UNIVERSITE ABOU BEKR BELKAID
FACULTE DE MEDECINE

جـــامعــة أبـو بكـــر بلقا يد
كليـــــة الطـــب

Alimentation du prématuré : Quoi de neuf ?

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Deuxième Journée pédiatrique du Marfan
29 mars 2019

Définitions de la prématurité

- Naissance avant 37 semaines d'aménorrhée (SA)
- *Plusieurs classifications selon le terme*
  - Prématurité extrême 22 à 27 SA + 6j ≈ 5%
  - Grande prématurité 28 à 31 SA + 6j ≈ 15%
  - Prématurité modérée 32 à 33 SA +6j ≈ 20%
  - Prématurité tardive 34 à 36 SA +6j ≈ 60-70%

Introduction

- ≈ 18 millions des nouveau-nés naissent avec un PN <2500g chaque année.
- Les PPN ne représentent qu' ≈ 14% du total des naissances vivantes, mais 60-80% du total des décès néonatals.
- La plupart de ces décès peuvent être évités en prêtant une attention particulière à leur environnement thermique, à la prévention des infections et, de façon plus importante, à une **alimentation optimale**.

Alimentation des prématurés: pourquoi est-ce important?

- La prise en charge nutritionnelle conditionne la survie immédiate ainsi que la croissance et le développement ultérieur
- Des mesures aussi simples telles que l'initiation précoce de l'allaitement maternel et l'évitement de l'alimentation pré-lactée (toute autre aliment que le lait maternel) améliorent la survie dans les pays à ressources limitées
- La nutrition pourrait également influencer à long terme le développement neurologique et le métabolique à l'âge adulte.

Rôle essentiel de la nutrition des premières années de la vie

Le « Programming »

Insuffisance d'apports

Excés d'apports

Conséquences Définitives

BMJ Arch Dis Child Fetal Neonatal Ed Month 2018 Vol 0 No 0

RCPCH

Editorial

Is preterm nutrition a trade-off between head and heart?

Gopi Menon,[1] Angela L Davidson,[1] Amanda Jane Drake,[2] Nicholas D Embleton[3]

- A regular subject of discussion on neonatal ward rounds is the rate of weight gain in preterm infants.
- This is because we believe that good nutrition is important for optimal body growth, including brain growth and development.

Alimentation des prématurés : en quoi est-elle différente?

- Compétences d'alimentation insuffisantes nécessitant d'autres méthodes d'alimentation tels que par la cuillère ou par gavage.
- Ces enfants sont susceptibles d'avoir des complications graves dans les premières semaines de la vie; une pathologie sous-jacente empêche souvent une alimentation entérale.
- Les prématurés de TFPN nécessitent des apports liquidiens plus élevés dans les premiers jours de la vie en raison des pertes excessives d'eau insensible.
- L'accrétion intra utérine des nutriments se produisant principalement vers la fin du T3, les nouveau-nés TFPN ont des réserves corporelles faibles à la naissance. Ils nécessitent par conséquent, une supplémentation en divers éléments nutritifs.
- En raison de l'immaturité intestinale, ils sont plus susceptibles d'avoir une intolérance digestive nécessitant une surveillance et une prise en charge adéquate.

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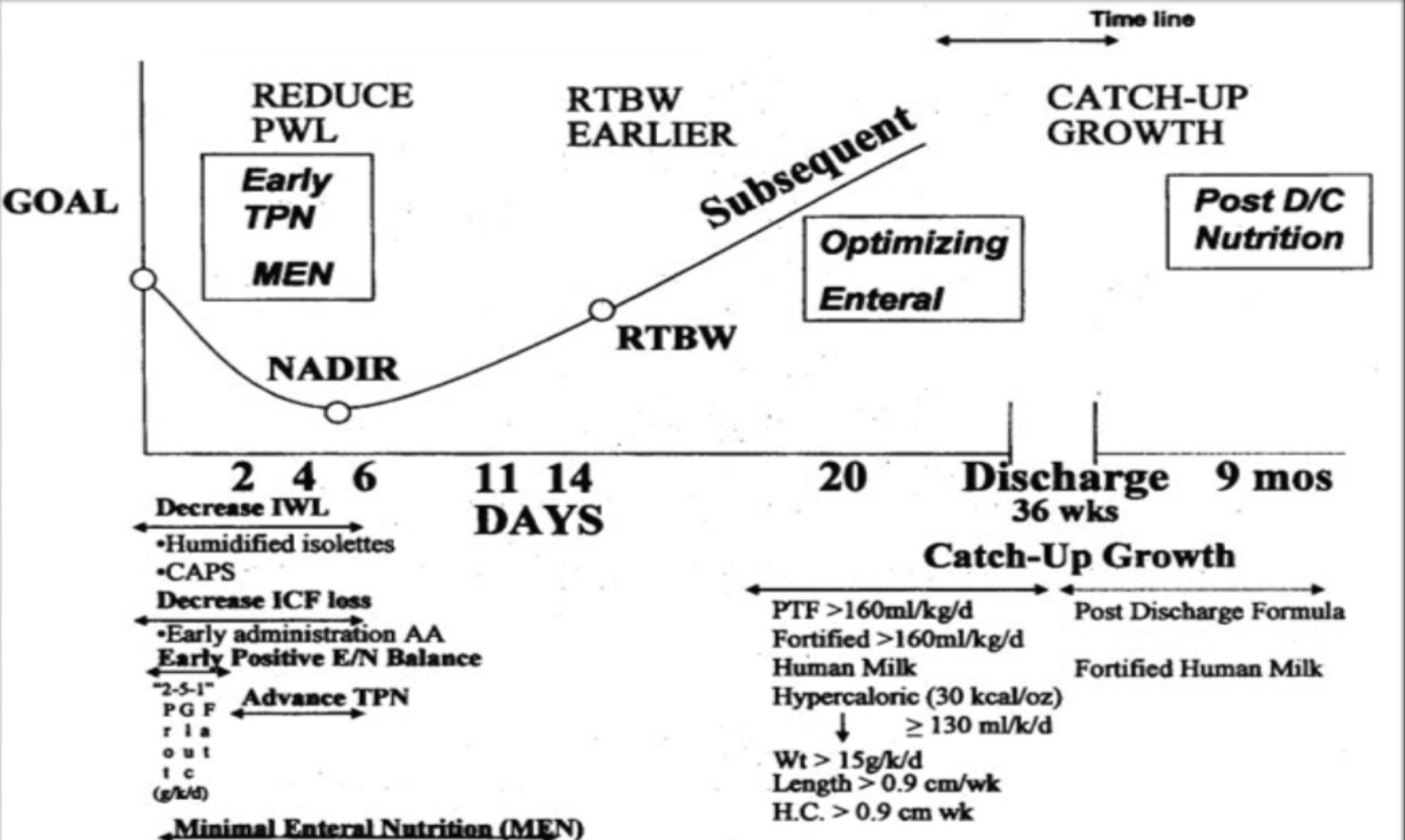
How to Prevent Extrauterine Growth Restriction



Aggressive nutrition to prevent extrauterine growth restriction. Adamkin DH. J Perinatol. 2005

Parenteral nutrition

New intravenous lipid formulations

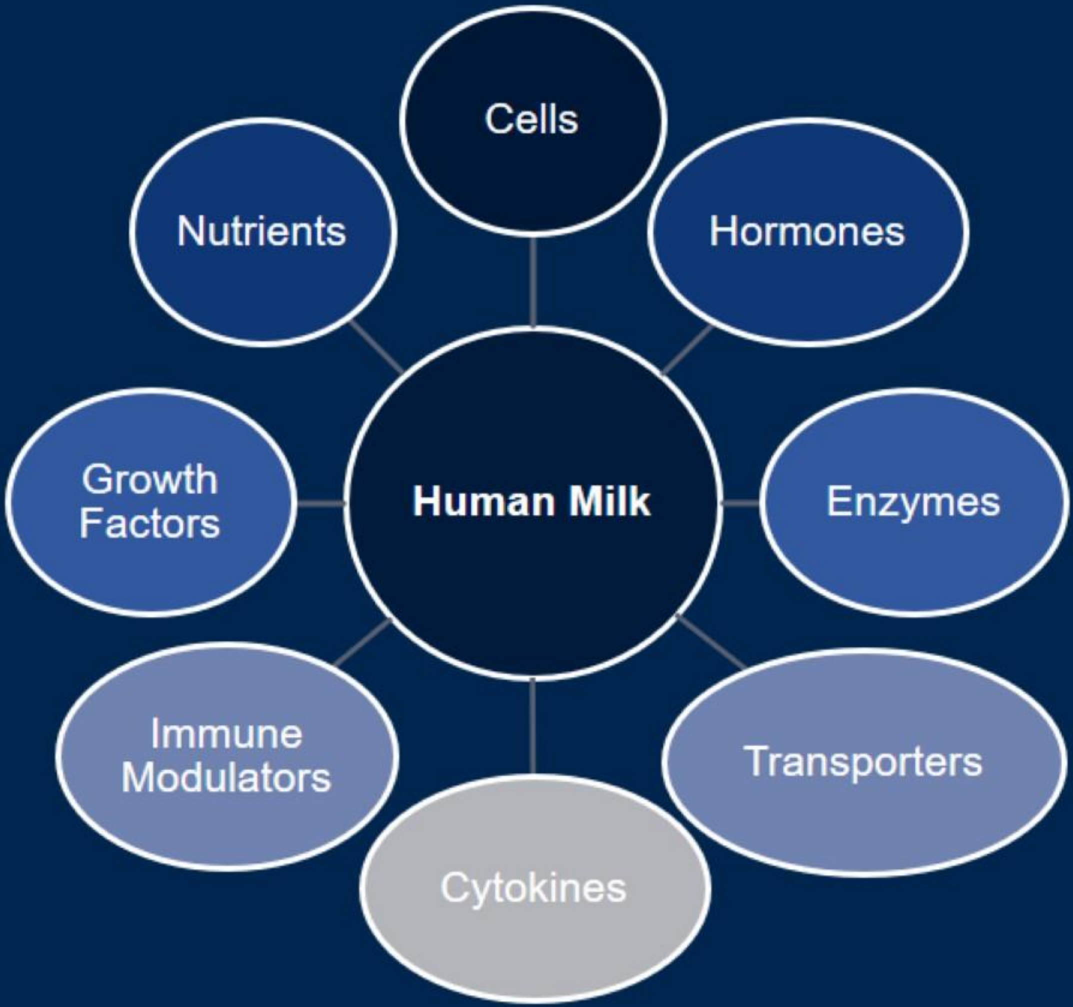
- Energy intake in the first week after birth is greatly affected by intake of lipid because of its high energy content per unit volume. Delayed administration of lipid can also lead to EFA deficiency.
- Increased cumulative intake of lipids during the first 2 weeks after birth has been associated with improved neurodevelopment at 1 year corrected age
- Traditional soybean-based lipid emulsions can contribute to increased levels of proinflammatory cytokines and oxidative stress in newborn infants.
- New lipid emulsions containing fish, olive, and coconut oils provide a balanced ratio of omega-6 and and omega-3 polyunsaturated fatty acids and may be beneficial for preterm infants, but more evidence is needed before their routine use can be recommended.

Lapillonne A, Eleni dit Trolli S, Kermorvant Duchemin E. Postnatal docosahexaenoic acid deficiency is an inevitable consequence of current recommendations and practice in preterm infants. *Neonatology 2010;* ***98: 397–403.***

Kapoor V, Glover R, Malviya MN. Alternative lipid emulsions versus pure soy oil based lipid emulsions for parenterally fed preterm infants. Cochrane Database Syst Rev 2015; 12: CD009172.

Enteral nutrition

Human Milk is a Complex Tissue



Allaitement maternel et développement neurologique de l'enfant prématuré

THE JOURNAL OF PEDIATRICS • www.jpeds.com ORIGINAL ARTICLES

Breastfeeding is Associated with Improved Child Cognitive Development: A Population-Based Cohort Study

Maria A. Quigley, BA, MSc[1], Christine Hockley, BA[1], Claire Carson, BSc, MSc, PhD[1], Yvonne Kelly, BSc, PhD[2], Mary J. Renfrew, RGN, SCM, DN, BSc, PhD[3], and Amanda Sacker, BSc, PhD[2]

Objective To assess the association between breastfeeding and child cognitive development in term and preterm children.

Study design We analyzed data on white singleton children from the United Kingdom Millennium Cohort Study. Children were grouped according to breastfeeding duration. Results were stratified by gestational age at birth: 37 to 42 weeks (term, n = 11 101), and 28 to 36 weeks (preterm, n = 778). British Ability Scales tests were administered at age 5 years (naming vocabulary, pattern construction, and picture similarities subscales).

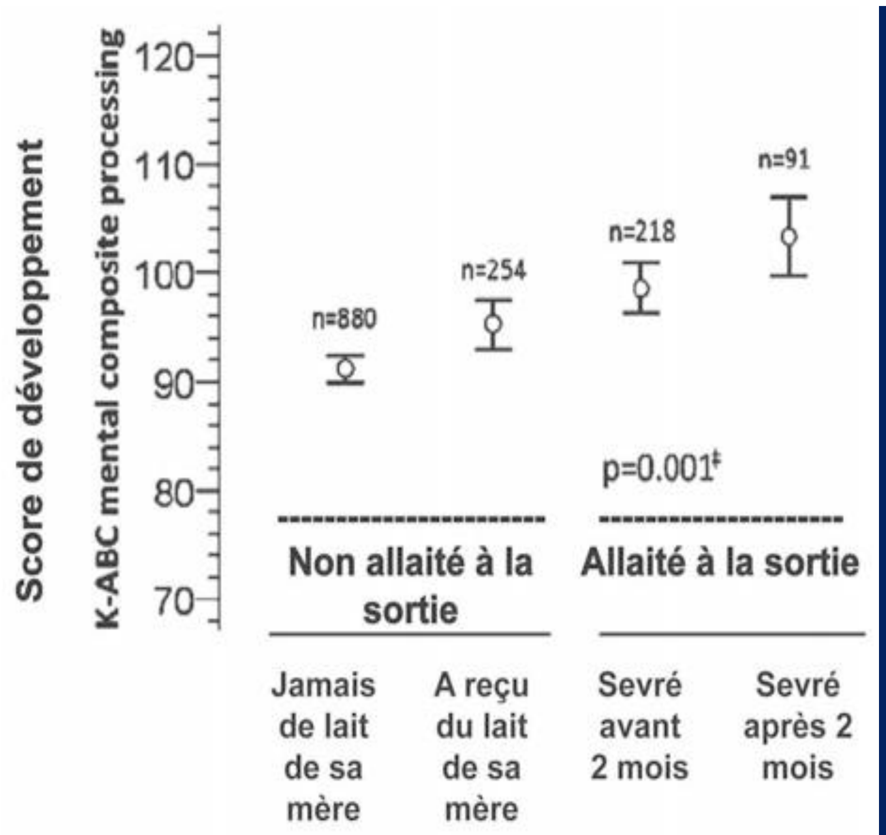
Results The mean scores for all subscales increased with breastfeeding duration. After adjusting for confounders, there was a significant difference in mean score between children who were breastfed and children who were never breastfed: in term children, a two-point increase in score for picture similarities (when breastfed ≥4 months) and naming vocabulary (when breastfed ≥6 months); in preterm children, a 4-point increase for naming vocabulary (when breastfed ≥4 months) and picture similarities (when breastfed ≥2 months) and a 6-point increase for pattern construction (when breastfed ≥2 months). These differences suggest that breastfed children will be 1 to 6 months ahead of children who were never breastfed.

Conclusions In white, singleton children in the United Kingdom, breastfeeding is associated with improved cognitive development, particularly in children born preterm. (*J Pediatr 2012;160:25-32*).

BMJ open

The apparent breastfeeding paradox in very preterm infants: relationship between breast feeding, early weight gain and neurodevelopment based on results from two cohorts, EPIPAGE and LIFT

Jean-Christophe Rozé,[1,2,3,4] Dominique Darmaun,[4] Clair-Yves Boquien,[4] Cyril Flamant,[1,2,3] Jean-Charles Picaud,[5] Christophe Savagner,[6] Olivier Claris,[7] Alexandre Lapillonne,[8] Delphine Mitanchez,[9,10] Bernard Branger,[3] Umberto Simeoni,[11] Monique Kaminski,[12] Pierre-Yves Ancel[12]



Nutritional Components of Human Milk

Macronutrients

Carbs
- Lactose
- Glucose
- Galactose
- Oligosaccharides

Proteins
- Caseins
- Whey
- Amino Acids
- Mucins

Lipids
- Triglycerides (167 identified)
- Phospholipids
- Sphingolipids
- Sterols
- Fatty acids

Micronutrients

Minerals
- Calcium
- Phosphorus
- Iron
- Zinc
- Copper
- Manganese
- Magnesium
- Sodium
- Potassium
- Chloride
- Sulphur

Vitamins
- Vitamin A
- Niacin
- Thiamine
- Vitamin B6
- Pantothenic Acid
- Biotin
- Folate
- Vitamin B12
- Vitamin C
- Vitamin D
- Vitamin E
- Vitamin K

Non-Nutritional Components of Human Milk

Antimicrobial

secretory IgA, IgM, IgG
lactoferrin
lysozyme
complement C3
leukocytes
bifidus factor
lipids and fatty acids
antiviral mucins, GAGs
oligosaccharides

Hormones

feedback inhibitor of lactation (FIL)
insulin
prolactin
thyroid hormones (T2, T3, Reverse T3)
corticosteroids, ACTH
oxytocin
calcitonin
parathyroid hormone
erythropoietin
progesterone
estrogen

Digestive enzymes

amylase
bile acid-stimulating esterase
bile acid-stimulating lipases
lipoprotein lipase
Proteases

Anti-inflammatory

tumor necrosis factor
interleukins
interferon-g
prostaglandins
a_1-antichymotrypsin
a_1-antitrypsin
platelet-activating factor: acetyl hydrolase

Growth factors

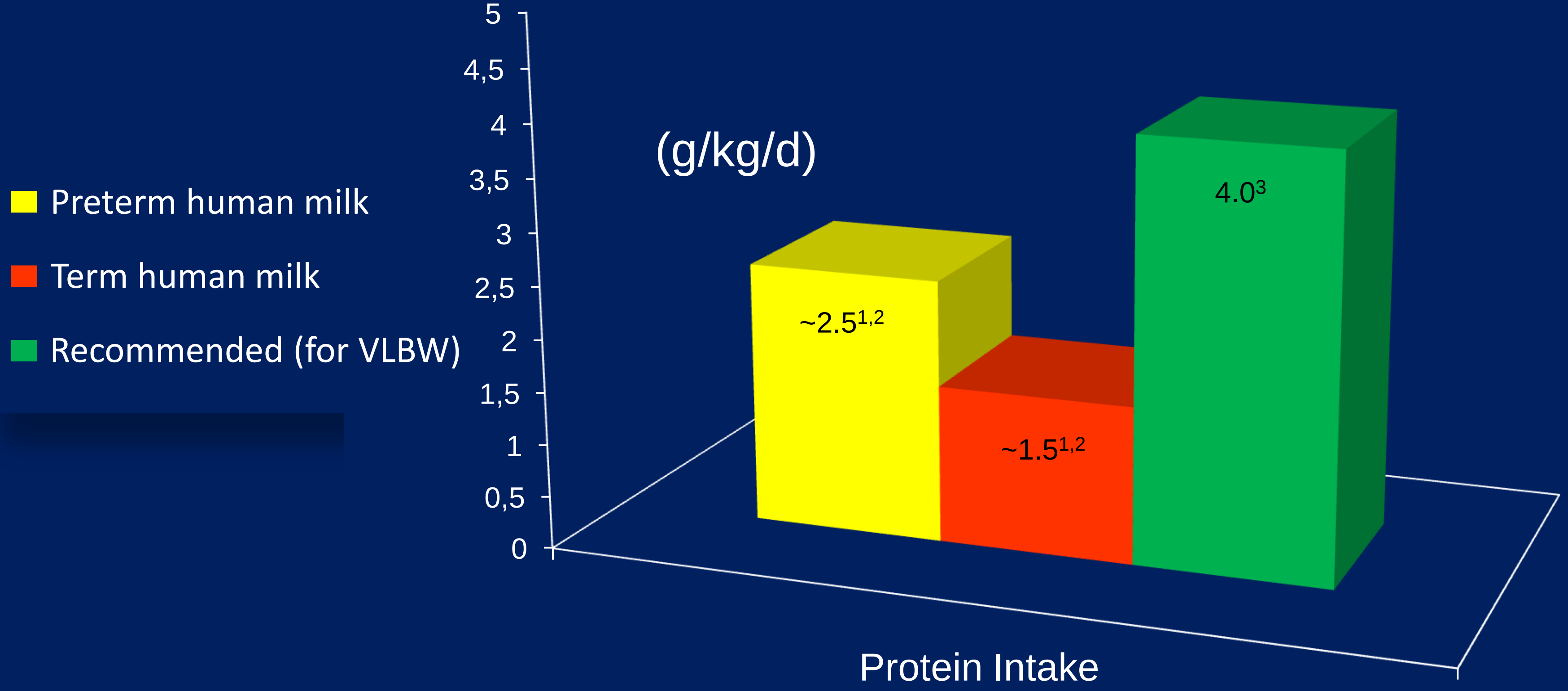
epidermal (EGF)
nerve (NGF)
insulin
insulin-like (IGF)
transforming (TGF)
taurine
polyamines
gastrin
gastric inhibitory peptide (GIP)
Gastric regulatory peptide (GRP)
neurotensin
peptide histidine methionine (PHM)
Peptide YY (PYY)

Transporters

lactoferrin (Fe)
xanthine oxidase
glutathione peroxidase
alkaline phosphatase
folate binder
cobalamin binder
IgF binder
thyroxine binder
corticosteroid binder

Human Milk Alone Does Not Meet the Nutritional Needs of VLBW Infants

Human milk requires fortification to provide nutritional needs of preterm infants



VLBW = very low birth weight.
1. Premji SS, et al. *Cochrane Database Syst Rev*. 2006 Jan 25;(1):CD003959; 2. Carlson SJ, Ziegler EE. *J Perinatol.* 1998;18:252-258; 3. Zeigler EE, et al. In: Suskind RM, Lewinter-Suskind L, eds. *Textbook of Pediatric Nutrition*. 1981:29-39.

AAP Statement 2012, 2017
"Breastfeeding and the Use of Human Milk"

- Mother's own milk, fresh or frozen, should be the primary diet, and it should be fortified appropriately for the infant born weighing < 1500 grams

- Pasteurized donor human milk (DHM), appropriately fortified, should be used if mother's own milk is unavailable or its use is contraindicated

- Significant short and long-term beneficial effects of feeding preterm infants human milk

AAP Section of Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics*. 2012; 129(3): e827-e841.
AAP CON, Section of Breastfeeding, COFN. Donor Human Milk for the High-Risk Infant: Preparation, Safety, and Usage Options in the United States. *Pediatrics* 2017; 139(1): e20163440

AAP Statement 2017
"Donor Human Milk for the High-Risk Infant"

- "Both types of fortifiers have been shown to lead to appropriate growth, and the use of donor human milk does not need to be limited on the basis of growth concerns in most high-risk infants."

AAP CON, Section of Breastfeeding, COFN. Donor Human Milk for the High-Risk Infant: Preparation, Safety, and Usage Options in the United States. *Pediatrics* 2017; 139(1): e20163440

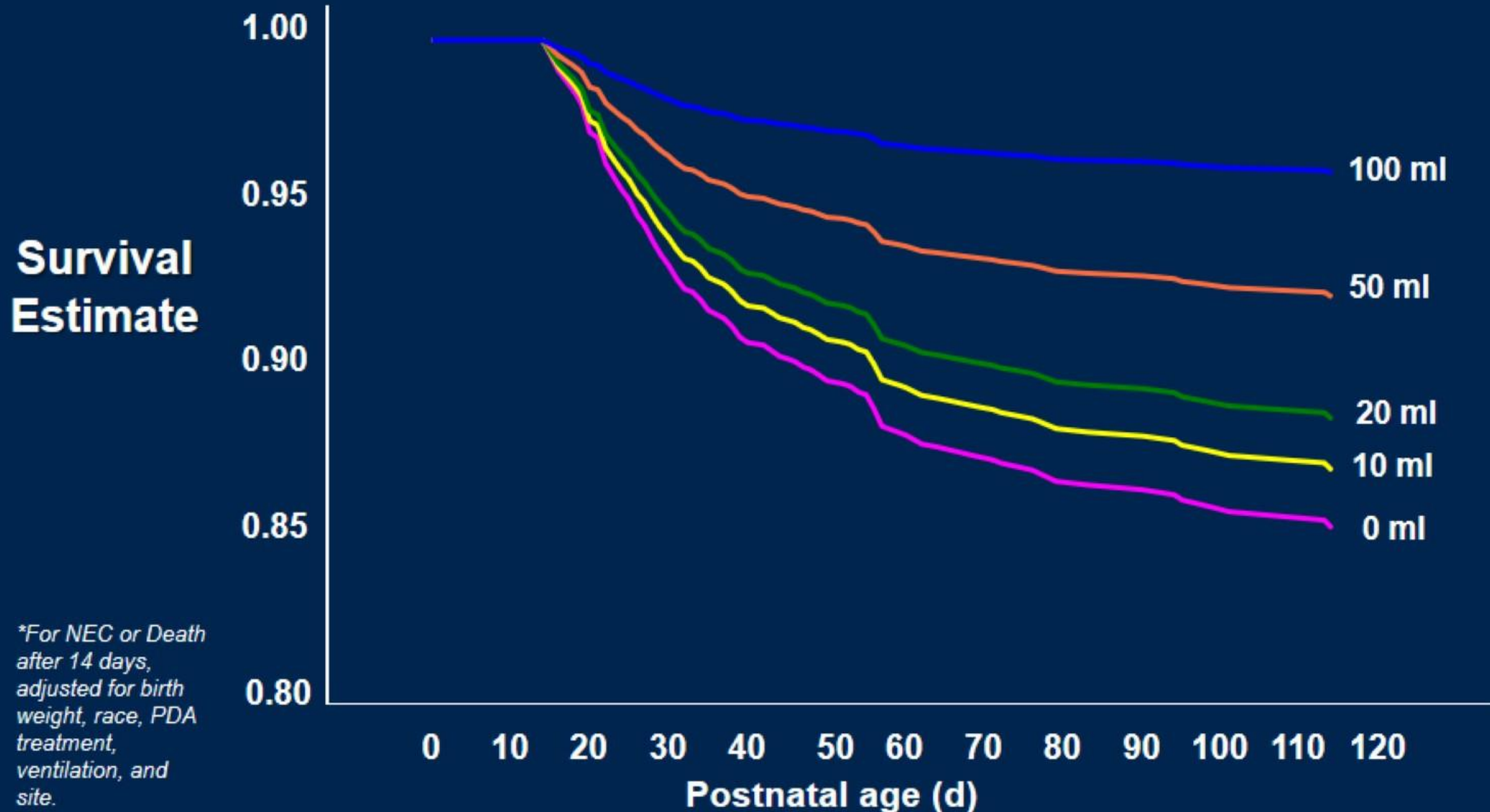
Mother's Own Milk

AAP: Mother's own milk, fresh or frozen, should be the primary diet unless contraindicated

- Providing breast milk is challenging for mothers of preterm infants
- Early breast milk expression results in successful and longer lactation
- Prenatal consults by Neonatologists
- Mother's milk as a standard of care
- Hospital grade electric pumps, lactation rooms, lactation consultants

Murphy et al. A Quality Improvement Project to Improve the Rate of Early Breast Milk Expression in Mothers of Preterm Infants. Journal of Human Lactation. 2014, 398-401.

'Survival' Curves for NEC or Death* by Amount of Human Milk (ml/kg/d)

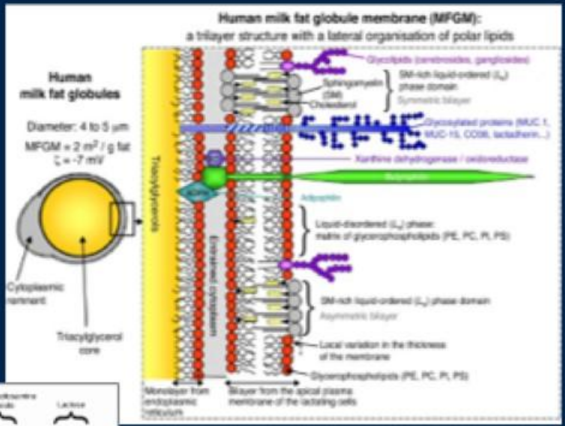


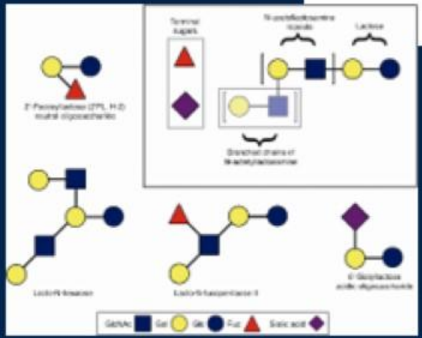
**For NEC or Death after 14 days, adjusted for birth weight, race, PDA treatment, ventilation, and site.*

Meinzen-Derr, et al NICHD Neonatal Network, *J Perinatology* 2009

Innovation: Lacto-Engineering

- Components of Human Milk
  - Donor human milk-derived fortifier
  - Human Milk Cream
  - Human Milk Oligosaccharides
  - Milk Fat Globules
  - Milk Analysis
    - Targeted fortification, Individual fortification
    - Re-blending donor milk to 20 kcal/oz





Human Milk Diet

Human Milk Fortifier

Mother's Milk

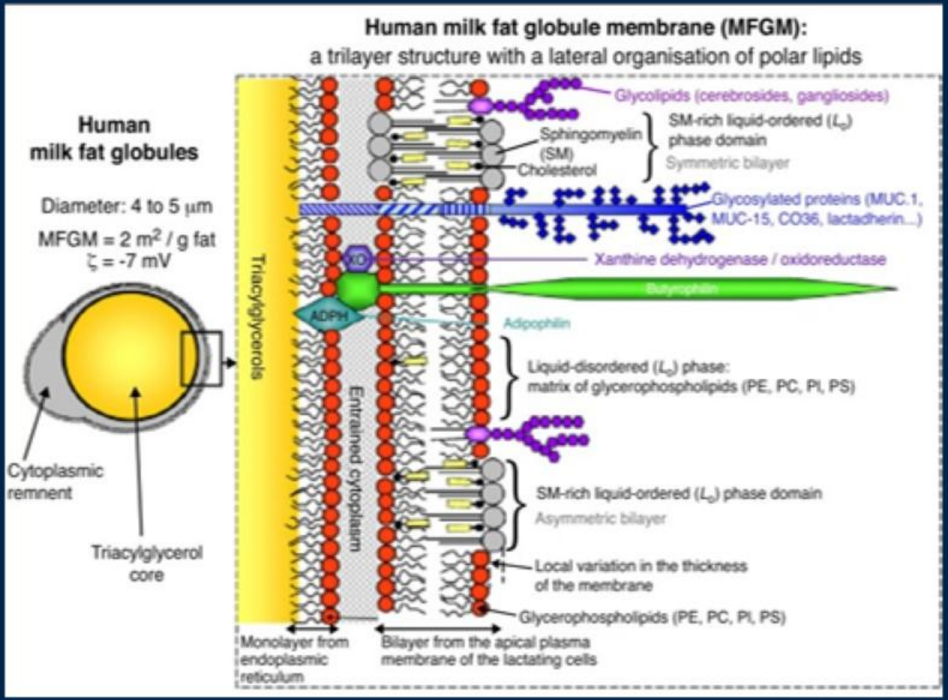
Donor Milk

Milk Fat Globule Membranes

- MFGM glycosphingolipids comprise cerebrosides and gangliosides, which have been shown to contribute to the development of the brain and gut immune system of infants

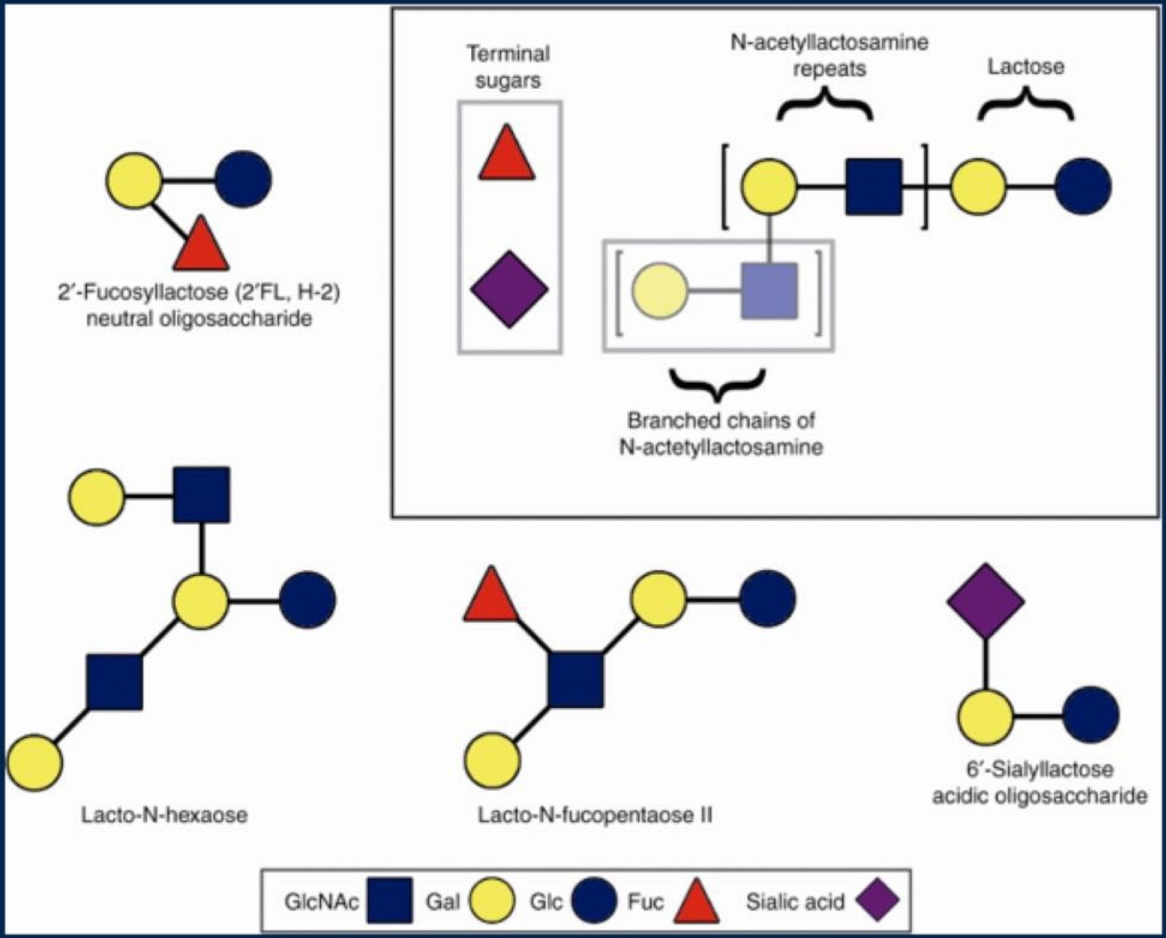
- The glycoproteins and glycolipids form the MFGM glycocalyx which is a rich source of bacterial and viral ligands

    - The MFGM lipids and proteins have important biological functions such as antimicrobial, antibacterial and antiviral activities



Zou et al. Current Opinion in Food Science. (16):28-39; 2017

Human Milk Oligosaccharides (HMOs)



Newburg et al. *Peds Research.* 75(675-679); 2014

Benefits of Exclusive HM-Based Diet

- Necrotizing Enterocolitis
  - 50% ↓ in NEC (NNT to prevent one case of NEC = 10)
  - 90% ↓ in Surgical NEC (NNT to prevent one case of surgical NEC or Death = 8)

Additional Benefits

↑ Host Defense

↓ Mortality

↓ Late Onset Sepsis

↓ Retinopathy of Prematurity

↓ Bronchopulmonary Dysplasia

Human Milk Diet

Human Milk Fortifier

Mother's Milk

Donor Milk

Schanler RJ: Outcomes of human milk-fed premature infants. *Semin Perinatol.* 2011; 35(1): 29-33

Sullivan S, Schanler RJ, Kim JH, et al. An exclusively human milk-based diet is associated with a lower rate of necrotizing enterocolitis than a diet of human milk and bovine milk-based products. *J Pediatr.* 2010; 156(4): 562-567

Hair et al. Beyond Necrotizing Enterocolitis Prevention: Improving Outcomes with an Exclusive Human Milk Based Diet. *Breastfeed Med* 2016: 11(2): 70-74567.

Nutrition is a Challenge in Preemies

- Want to avoid postnatal growth failure
- In-hospital growth is associated with long-term neurodevelopmental outcomes
- <u>Goal is to optimize enteral nutrition without increasing risk of NEC</u>

Growth and Human Milk

- Studies by Schanler et al and Montjaux-Régis N. et al have suggested decreased growth velocity with use of DM compared to <u>both</u> MOM and formula
  - Fat and protein in milk *decrease* with duration of lactation
    - DM (pooled from mothers of older infants) thus contains lower fat and protein content than preterm milk
  - <u>Holder pasteurization</u> and <u>frozen storage</u> reduce fat, lactose, and overall energy content of human milk
  - Pasteurization and freezing diminish lactase activity, which reduces fat absorption

Human Milk Fortification

Bovine Diet	Human Milk Diet
Bovine Fortifier	**Human Milk Fortifier**
Mother's milk	**Mother's milk**
Donor Milk	**Donor Milk**

Human Milk Fortification

- **Liquid HMF (LHMF)-Bovine**
  - Each packet/vial of LHMF is 5 mL
  - 1 packet/vial of LHMF + 25mL EBM = 30 mL of 24 kcal/ounce
- **Powder HMF-Bovine**
  - Each packet/sachet of HMF, when added to 100 mL EBM increases calories by 1 kcal/oz
  - 4 packets/sachets of HMF per 100 mL EBM = 24 kcal/oz
- **Donor human milk-derived fortifier**
  - 24 kcal/oz: 80 mL EBM+20 mL +4 (4:1)
  - 26 kcal/oz: 70 mL EBM+30 mL +6 (7:3)
  - 28 kcal/oz: 60 mL EBM+40 mL +8 (3:2)
  - 30 kcal/oz: 50 mL EBM+50 mL +10 (1:1)

Nutrients per kg/day	AAP[1] 2014	ESPGHAN[2] 2010 *<1000g	EBM + 4 Similac Powder HMF per 100 mL	EBM + 4 MJ Liquid HMF per 100 mL	EBM + 4 Similac Liquid HMF per 100 mL	EBM + Prolacta+6 per 100 mL
Volume (mL)	--	--	150	150	150	150
Energy (kcal)	105-130	110-135	120	120	120	130
Protein (g)	3.5-4	3.5-4 *4-4.5	2.9	3.9	3.6	3.6
Calcium (mg)	100-220	120-140	202	174	179	183
Phosphorus (mg)	60-140	60-90	120	96	102	96
Iron (mg)	2-4	2-3	0.6	2.3	0.6	0.3

[1]Kleinman RE (ed.) American Academy of Pediatrics. Committee on Nutrition. *Pediatric Nutrition Handbook* 7th edition. Academy of Pediatrics, Elk Grove Village, Illinois. 2014; 83-121.

[2]Agostoni C, et al; Enteral nutrient supply for preterm infants: commentary from the ESPGHAN Committee on Nutrition. *J Pediatr Gastroenterol Nutr.* 2010;50(1):85-91.

Human Milk Fortification

- **<u>Bovine human milk fortifier- *Liquid*</u>**
    - Sterile, DHA
    - Displaces more human milk than powder
- **<u>Bovine human milk fortifier- *Powder*</u>**
    - Displaces less human milk than liquid
    - Not sterile, lower protein
- **<u>Donor human milk-based fortifier</u>**
    - Early fortification, provides an exclusive human milk protein diet
    - Can concentrate calories of feeds without increasing osmolarity
    - Decreases morbidities associated with prematurity, NEC, mortality, sepsis, BPD, ROP
    - Need to supplement vitamins and iron, $$

Studies Demonstrate That Exclusive Human Milk Feeding (Including DM and DM-Milk Derived Fortifier) is Sufficient for Adequate Growth in VLBW Infants

RESEARCH ARTICLE **Open Access**

Human milk feeding supports adequate growth in infants ≤ 1250 grams birth weight

Amy B Hair[*†], Keli M Hawthorne[†], Katherine E Chetta[†] and Steven A Abrams[†]

Abstract

Background: Despite current nutritional strategies, premature infants remain at high risk for extrauterine growth restriction. The use of an exclusive human milk-based diet is associated with decreased incidence of necrotizing enterocolitis (NEC), but concerns exist about infants achieving adequate growth. The objective of this study was to evaluate growth velocities and incidence of extrauterine growth restriction in infants ≤ 1250 grams (g) birth weight (BW) receiving an exclusive human milk-based diet with early and rapid advancement of fortification using a donor human milk derived fortifier.

Methods: In a single center, prospective observational cohort study, preterm infants weighing ≤ 1250 g BW were fed an exclusive human milk-based diet until 34 weeks postmenstrual age. Human milk fortification with donor human milk derived fortifier was started at 60 mL/kg/d and advanced to provide 6 to 8 additional kilocalories per ounce (or 0.21 to 0.28 kilocalories per gram). Data for growth were compared to historical growth standards and previous human milk-fed cohorts.

Results: We consecutively evaluated 104 infants with mean gestational age of 27.6 ± 2.0 weeks and BW of 913 ± 181 g (mean ± standard deviation). Weight gain was 24.8 ± 5.4 g/kg/day with length 0.99 ± 0.23 cm/week and head circumference 0.72 ± 0.14 cm/week. There were 3 medical NEC cases and 1 surgical NEC case. 22 infants (21%) were small for gestational age at birth. Overall, 45 infants (43%) had extrauterine growth restriction. Weight velocity was affected by day of fortification ($p = 0.005$) and day of full feeds ($p = 0.02$). Our cohort had significantly greater growth in weight and length compared to previous entirely human milk-fed cohorts.

Conclusions: A feeding protocol for infants ≤ 1250 g BW providing an exclusive human milk-based diet with early and rapid advancement of fortification leads to growth meeting targeted standards with a low rate of extrauterine growth restriction. Consistent nutritional policies using this approach may be considered for this population.

Keywords: Neonate, Growth, Nutrition, Human milk, Growth failure, Necrotizing enterocolitis

Randomized Trial of Human Milk Cream as a Supplement to Standard Fortification of an Exclusive Human Milk-Based Diet in Infants 750-1250 g Birth Weight

Amy B. Hair, MD[1], Cynthia L. Blanco, MD[2], Alvaro G. Moreira, MD[2], Keli M. Hawthorne, MS, RD[1], Martin L. Lee, PhD[3], David J. Rechtman, MD[3], and Steven A. Abrams, MD[1]

Objective To evaluate whether premature infants who received an exclusive human milk (HM)-based diet and a HM-derived cream supplement (cream) would have weight gain (g/kg/d) at least as good as infants receiving a standard feeding regimen (control).

Study design In a prospective noninferiority, randomized, unmasked study, infants with a birth weight 750-1250 g were randomly assigned to the control or cream group. The control group received mother's own milk or donor HM with donor HM-derived fortifier. The cream group received a HM-derived cream supplement if the energy density of the HM tested <20 kcal/oz using a near infrared HM analyzer. Infants were continued on the protocol until 36 weeks postmenstrual age. Primary outcomes included growth velocities and amount of donor HM-derived fortifier used. The hypothesis of noninferiority was established if the lower bound of the one-sided 95% CI for the difference in weight velocities exceeded −3 g/kg/day.

Results There were no differences between groups in baseline demographics for the 78 infants studied except racial distribution ($P = .02$). The cream group ($n = 39$) had superior weight (14.0 ± 2.5 vs 12.4 ± 3.0 g/kg/d, $P = .03$) and length (1.03 ± 0.33 vs 0.83 ± 0.41 cm/wk, $P = .02$) velocity compared with the control group ($n = 39$). There were no significant differences in amount of fortifier used between study groups. The 1-sided 95% lower bound of the CI for the difference in mean velocity (cream-control) was 0.38 g/kg/d.

Conclusions Premature infants who received HM-derived cream to fortified HM had improved weight and length velocity compared with the control group. HM-derived cream should be considered an adjunctive supplement to an exclusive HM-based diet to improve growth rates in premature infants. *(J Pediatr 2014;165:915-20).*

Human Milk Feeding Supports Adequate Growth

- Exclusive Human Milk-Based Diet
  - Early and rapid advancement of fortification[1]
  - 104 infants, consecutively followed, BW ≤ 1250 g, received diet until 34 weeks PMA
  - Weight gain 24.8 ± 5.4 g/kg/day, length 0.99 ± 0.23 cm/week, HC 0.72 ± 0.14 cm/week
  - Compared to human milk-fed cohorts (Sullivan et al[2])
  - Infants had greater growth in weight and length
  - 43% of infants had postnatal growth failure
  - Non-industry funded study

[1]Hair et al: Human Milk Feeding Supports Adequate Growth in Infants ≤ 1250 grams birth weight. *BMC Res Notes* 2013; 6: 459, 1-8. [2]Sullivan et al: An exclusively human milk-based diet is associated with a lower rate of necrotizing enterocolitis than a diet of human milk and bovine milk-based products. *J Pediatr* 156(4): 562-567, 2010.

Caloric Variation of Human Milk

Study of 415 sequential samples from 273 unique donors

- Analyzed for fat, protein, carbohydrate
- Mean energy content of milk was 19 kcal/oz
  - 25% of the samples were < 17 kcal/oz
  - 65% were < 20 kcal/oz
- Fat content was the most variable
  - 3.2 g/dL

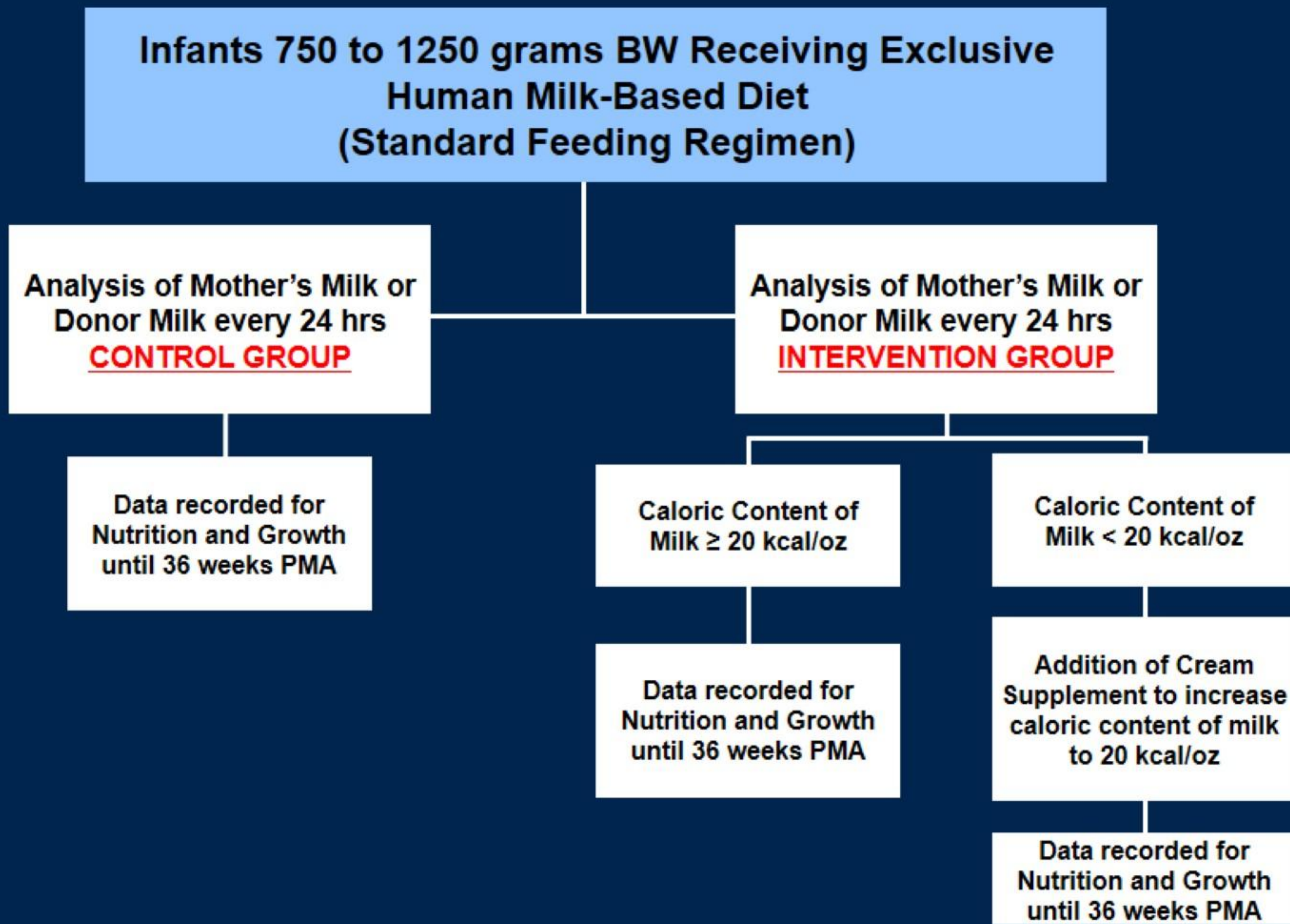
Wojcik KY, Rechtman DJ, Lee ML et al. Macronutrient analysis of a nationwide sample of donor breast milk. *J Am Diet Assoc* 109:137-140, 2009.

Human Milk Cream

- We have the ability to measure the caloric density and macronutrients of human milk
  - IR analyzer
  - Requires < 5 mL of milk
- A novel donor human milk-derived cream supplement is now available
- Human Milk Cream or Human Milk Fat is derived from the processing of donor human milk
- Caloric content is 2.5 kcal/mL

Randomized Trial of Human Milk Cream as a Supplement to Standard Fortification of an Exclusive Human Milk-Based Diet in Infants 750-1250 g BW

Hair et al. *J Peds.* 2014


Infants 750 to 1250 grams BW Receiving Exclusive Human Milk-Based Diet (Standard Feeding Regimen)
Analysis of Mother's Milk or Donor Milk every 24 hrs CONTROL GROUP
Analysis of Mother's Milk or Donor Milk every 24 hrs INTERVENTION GROUP
Data recorded for Nutrition and Growth until 36 weeks PMA
Caloric Content of Milk ≥ 20 kcal/oz
Caloric Content of Milk < 20 kcal/oz
Data recorded for Nutrition and Growth until 36 weeks PMA
Addition of Cream Supplement to increase caloric content of milk to 20 kcal/oz
Data recorded for Nutrition and Growth until 36 weeks PMA

Addition of Cream to Human Milk

Caloric Content of Mothers Own Milk or Donor HM (Kcal/oz)	Volume of HM	Volume of Cream to Add to HM
19-20	98 mL	2 mL
18-18.9	96 mL	4 mL
17-17.9	94 mL	6 mL
16-16.9	93 mL	7 mL

Comparison of Growth Velocities

	Control group (n=39)	Cream group (n=39)	p-value
Weight velocity (g/kg/day)	12.4 ± 3.9*	14.0 ± 2.5	0.03
Length velocity (cm/week)	0.83 ± 0.41	1.03 ± 0.33	0.02
Head circumference (cm/week)	0.84 ± 0.22	0.90 ± 0.19	0.21
Weight velocity from time infant regained BW (g/kg/day)	13.7 ± 4.0	15.7 ± 2.5	0.02

*Mean ± SD, weight velocity calculated using Patel method 2009

Nutrition is a Challenge in Preemies

- Balance between over and under nutrition
- <u>Variation in Calories of Human Milk</u>
  - Are we really giving the calories we think we are?
  - Are we delivering the calories?
  - Pasteurization and freezing

https://www.flickr.com/photos/61056899@N06/5751301741

Picture: Craig Borrow

Objective: Determine the Effect of Syringe Orientation on Fat Retention

Hypothesis: Fat retention will be greatest with the syringe facing “up”, and lowest with syringe “down.”

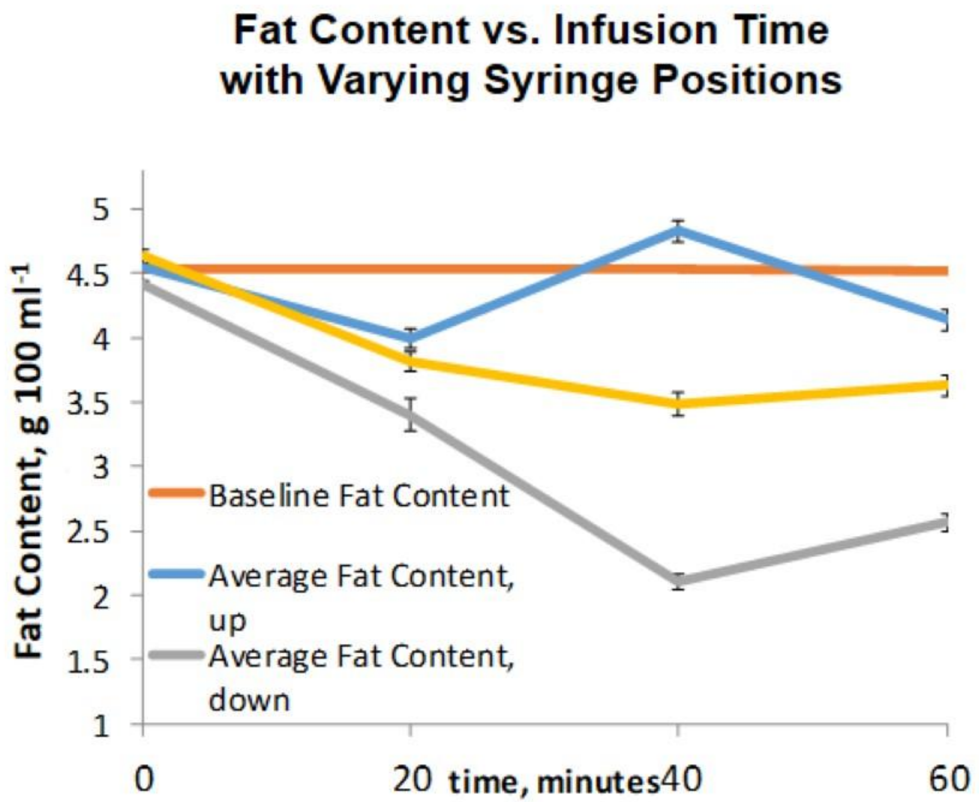
“down”

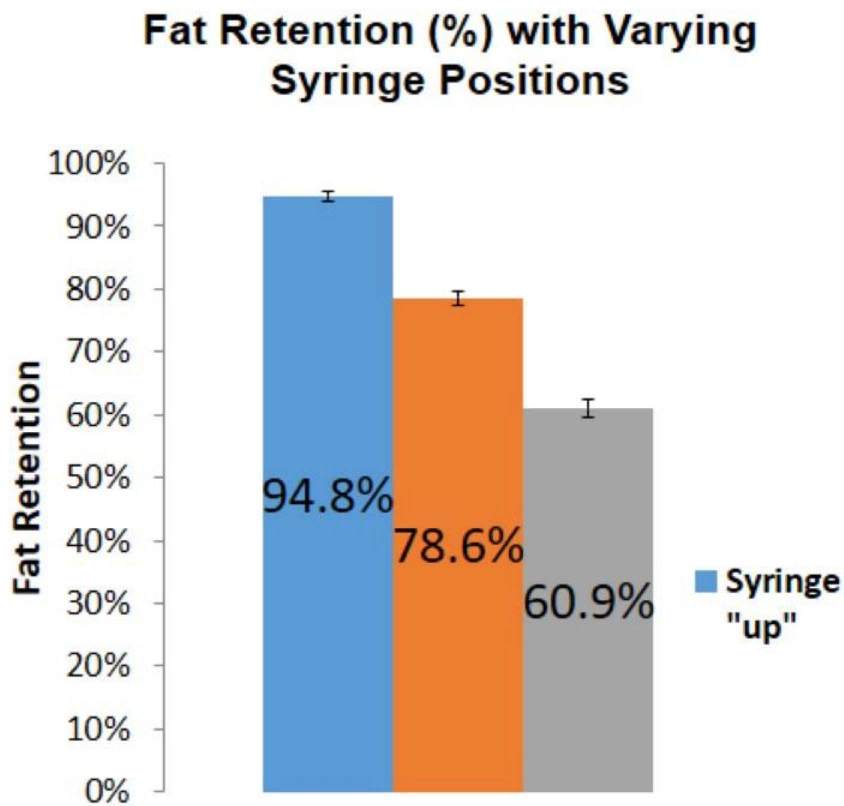
“flat”

“up”

Abdelrahman and Hair et al, Poster presentation, PAS Meeting 2015

Determine the Effect of Syringe Orientation on Fat Retention





Abdelrahman and Hair et al, Poster presentation, PAS Meeting 2015

Oral Care with Colostrum

- Oropharyngeal administration involves placing small amounts of a liquid directly onto the oral mucosa

- Produced when the tight junctions in the mammary epithelium are open
  - Paracellular transport of immunologically derived protective components from mother's circulation into milk

- Contain various immunomodulatory agents
  - Secretory immunoglobulin A [sIgA]
  - Growth Factors
  - Lactoferrin
  - Anti-inflammatory cytokines

- More highly concentrated in preterm milk

Rodriguez, N.A., et al., Oropharyngeal administration of colostrum to extremely low birth weight infants: theoretical perspectives. *J Perinatol*, 2009. 29(1): p. 1-7.

Evidence That Oral Colostrum Care Benefits Preterm Babies

- **Seigel 2013**
  - Retrospective cohort study of 369 inborn ELBW infants, 5 day treatment
  - Mortality, surgical NEC, SIP rates unchanged
  - Higher weight at 36 weeks (1666g vs. 1380g $p<0.001$)
- **Lee 2015**
  - Double blind, placebo-controlled trial of 45 infants <28 weeks gestation in South Korea
  - Increased urine levels of immunoglobulin A and lactoferrin
  - Significant decrease in clinical sepsis
- **Sohn 2016**
  - Impact of buccal administration of human colostrum on the oral microbiota of 12 VLBW infants
  - OCC altered the colonization of the oral cavity with effects lasting after the intervention

Strategies to Promote Adequate Growth

- Oral care with colostrum
- Feeding Protocol focusing on early enteral feeding and early fortification of feedings with HM
- Consider the need for increased calories due to human milk < 20 kcal/oz and possible fat loss via feeding tubes and transfer between containers
- Monitor growth with growth curves (Fenton 2013)
- Increase fortification (up to 26 or 28 kcal/oz with donor milk-derived fortifier, add human milk cream)

Effects of Cream Supplement on Length of Stay and Bronchopulmonary Dysplasia

- The Human Milk Cream Study showed a trend towards a 2-week decreased length of stay for babies who received cream supplement, especially babies who had BPD
- Randomized Controlled Trial comparing the use of a cream supplement routinely to infants' exclusive human milk-based diet compared to standard regimen
- Secondary outcomes include BPD, ROP, mortality, growth, NEC

Définitions de la prématurité

- Naissance avant 37 semaines d'aménorrhée (SA)
- *Plusieurs classifications selon le terme*
  - Prématurité extrême 22 à 27 SA + 6j ≈ 5%
  - Grande prématurité 28 à 31 SA + 6j ≈ 15%
  - Prématurité modérée 32 à 33 SA +6j ≈ 20%
  - Prématurité tardive 34 à 36 SA +6j ≈ 60-70%

Importante morbidité!

Complication	Frequency in late preterm infants	Frequency in term infants
Jaundice	54%	38%
Evalution for sepsis	37%	13%
Feeding difficulties	32%	7%
I.v. Fluids	27%	5%
Hypoglycemia	16%	5%
Thermal instability	10%	< 0,1%
Apnea	6%	< 0,1%
Mechanical ventilation	3,4%	0,9%
Mortality (2002)	7,9/1000 live births	2,4/1000 live births

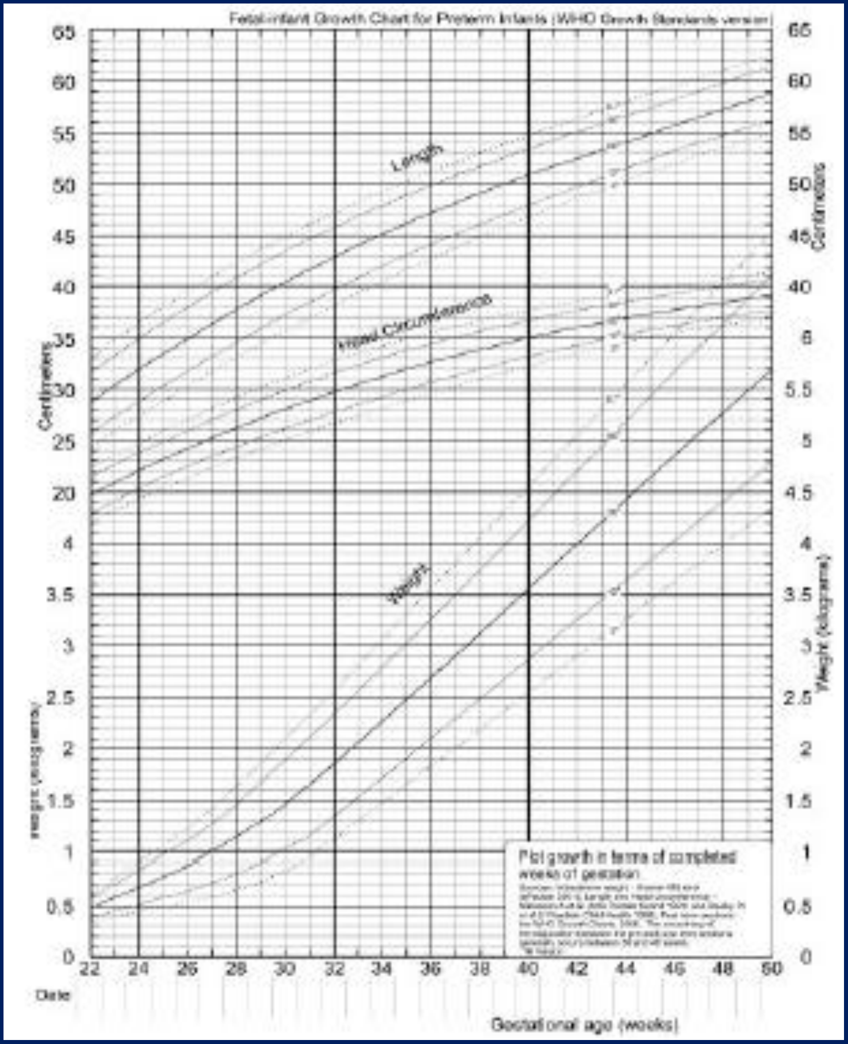
Fanaroff AA. Late Preterm Infants at Risk for Short-Term and Long-Term Morbidity and Mortality
Buonocore G. Bracci R, Weinding M. Neonatology: A Parctical Approach to Neonatal Diseases.

Nutrition du prématuré proche du terme : Pourquoi est ce important? (1)

- La croissance des nouveau-nés prématurés tardifs est souvent déficiente - le risque de poids insuffisant est 2 fois plus élevé

    Santos et al. BMC Pediatrics, 2009

- La croissance doit être évaluée sur des courbes de prématurés
- Au cours des deux premières années de la vie, on s'attend à ce que la croissance des prématurés rattrape son retard
- Le déficit de croissance est associée à une morbidité à long terme



Nutrition du prématuré proche du terme : Pourquoi est ce important? (2)

- Troisième trimestre – Période critique
- Surtout pour le développement du cerveau – croissance du cortex
- Augmentation rapide des dépôts de graisse - thermorégulation.
- Important transfert de nutriments par le placenta - protéines, calcium, phosphore, zinc - l'essentiel du transfert a lieu au 3ème trimestre
- La vitesse de croissance diminue de 18-20 g/kg/jour à 28 SA à 10 g/kg/jour à terme (environ 30-35 g / jour).
- Les besoins en protéines diminuent avec l'augmentation de l'AG
- La minéralisation osseuse reste en deçà de la croissance osseuse chez tous les prématurés

Lapillonne et al. *J Pediatr 2013:162:S90-100.*

Estimated nutrient requirements preterm, late preterm and term infants

	28-31 wks	32-33 wks	34-36 wks	37-38 wks	39-41 wks
Fetal wt gain (g/kg/d)	17.5	15	13	11	10
Energy (kcal/kg/d)	125	130	127	115	110
Protein (g/kg/d)	3.9	3.5	3.1	2.5	2
Calcium (mg/kg/d)	120-140	120-140	120-140	70-120	70-120
Phosphorus (mg/kg/d)	60-90	60-90	60-90	35-75	35-75

Modified from Lapillonne et al. *J Pediatr 2013:162:S90-100.*

Estimated nutrient requirements preterm, late preterm and term infants

	28-31 wks	32-33 wks	34-36 wks	37-38 wks	39-41 wks
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Protein (g/kg/d)					
Calcium (mg/kg/d)					
Phosphorus (mg/kg/d)	60-90	60-90	60-90	35-75	35-75

Les besoins estimés / kg en protéines et en minéraux restent augmentés jusqu'à > 37 semaines

Modified from Lapillonne et al. *J Pediatr 2013:162:S90-100.*

Nutrition du prématuré proche du terme- Recommandations (1)

- Lait maternel?
  - Fortification?
- Formule ?
  - Quelle formule?

Nutritional Requirements of the Late Preterm Infants *VS* Nutritional Components of Human Milk and Formula

	Requirements		Human Milk		Formula	
	32-33 wks	34-36 wks	Breastmilk	Breastmilk + HMF	Term	Preterm Discharge
Energy (kcal/kg/d)	130	127	125	125	125	125
Protein (g/kg/d)	305	30.	1.9	3.5-4.1	2.7	3.5
Calcium (mg/kg/d)	120-140	120-140	51	180	98	150
Phosphorus (mg/kg/d)	60-90	60-90	26	98	54	83

Susan K Carlson et al. *Perinatal Letter 2014.*

Nutrition du prématuré proche du terme - Recommandations (1)

- Stratégies pour améliorer l'allaitement
  - Contact peau à peau
  - Conseils d'allaitement
  - pompage du lait
  - Former le personnel à l'allaitement
  - Hôpital Ami des Bébés

Renfrew et al., Health Technol Assess, 2009

- Attention au positionnement
  - Dysproportion de la tête, muscles du cou plus faibles
  - Petite bouche comparée à l'aréole
  - Réserves physiques limitées
  - Somnolence, fatigue

Wight, N. Pediatric Annals 2003;
Meier PP et al. J Hum Lact 2000;
ABM Clinical protocols

Nutrition du prématuré proche du terme - Recommandations (2)

- Autres stratégies
  - Rooming-in avant la sortie
  - Approche pratique et individualisée
  - Former la mère à exprimer le lait
  - Temps d'allaitement limité
  - Complément aux besoins du bébé pour éviter les complications
  - Ajuster le support en fonction des progrès du bébé

Mortton,, JA Pediiatric Annals,, May 2003

- Attention aux biberons et aux tétines:
  - Réduise les taux d'allaitement
  - Marqueurs des difficultés d'allaitement
  - Marqueurs d'une faible motivation de la mère
  - Les raisons possibles de la cessation précoce de l'allaitement maternel ou de l'allaitement insuffisant

Nutrition du prématuré proche du terme - Recommandations (3)

- Autres stratégies possibles
  - suppléments 5 - 10 ml / alimentation le premier jour - colostrum / EBM de préférence
  - 10 - 30 ml / repas après le premier jour
  - LM > LM donneur pasteurisé > formule
  - Pas de formule au soja
  - Pas d'eau sucrée

Wight, N. Pediatric Annals 2003
ABM Clinical protocols #10 si #3

- Modes d'alimentation - adaptés aux besoins et aux possibilités du prématuré:
  - Biberon
  - Gavage
  - Systèmes de supplémentation
  - tasse
  - Alimentation au doigt

Nutrition du prématuré proche du terme - Recommandations (4)

- Alimentation à la tasse:
  - Secure et efficace
  - Encore plus efficace que le biberon
  - N'interfère pas avec l'allaitement chez les bébés nécessitant une supplémentation

Collins et al. Br Med Journal 2004;
Howard et al. Pediatrics 2003

- Alterner sein / biberon
- Utilisation des téterelles
- Monitorer la croissance
- Éviter la perte de poids excessive (> 3% le premier jour ou> 7% le troisième jour)
- Plan d'alimentation individualisé élaboré avec la mère

Nutrition du prématuré proche du terme – Recommandations/Résumé

- Adaptation de l'apport en nutriments de la même manière que pour le autres nouveau-nés prématurés
- Promotion de l'allaitement
- Fortifier LM si poids corporel <1800 g ou nutrition parentérale durée> 2 semaines
- En absence de LM : préparation pour nourrissons prématurés ou enrichie en nutriments (après la sortie) jusqu'à l'âge corrigé de 40 semaines, voire de 52 semaines
- Evaluation de la croissance sur les courbes de prématurité en tenant compte de l'âge corrigé

Lipillonne A et al. J Pediatr. 2013

Academy of Breastfeeding Medicine; Breastfeeding Medicine 2011

Nutrition du prématuré proche du terme – Recommandations à la sortie

- Éducation familiale en matière d'alimentation
- Le nourrisson peu prématuré tarde à manger, et peut avoir besoin de manger plus souvent
- Coordination succion / déglutition / respiration difficile
- Besoin d'une surveillance plus attentive pendant les repas
- Initialement, le bébé peut bien s'alimenter pendant de l'hospitalisation et devient rapidement fatigué et des troubles alimentaires peuvent se produire

Pour en savoir plus

european standards of
care for newborn health

EFCNI, Lapillonne A, Koletzko B et al., European Standards of Care for Newborn Health: Feeding of late preterm infants. 2018

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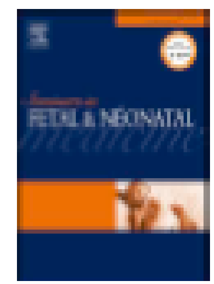

Nutritional policies for late preterm and early term infants – can we do better?

Mariana Muelbert, Jane E. Harding, Frank H. Bloomfield*

https://doi.org/10.1016/j.siny.2018.10.005

En au saura peut être plus

Bloomfield et al. BMC Pediatrics (2018) 18:220
https://doi.org/10.1186/s12887-018-1195-7

BMC Pediatrics

STUDY PROTOCOL — Open Access

The DIAMOND trial – DIfferent Approaches to MOderate & late preterm Nutrition: Determinants of feed tolerance, body composition and development: protocol of a randomised trial

Frank H. Bloomfield[1,2*], Jane E. Harding[1], Michael P. Meyer[3,5], Jane M. Alsweiler[2,3], Yannan Jiang[4], Clare R. Wall[6], and Tanith Alexander[1,5] on behalf of the DIAMOND Study Group

Messages clés

- La prématurité est une urgence nutritionnelle
- Le lait maternel est l'aliment optimal pour tous les nourrissons et est généralement fortifié pour soutenir la croissance des nouveau-nés très prématurés
- Une croissance précoce rapide est associée à un meilleur devenir cognitif chez les aux dépens de résultats métaboliques défavorables; une nutrition optimale aux premiers stades peut améliorer ce compromis
- Les stratégies nutritionnelles néonatales doivent avoir pour objectif d'optimiser le développement neurologique plutôt que la croissance uniquement.
- Cependant, les données de haute qualité sont insuffisantes concernant les apports optimaux en macronutriments pour les prématurés.
- Il existe peu de données probantes de grande qualité sur les meilleures méthodes d'alimentation en cas de prématurité modérée ou tardive.