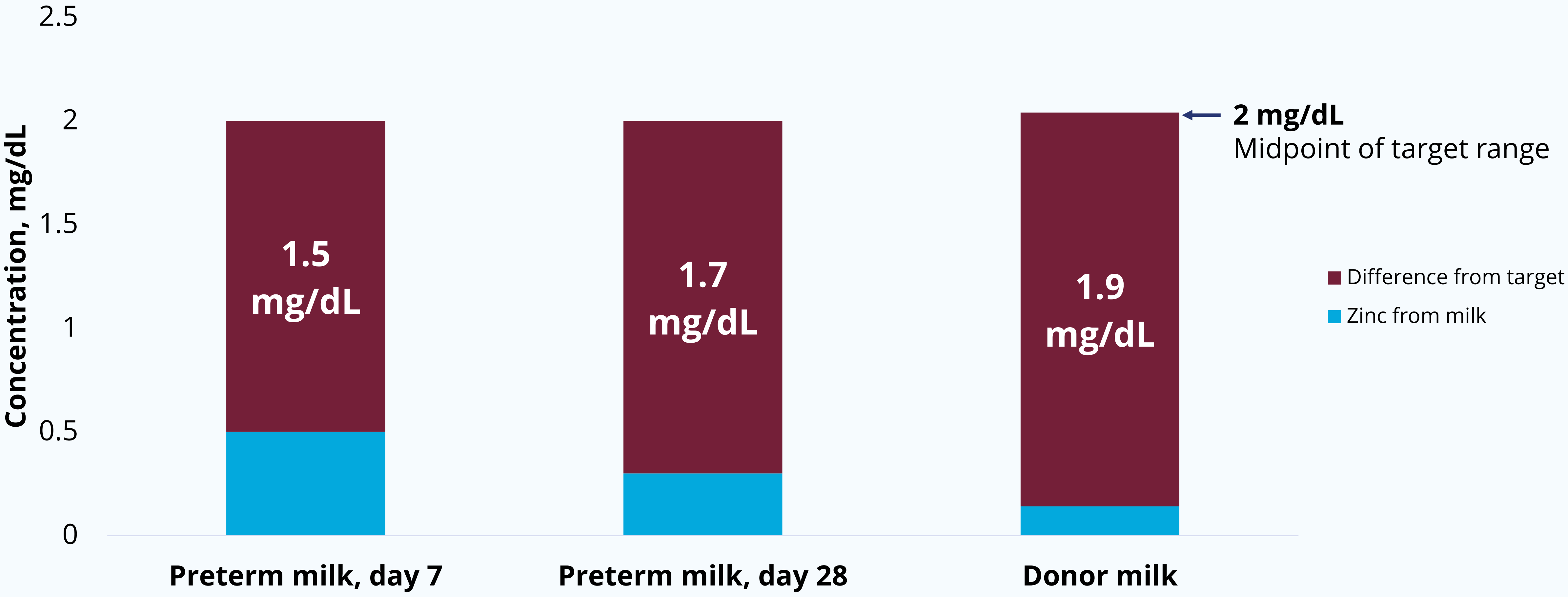
[1]. Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719-1728. [2]. Piemontese P et al. *BMC Pediatr.* 2019;19(1):58.

Differences in Sodium Between Preterm Mother's Own Milk[1] and Donor Milk[2]



[1]. Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719-1728. [2]. Perrin MT et al. *J Pediatr.* 2022;244:219-223.e1.

Differences in Zinc Between Preterm Mother's Own Milk [1] and Donor Milk [2]



[1]. Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719-1728. [2]. Young BE et al. *J Pediatr.* 2019;214:54-59.

✦ Key Takeaway:
All Human Milk Requires Fortification to Meet Recommended Intakes, But Milk Variability Can Influence Fortification Needs

Nutrient	Preterm milk [1] (per 100 mL)	Term milk [3] (per 100 mL)	Recommended preterm intake [2] (per kg/day)
Energy, kcal	66–70	65–70	110–130
Protein, g	1.6–2.2	0.9–1.2	3.5–4.5
Carbohydrate, g	7.5–7.7	6.7–7.8	11–13
Fat, g	3.1–3.7	3.2–3.6	4.5–8.0
Sodium, mg	29–36	15–26	69–115
Potassium, mg	50–64	40–55	78–195
Chloride, mg	58–70	40–50	107–178
Calcium, mg	21–24	20–25	120–220
Phosphorus, mg	13–15	12–16	70–120
Iron, mg	0.09 [2]	0.03–0.09	2–3
Zinc, mg	0.3–0.5	0.1–0.3	2–3

[1]. Gates A et al. *Am J Clin Nutr.* 2021;114(5):1719–1728. [2]. Koletzko B et al, eds. In: Koletzko B et al, eds. *Nutritional Care of Preterm Infants. Scientific Basis and Practical Guidelines, 2nd ed.* Karger; 2021:430–449. [3]. Kim SY, Yi DY. *Clin Exp Pediatr*. 2020;63(8):301–309.

Importance of Human Milk Fortification for Preterm Infants

Term infant formula and unfortified human milk do not meet the nutritional requirements of preterm infants [1]

In a meta-analysis of 18 trials (N = 1456), human milk fortification was associated with several growth benefits during hospitalization: [2]

- Increased **weight gain** (mean difference vs unfortified milk, 1.76 g/kg/d; 95% CI, 1.30–2.22 g/kg/d)
- Increased **body length** (0.11 cm/week; 0.0–0.15 cm/week)
- Increased **head circumference** (0.06 cm/week; 0.0–0.08 cm/week)

[1]. Kleinman RE, Greer FR, eds. *Pediatric Nutrition, 8th ed*. American Academy of Pediatrics; 2020. [2]. Brown JV et al. *Cochrane Database Syst Rev.* 2016;(5):CD000343.

Best Practices for Human Milk Fortification in Preterm Infants

Volume of Unfortified Milk Needed to Meet Nutritional Requirements

Recommended preterm feeding volume:
135–200 mL/kg/day[4]

Nutrient	Preterm milk[1] (per 100 mL)	Term milk[3] (per 100 mL)	Recommended preterm intake[2] (per kg/day)
Energy, kcal	66–70	65–70	110–130
Protein, g	1.6–2.2	0.9–1.2	3.5–4.5
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MOM, mother's own milk; DHM, donor human milk.

[1]. Gates A et al. *Am J Clin Nutr*. 2021;114(5):1719-1728. [2]. Koletzko B et al, eds. *Nutritional Care of Preterm Infants. Scientific Basis and Practical Guidelines, 2nd ed*. Karger; 2021. [3]. Kim SY, Yi DY. *Clin Exp Pediatr*. 2020;63(8):301-309. [4]. Arslanoglu S et al. *Front Pediatr*. 2019;7:76.

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Recommended preterm feeding volume:
135–200 mL/kg/day [4]

Volume (per kg/d)

MOM	DHM
220 mL	390 mL

MOM, mother's own milk; DHM, donor human milk.

[1]. Gates A et al. *Am J Clin Nutr*. 2021;114(5):1719-1728. [2]. Koletzko B et al, eds. *Nutritional Care of Preterm Infants. Scientific Basis and Practical Guidelines, 2nd ed*. Karger; 2021. [3]. Kim SY, Yi DY. *Clin Exp Pediatr*. 2020;63(8):301-309. [4]. Arslanoglu S et al. *Front Pediatr*. 2019;7:76.

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Energy, kcal	66–70	65–70	110–130		
Protein, g	**1.6**–2.2	**0.9**–1.2	**3.5**–4.5	**220 mL**	**390 mL**
Carbohydrate, g	7.5–7.7	6.7–7.8	11–13		
Fat, g	3.1–3.7	3.2–3.6	4.5–8.0		
Sodium, mg	**29**–36	**15**–26	**69**–115	**240 mL**	**465 mL**
Potassium, mg	50–64	40–55	78–195		
Chloride, mg	58–70	40–50	107–178		
Calcium, mg	21–24	20–25	120–220		
Phosphorus, mg	13–15	12–16	70–120		
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Potassium, mg	50–64	40–55	78–195		
Chloride, mg	58–70	40–50	107–178		
Calcium, mg	**21**–24	**20**–25	**120**–220	**570 mL**	**600 mL**
Phosphorus, mg	**13**–15	**12**–16	**70**–120	**540 mL**	**580 mL**
Iron, mg	**0.09**[2]	**0.03**–0.09	**2**–3	**>2000 mL**	**>6000 mL**
Zinc, mg	**0.3**–0.5	**0.1**–0.3	**2**–3	**670 mL**	**2000 mL**

MOM, mother's own milk; DHM, donor human milk.

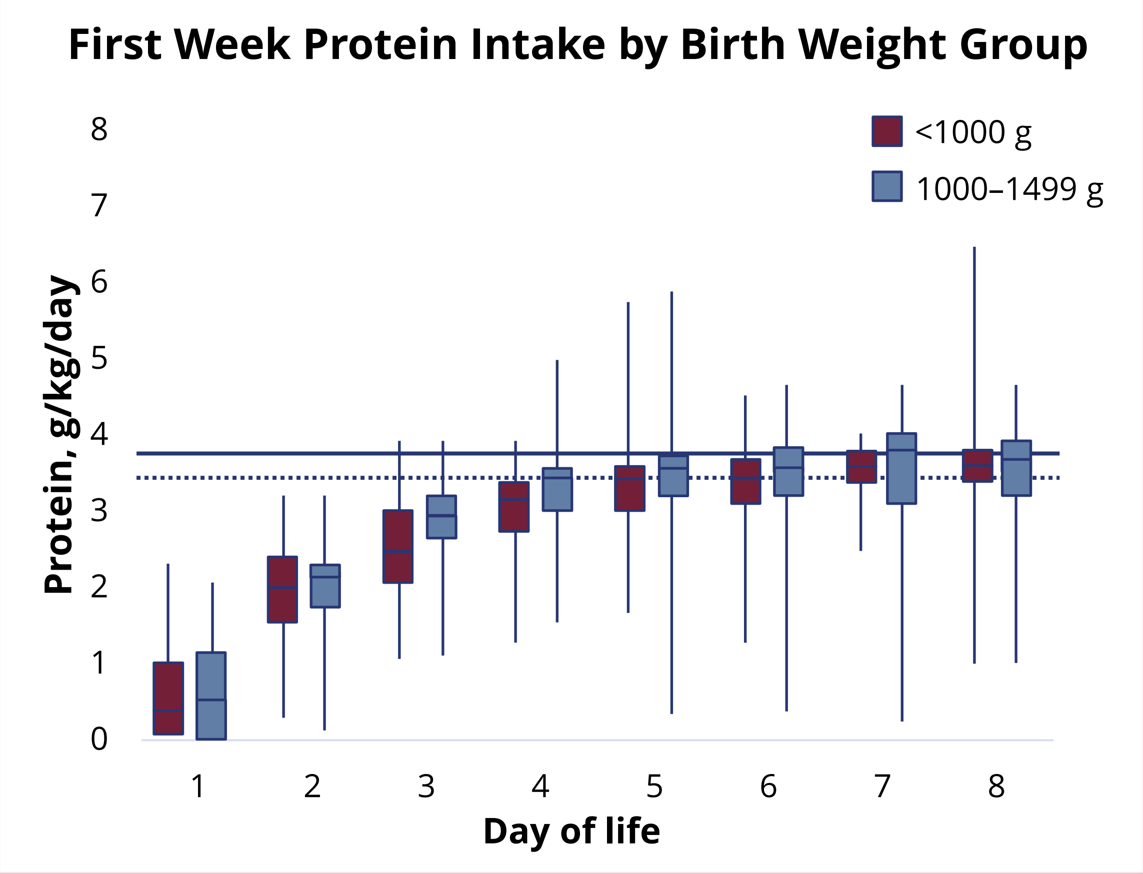
[1]. Gates A et al. *Am J Clin Nutr*. 2021;114(5):1719-1728. [2]. Koletzko B et al, eds. *Nutritional Care of Preterm Infants. Scientific Basis and Practical Guidelines, 2nd ed*. Karger; 2021. [3]. Kim SY, Yi DY. *Clin Exp Pediatr*. 2020;63(8):301-309. [4]. Arslanoglu S et al. *Front Pediatr*. 2019;7:76.

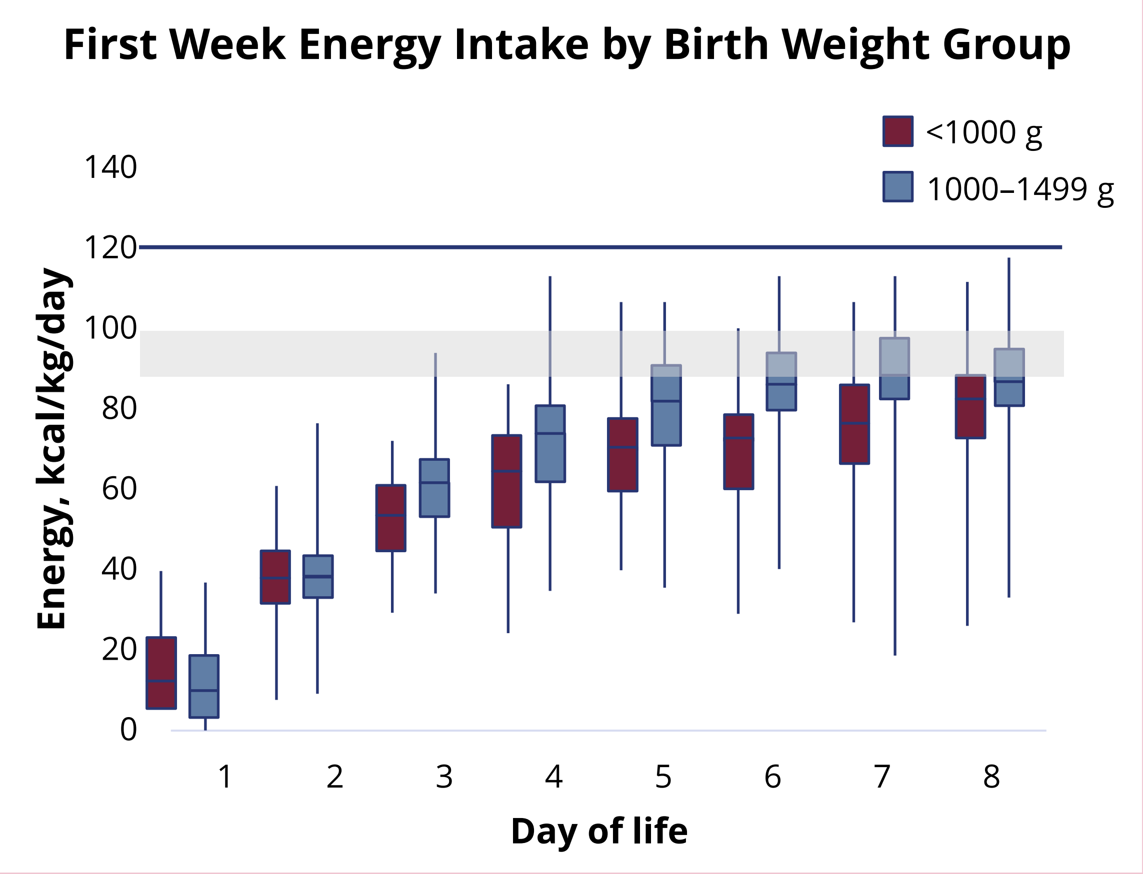
Goals of Human Milk Fortification

- Augment—but not replace—human milk to meet energy needs for rapid preterm infant growth
  - Avoid displacement of mother's own milk
  - Support milk supply
  - Limit formula exposure
- Provide optimal levels of protein and micronutrients (calcium, phosphorous, magnesium, vitamins, and trace elements) with a limited volume

Koletzko B et al, eds. *Nutritional Care of Preterm Infants. Scientific Basis and Practical Guidelines, 2nd ed*. Karger; 2021.

Nutritional Fortification in NICUs: Frequently Inadequate to *Meet* Target Intakes





Ng DV et al. *JPEN J Parenter Enteral Nutr*. 2017;41(3):500-506. Adapted from figures 2 and 5.

Methods of Human Milk Fortification

Standard most common & easiest	Adjustable more cost efficient & less labor intensive than individualized	Targeted most accurate & most costly
• Fixed amount of fortifier added to fixed human milk volume • Based on manufacturer's instructions, which typically assumes starting protein and energy content of 1.5 g/dL and 20 kcal/oz, respectively	• Protein concentration is adjusted based on serial BUN measurements • Additional protein supplementation added to standard fortification if level is <10 mg/dL	• Macronutrient concentrations in human milk are analyzed with a bedside human milk analyzer • Fortification procedures are based on analysis

Bergner EM et al. *Clin Perinatol.* 2022;49(2):447-460.

Standard Fortification of Human Milk

Standard fortification practices have some limitations:

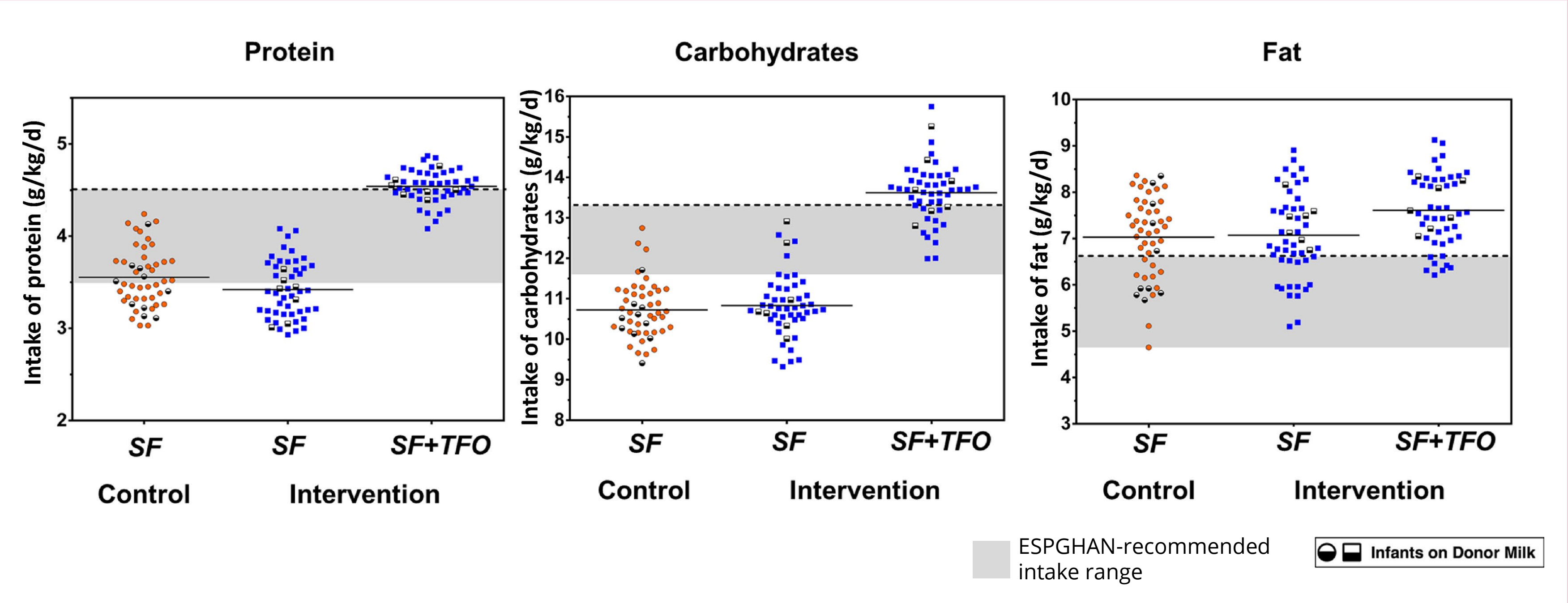
- No accounting for variability in human milk composition over time
- May not always meet nutritional requirements of preterm infants
- Often fail to meet protein requirements

Observational studies have shown that preterm infants fed human milk fortified using standard practices tend to have **slower growth** than those fed preterm formula [1],[2]

[1]. Arslanoglu S et al. *Front Pediatr*. 2019;7:76. [2]. Maas C et al. *BMC Pediatr.* 2013;13:178. [3]. O'Connor DL et al. *J Pediatr Gastroenterol Nutr*. 2003;37(4):437-446.

Standard vs Targeted Fortification: Effects on Nutritional Composition

Double-blind randomized controlled trial of infants <30 weeks, comparing standard vs targeted fortification (N = 103) [1]

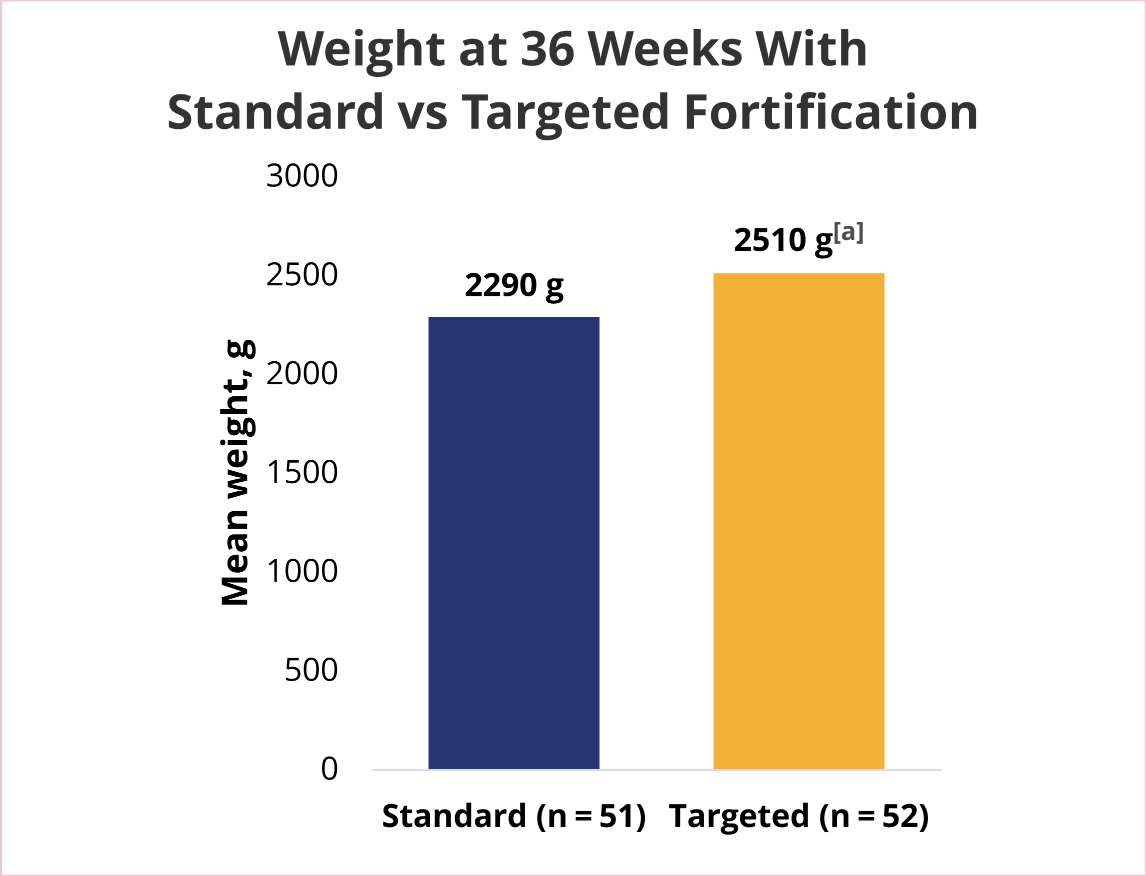


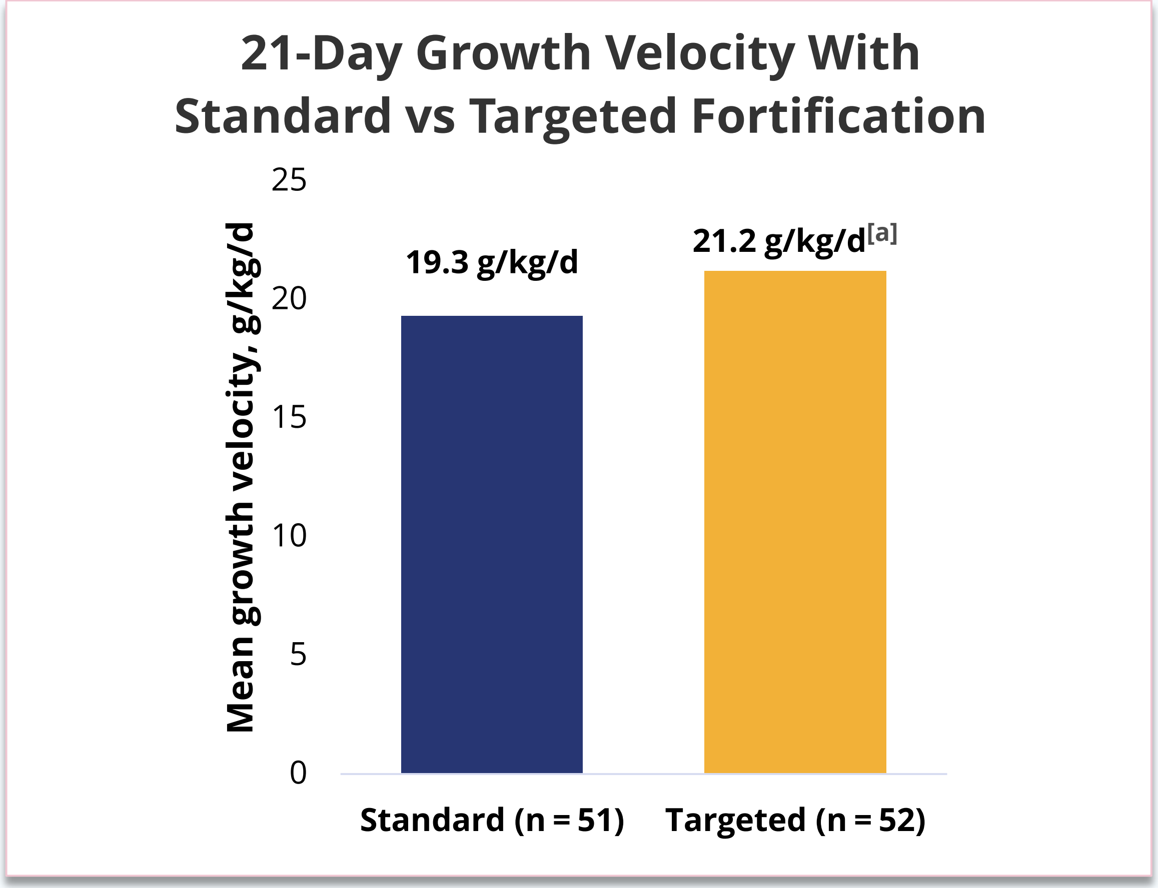
Note: In 2023, ESPGHAN updated the recommended intake range for protein to 3.5–4.0 g/kg/d [2]

SF, standard fortification; TFO, target fortification.

[1]. Rochow N et al. *Clin Nutr.* 2021;40(1):54-63. Figure 3 reprinted with permission from Elsevier. [2]. Embleton ND et al. *J Pediatr Gastroenterol Nutr.* 2023;76(2):248-268.

Standard vs Targeted Fortification: Effects on Growth

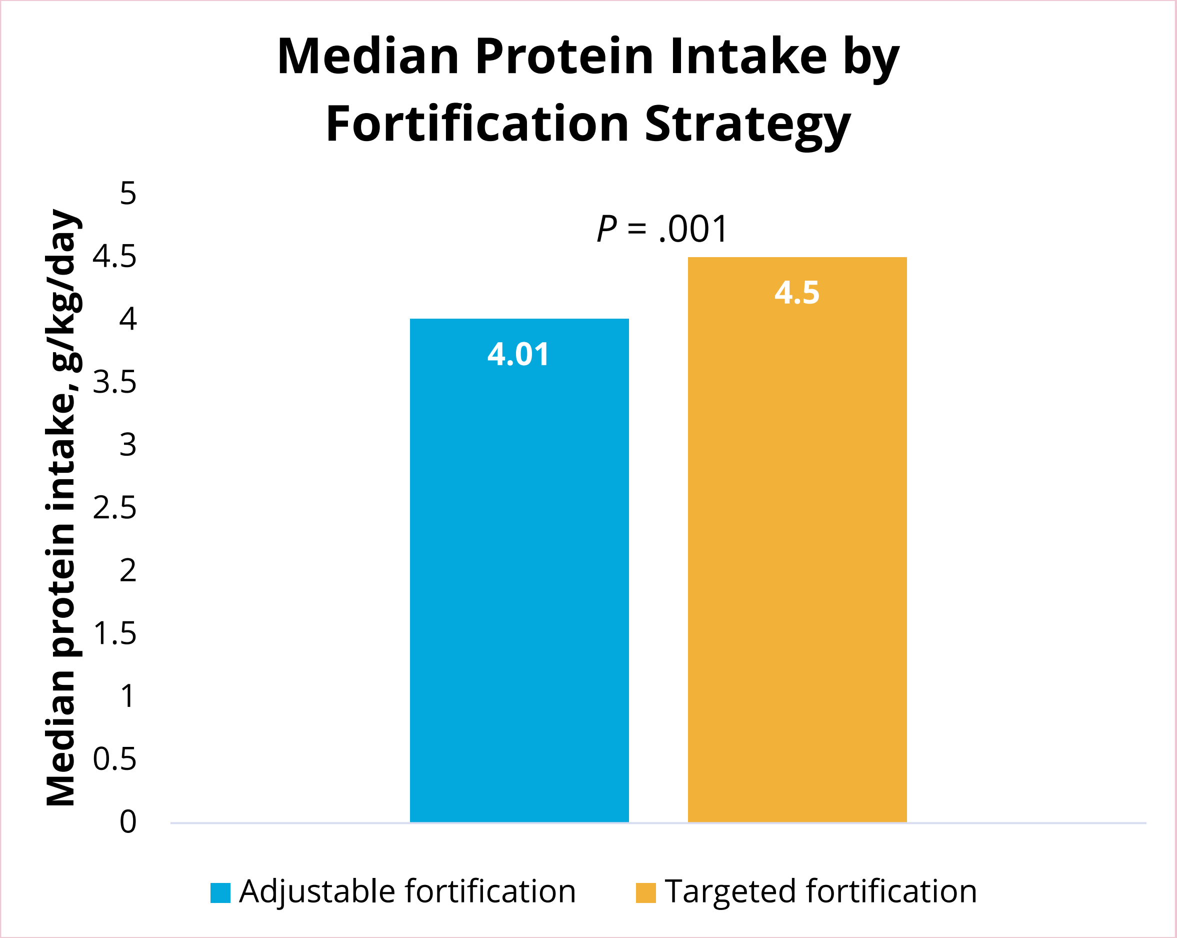


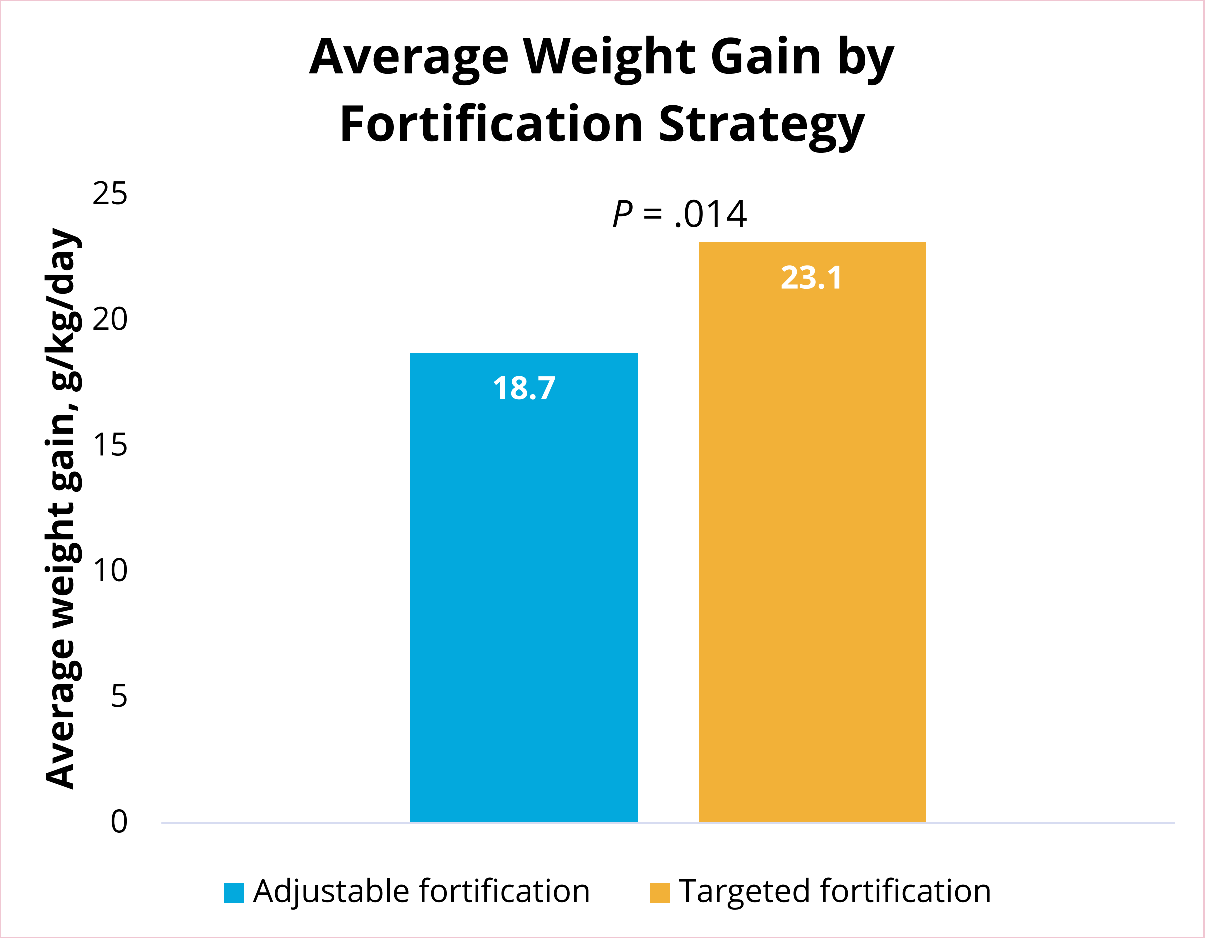


a. *P* < .001

Rochow N et al. *Clin Nutr.* 2021;40(1):54-63.

Adjustable vs Targeted Fortification [1]

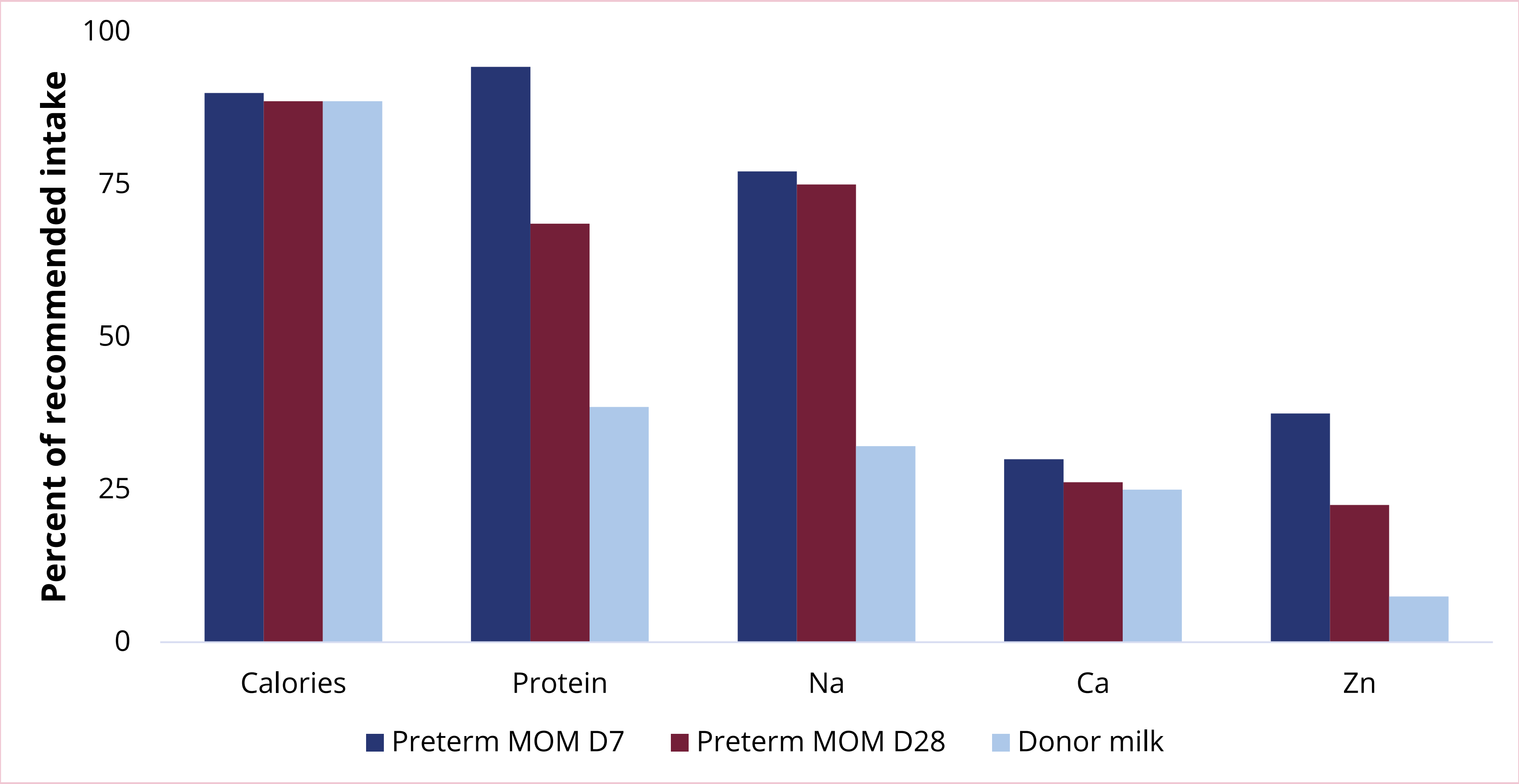




Note: In 2023, ESPGHAN updated the recommended intake range for protein to 3.5–4.0 g/kg/d [2]

[1]. Bulut O et al. *Nutr Clin Pract.* 2020;35(2):335-343. [2]. Embleton ND et al. *J Pediatr Gastroenterol Nutr*. 2023;76(2):248-268.

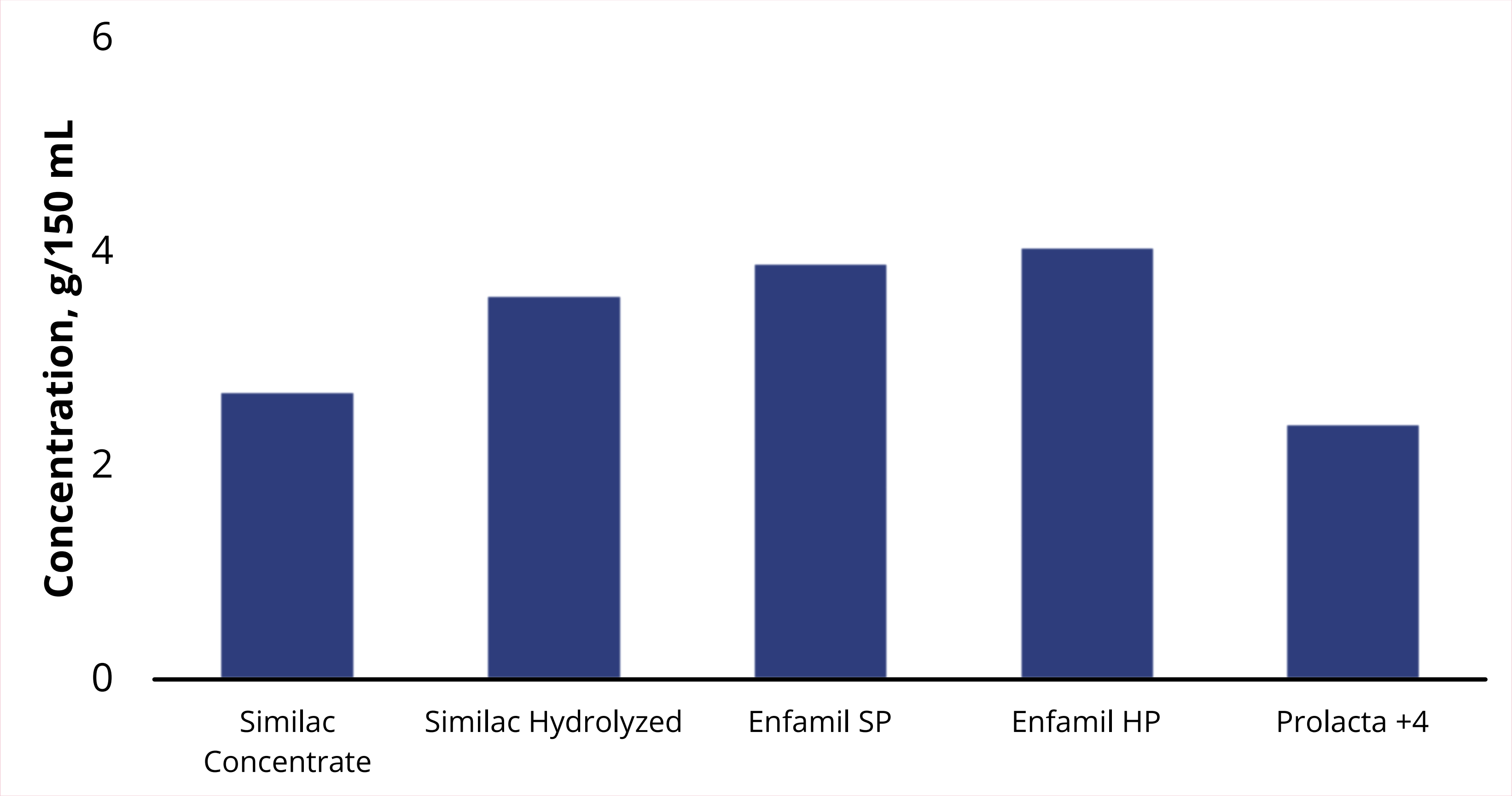
Reaching for the Goal



Lowest measured value to reach lowest recommended intake at 150 mL/kg/day

[1]. Maly J et al. *Arch Dis Child Fetal Neonatal Ed*. 2019;104(1):F50-F56. [2]. Gates A et al. *Nutr Clin Pract*. 2021;36(6):1163-1172. [3]. Gates A et al. *Am J Clin Nutr*. 2021;114(5):1719-1728. Figure adapted from Gates A.

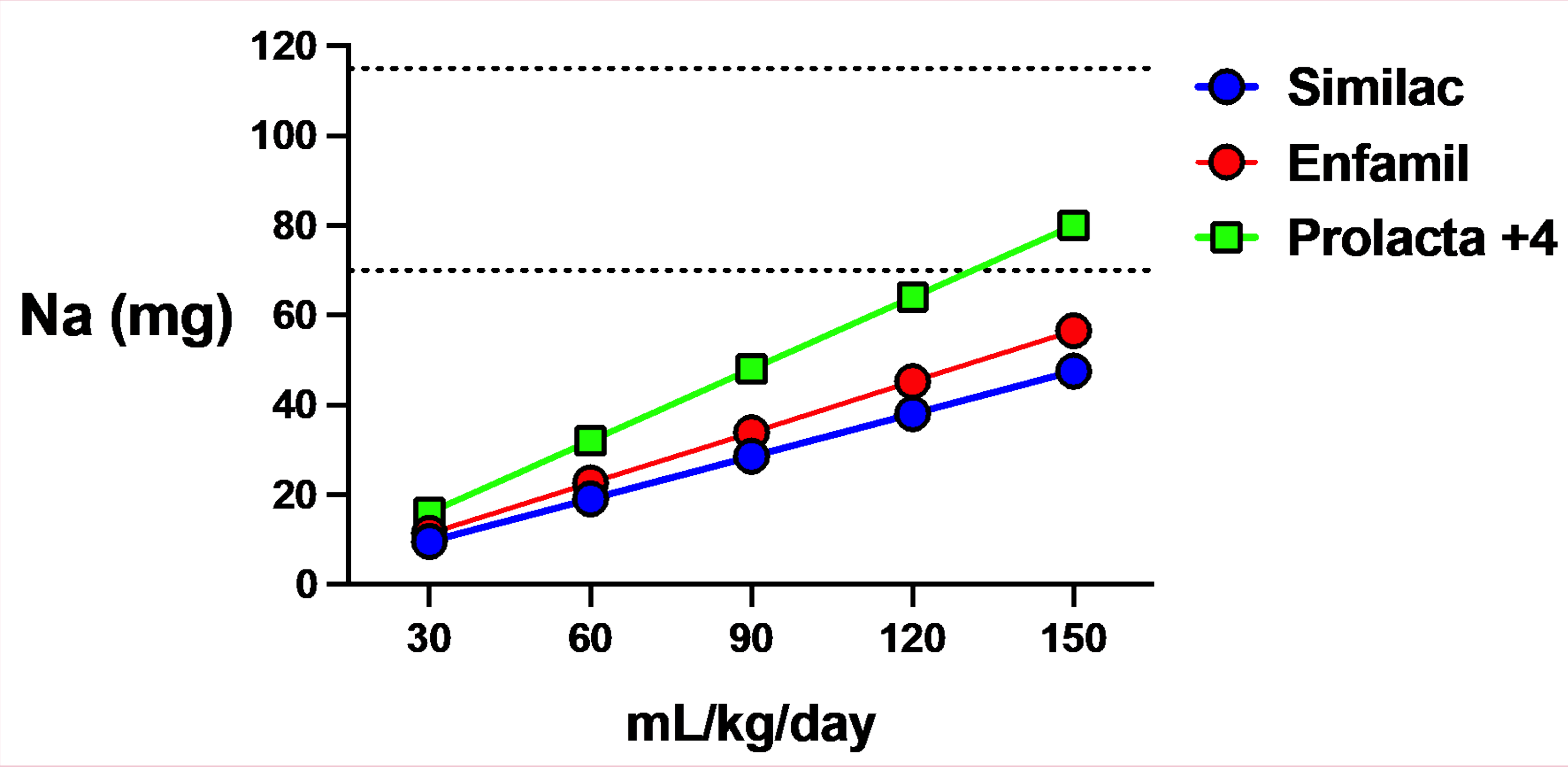
Protein in Fortified Donor Human Milk [a]



a. 24 kcal/oz

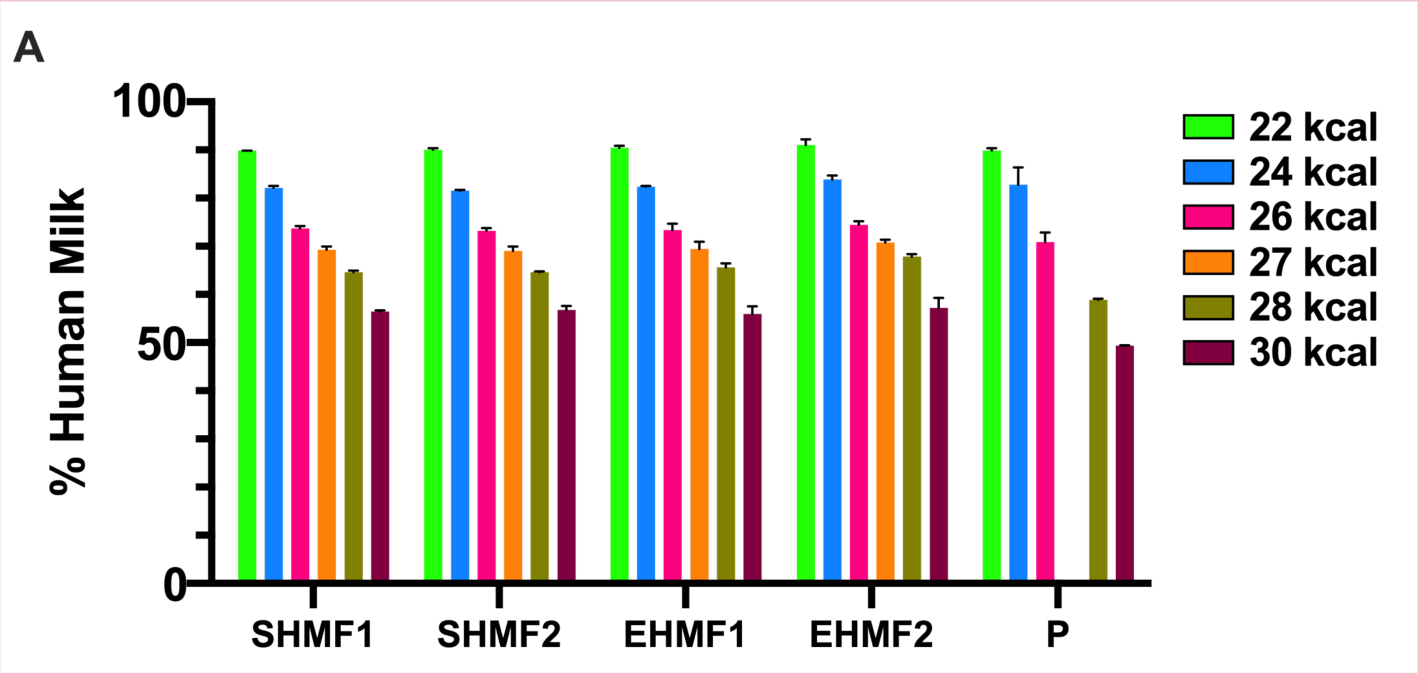
[1]. Maly J et al. *Arch Dis Child Fetal Neonatal Ed*. 2019;104(1):F50-F56. [2]. Gates A et al. *Nutr Clin Pract*. 2021;36(6):1163-1172. [3]. Gates A et al. *Am J Clin Nutr*. 2021;114(5):1719-1728.

Sodium in Fortified Donor Human Milk [a]



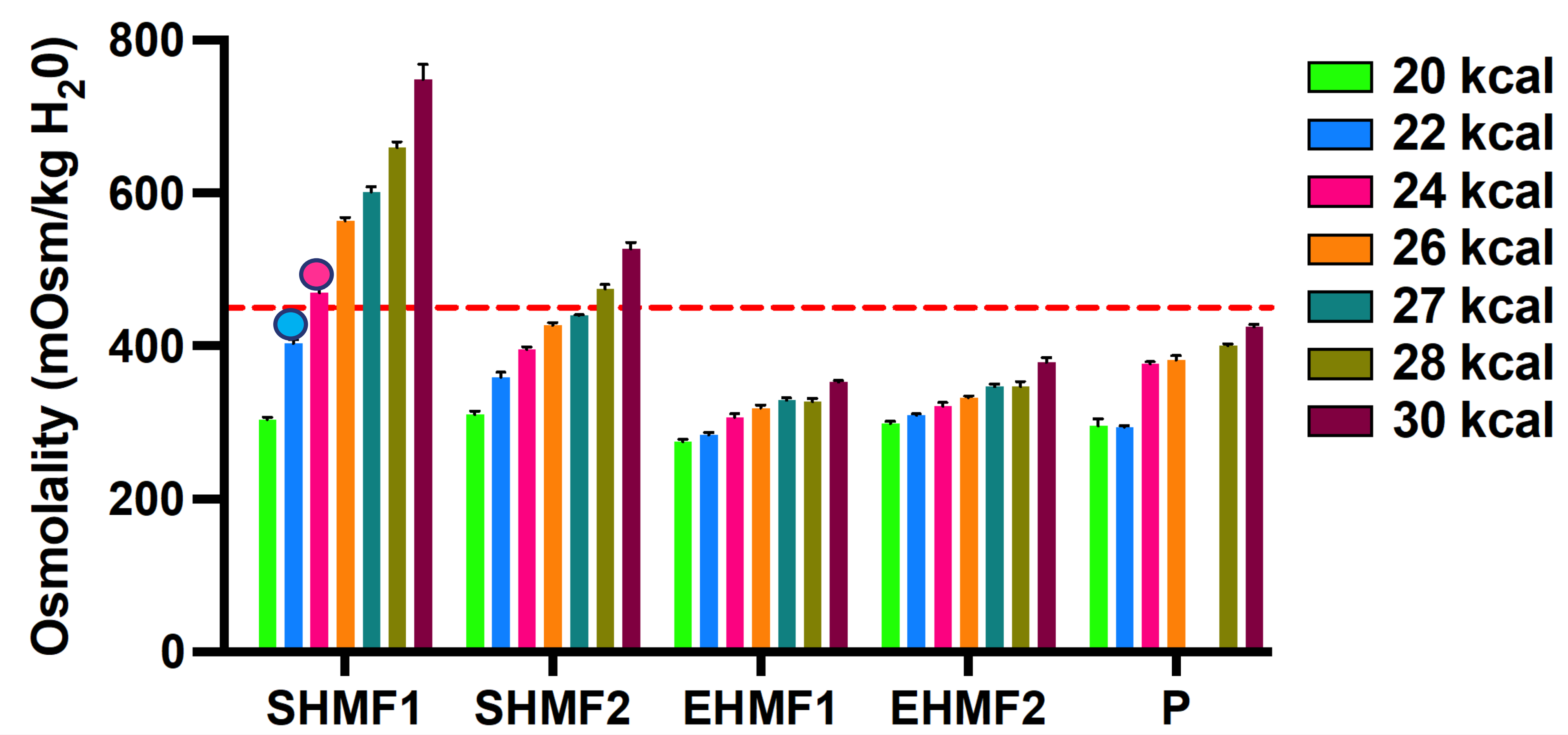
a. 24 kcal/oz

Other Considerations: Displacement



SHMF1, Similac® Human Milk Fortifier Extensively Hydrolyzed Liquid; SHMF2 , Similac® Human Milk Fortifier Concentrated Liquid; EHMF1 , Enfamil® Liquid Human Milk Fortifier Standard Protein; EHMF2 ,Enfamil® Liquid Human Milk Fortifier High Protein; EHMF3, Enfamil® Human Milk Fortifier Powder, P, Prolact CR; Prolact +4, +6, +8, +10 H^2MF.

Other Considerations: Osmolality



SHMF1, Similac® Human Milk Fortifier Extensively Hydrolyzed Liquid; SHMF2 , Similac® Human Milk Fortifier Concentrated Liquid; EHMF1 , Enfamil® Liquid Human Milk Fortifier Standard Protein; EHMF2 ,Enfamil® Liquid Human Milk Fortifier High Protein; EHMF3, Enfamil® Human Milk Fortifier Powder, P, Prolact CR; Prolact +4, +6, +8, +10 H^2MF.

Pineda D, Stansfied B.

Unpublished as of 22-Mar-2023—pending review.

Key Takeaways: Optimizing Human Milk

- **Preterm mother's own milk is dynamic:**
  - Protein-rich through first week ➡ SEQUENTIAL FEEDING
  - Higher protein, sodium, and zinc than donor human milk through the first month
  - Consider sodium supplementation after first week (particularly donor human milk)
  - Recognize that gestational age and race may influence mother's own milk composition
- **Pooling mother's own milk (24-h collection) provides more even distribution of nutrients**

Key Takeaways: Optimizing Human milk

Preterm mother's own milk ≠ **Donor human milk**

- **Donor human milk is...**
  - Pooled and pasteurized
  - Variable in composition
  - Inadequate in protein, sodium, and zinc
- **Fortification considerations:**[a]
  - Consider displacement if mother's own milk is primary
  - Osmolality may contribute to feeding intolerance (?)
  - High protein for 24 kcal/oz
  - Standard protein for early milk and if >24 kcal/oz
  - Powder formula meets caloric needs, but not calcium, sodium, protein, or zinc

a. For day 28 mother's own milk.