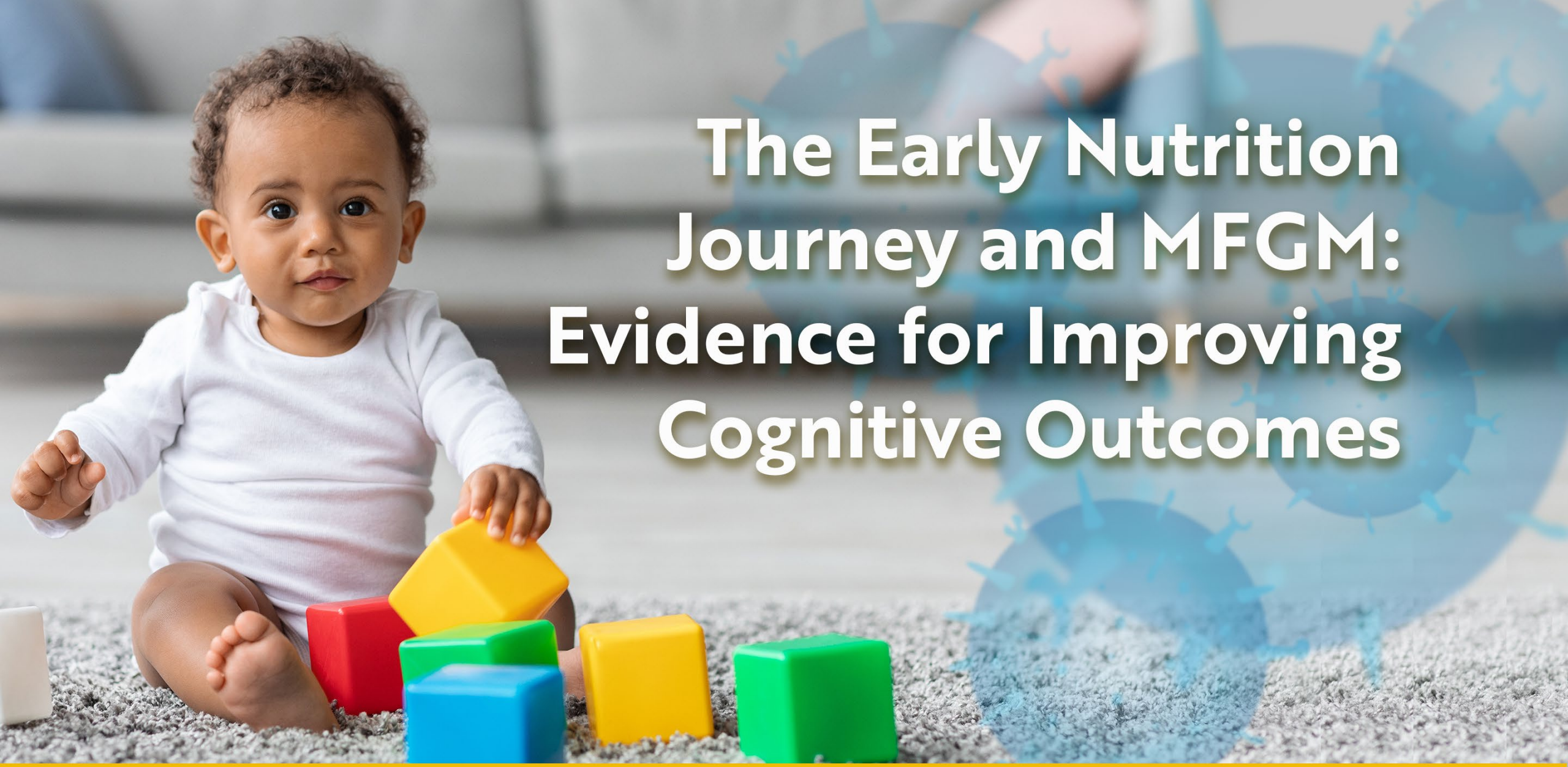




The Early Nutrition Journey and MFGM: Evidence for Improving Cognitive Outcomes



ANNENBERG CENTER FOR HEALTH SCIENCES
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Imparting knowledge. Improving patient care.

This activity is supported by an educational grant from Mead Johnson Nutrition.

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Faculty Disclosures

It is the policy of the Annenberg Center to ensure fair balance, independence, objectivity, and scientific rigor in all programming. All faculty participating in accredited programs are expected to identify and reference off-label product use and disclose any relationship with those supporting the activity or any others whose products or services are discussed.

John Colombo, PhD

<i>Advisory Board</i>	Ingenuity Foods, LLC and Nestle
<i>Consultant</i>	Reckitt Mead Johnson Nutrition
<i>Research Support</i>	Fonterra Bands, Inc.

Sean Deoni, PhD

<i>Speakers Bureau</i>	Mead Johnson Nutrition, Nestle Nutrition, Wyeth Nutrition
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Rafeal Jimenez-Flores, PhD

No relationships to disclose.

Faculty have documented that this presentation will involve discussion of unapproved or off-label, experimental, or investigational use. For complete disclosure information, please see our course syllabus.



Learning Objectives

By participating in this education, you will better:



Describe the molecular structure of MFGM as it relates to its key biological functions, including its role as a bioactive component in human milk



Identify the clinical significance of MFGM in early life nutrition and its impact on neurodevelopment and brain structure and function



Discuss the longitudinal benefits of early life MFGM supplementation on cognitive outcomes, measures of intelligence, and executive functioning



The Early Nutrition Journey and MFGM: Evidence for Improving Cognitive Outcomes

1

The Science and Structure of MFGM *and* Mechanisms of Action of MFGM on Health

2

MFGM and the Developing Brain

3

Supplemental MFGM and Neurodevelopmental Outcomes

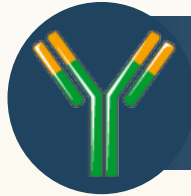
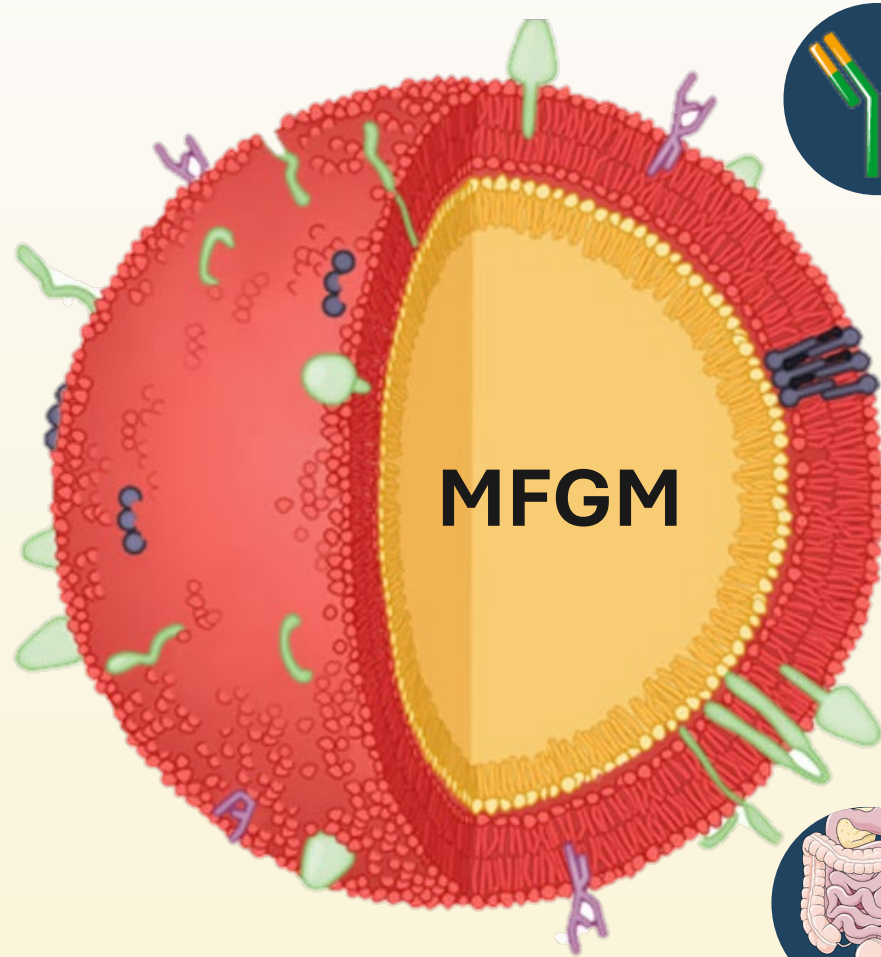


The Science & Structure of MFGM

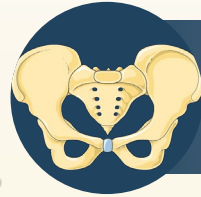
Rafael Jimenez-Flores, PhD



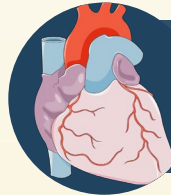
Link Between MFGM and Human Health



Modulation of the immune system



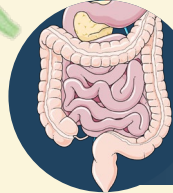
Bone mineral density



Cardiometabolic health



Cognitive function and brain development



Gut barrier function and microbiota



MFGM Benefits: Results From Selected International Studies

Study (Year)	Country	Neurodevelopment	Immune System	Other
Zavaleta et al (2011)	Peru		Less bloody diarrhea at 12 months	
Gurnida et al (2012)	Indonesia	Better coordination and performance at 6 months		
Veereman-Wauters et al (2012)	Belgium, France, Netherlands	Better behavior in preschoolers	Fewer fever episodes at 6 weeks	
Tanaka et al (2013)	Japan	Better behavior and attention in premature infants at 18 months		
Timby et al (2014)	Sweden	Better cognitive development scores at 12 months		
Timby N et al (2015)	Sweden		Lower incidence of otitis media at 6 months	
Li et al (2019)	China	Better cognitive, language, and motor functions at 12 months	Less diarrhea and IVRA	
Jaramillo-Ospina et al (2022)	Chile			Growth and safety



MFGM & Cognitive Development: Short- & Long-Term Outcomes in the Lighthouse Clinical Trial

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ORIGINAL
ARTICLES

Improved Neurodevelopmental Outcomes Associated with Bovine Milk Fat Globule Membrane and Lactoferrin in Infant Formula: A Randomized, Controlled Trial

Fei Li, MD, PhD¹, Steven S. Wu, MD², Carol Lynn Berseth, MD^{2,3}, Cheryl L. Harris, MS², James D. Richards, PhD^{4,5}, Jennifer L. Wampler, PhD², Weihong Zhuang, MS², Geoffrey Cleghorn, MD^{2,6}, Colin D. Rudolph, MD, PhD^{2,7}, Bryan Liu, MD, PhD^{2,8}, D. Jill Shaddy, MA⁹, and John Colombo, PhD⁹

Accelerated neurodevelopmental profile at 1 year following MFGM/lactoferrin supplementation (Li F et al, *J Pediatr*, 2019)

THE JOURNAL OF PEDIATRICS • www.jpeds.com



ORIGINAL
ARTICLES

Improved Neurodevelopmental Outcomes at 5.5 Years of Age in Children Who Received Bovine Milk Fat Globule Membrane and Lactoferrin in Infant Formula Through 12 Months: A Randomized Controlled Trial

John Colombo, PhD¹, Cheryl L. Harris, MS², Jennifer L. Wampler, PhD², Weihong Zhuang, MS², D. Jill Shaddy, MA³, Bryan Y. Liu, MD, PhD⁴, and Steven S. Wu, MD^{2,5}

Improved cognitive outcomes in multiple domains at 5.5 years following MFGM/lactoferrin supplementation (Colombo J et al, *J Pediatr*, 2023)

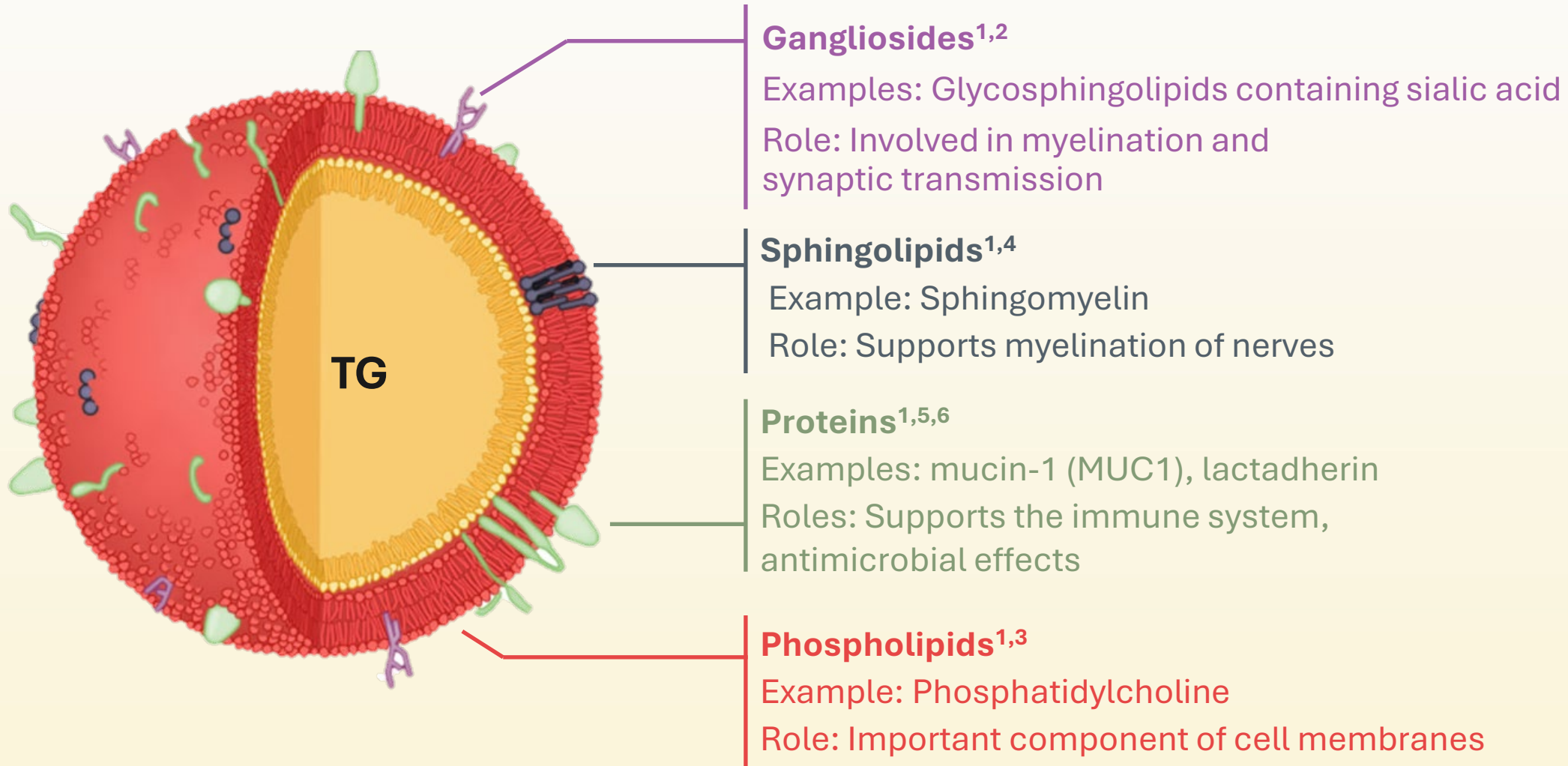


The Science & Structure of MFGM

What Is MFGM?



MFGM Components



TG, triglycerides



Nutrients Needed for Brain Development

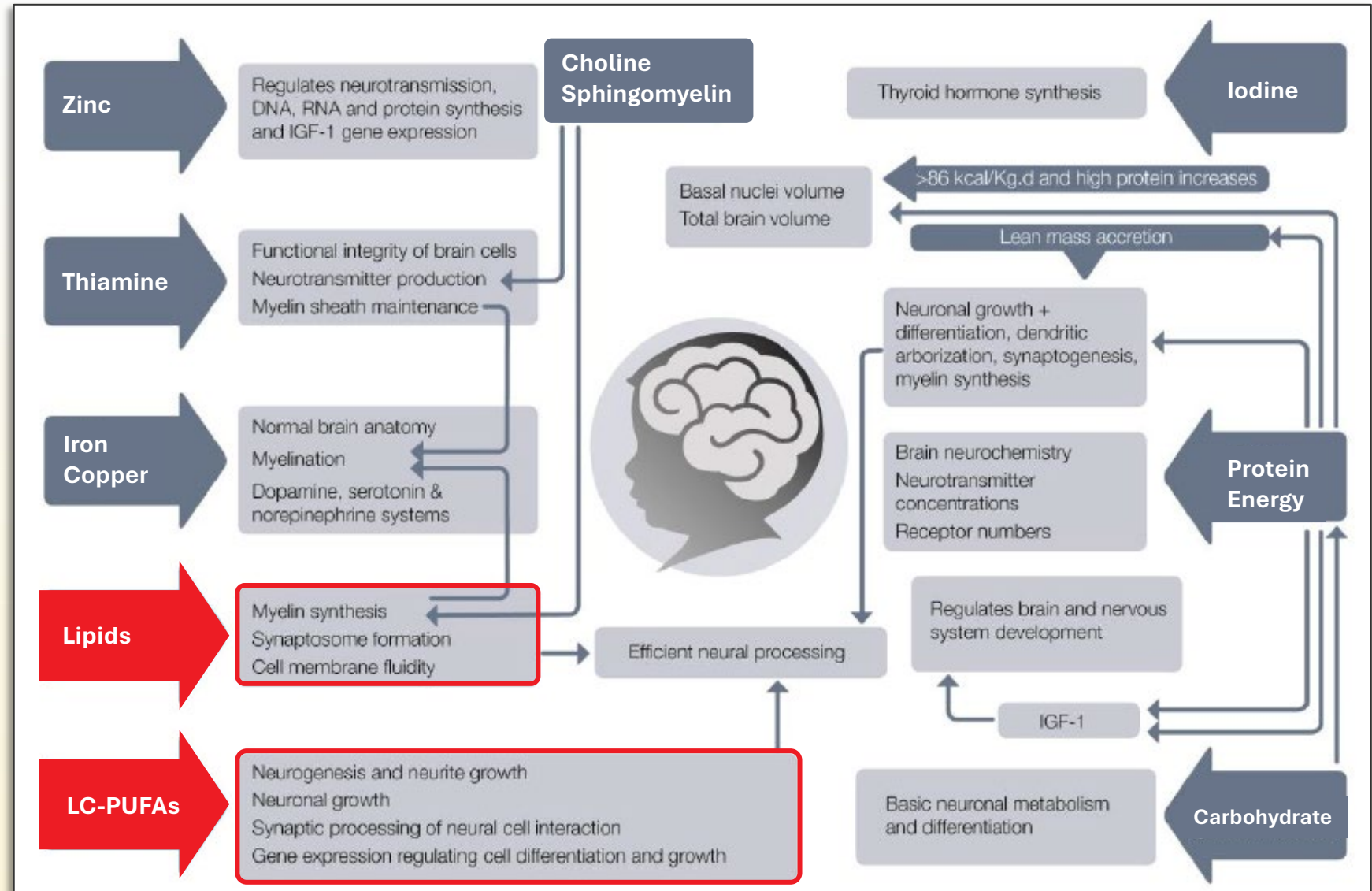
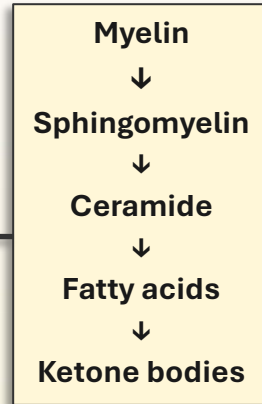
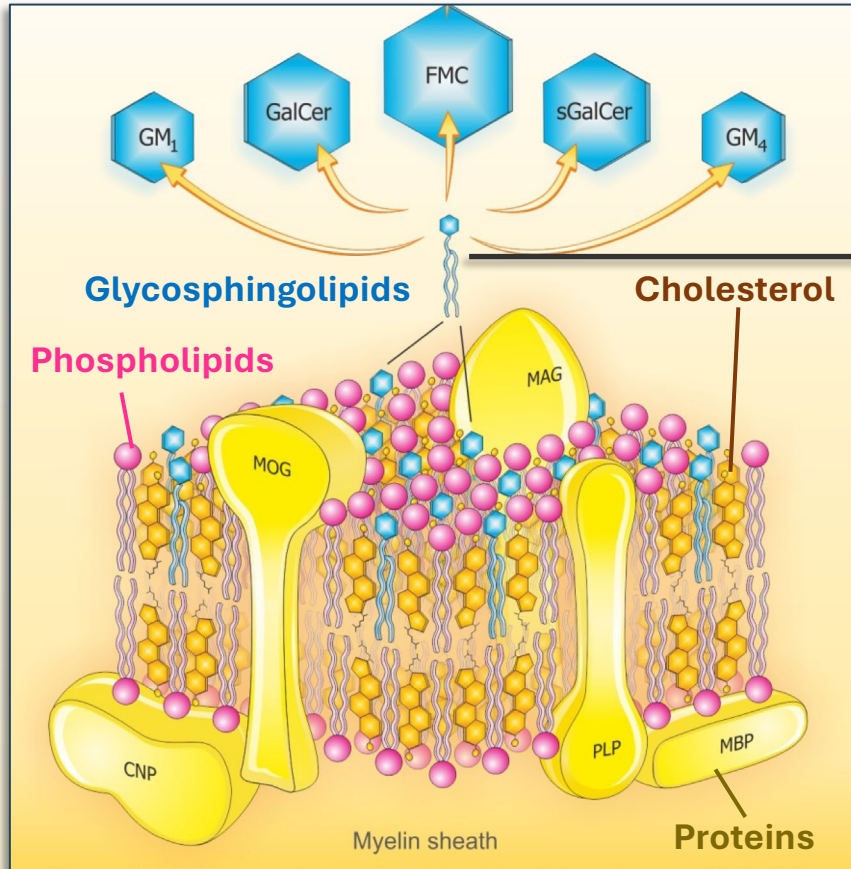


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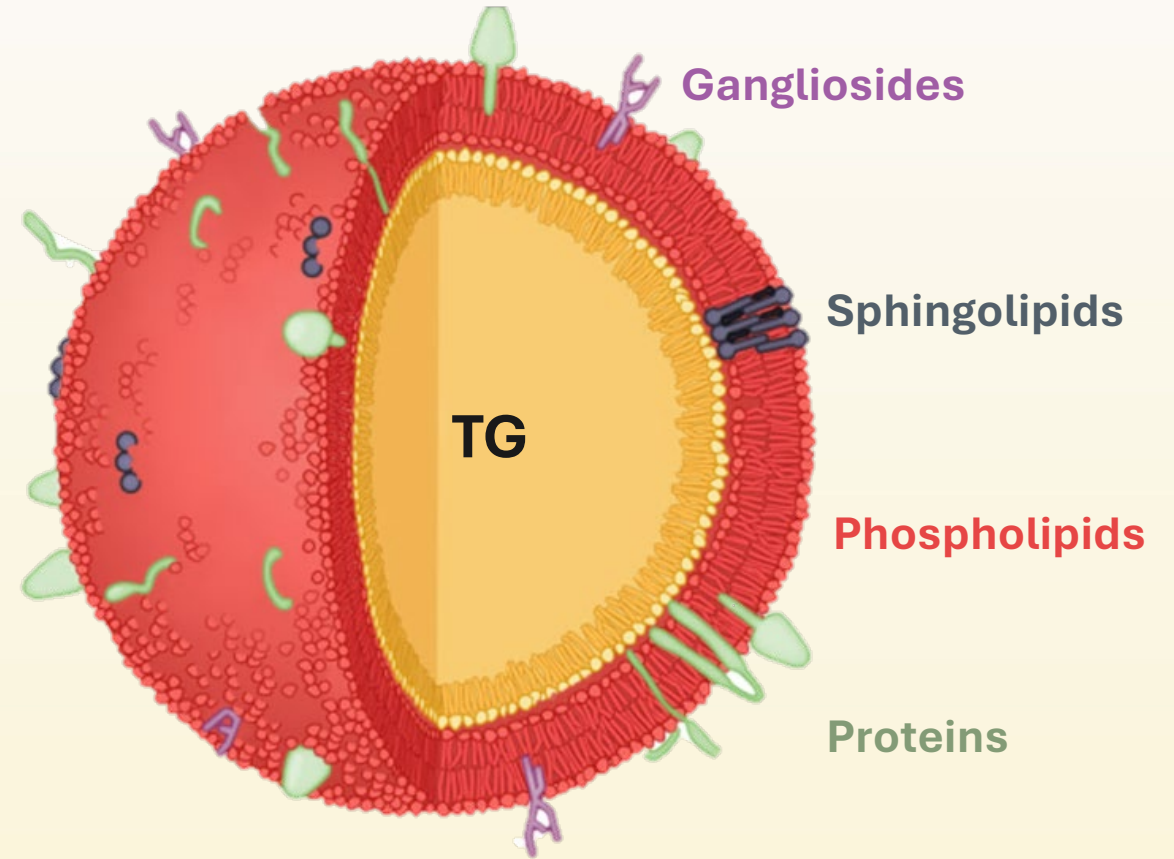


MFGM as a Source of Nutrients for Neurodevelopment

Myelin Sheath¹



MFGM²



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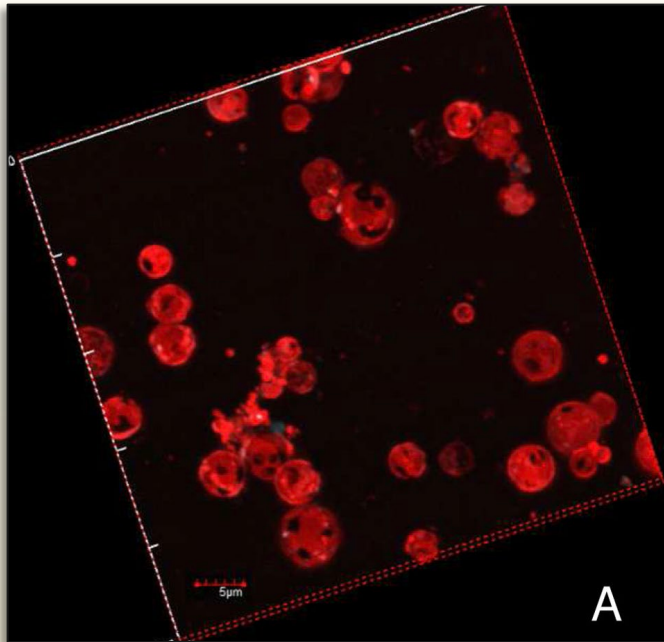
The Science & Structure of MFGM

MFGM Production & Manufacturing

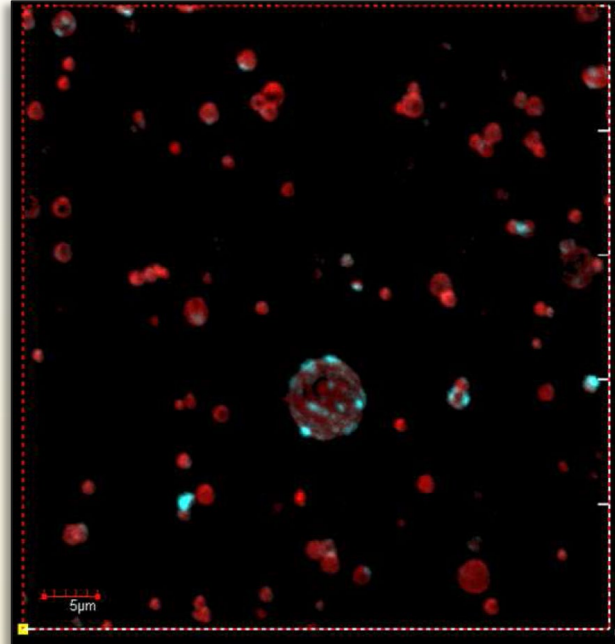


Effects of Processing on MFGM

MFGM From Raw Cream



MFGM From Pasteurized Cream

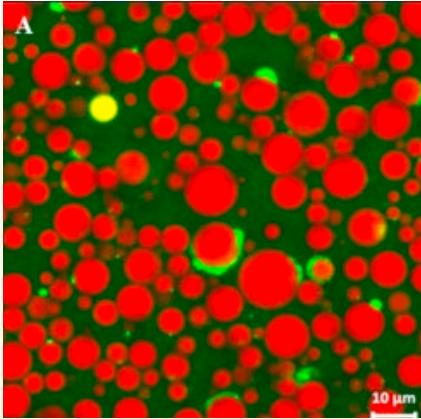


**With homogenization
and pasteurization,
fewer large fat globules,
higher amounts of
proteins (blue)**

Differences Between Lipids in Human Milk and Standard Infant Formula

Confocal Microscopy Images of Fat Droplets
Showing Lipids (Red) and Proteins (Green)¹

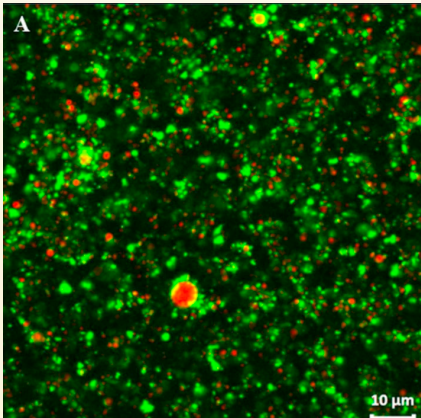
Human
milk



Characteristics of Human Milk Fat Droplets²

- High sphingomyelin content
- Dynamic across lactation stages
- Large fat globules (~5 μm)
- Phospholipid bilayer membrane

Standard
infant
formula



Characteristics of Standard Infant Formula Fat Droplets²

- High phospholipid content
- High phosphatidylcholine content
- Small fat globules (~0.2 μm)
- No phospholipid bilayer membrane

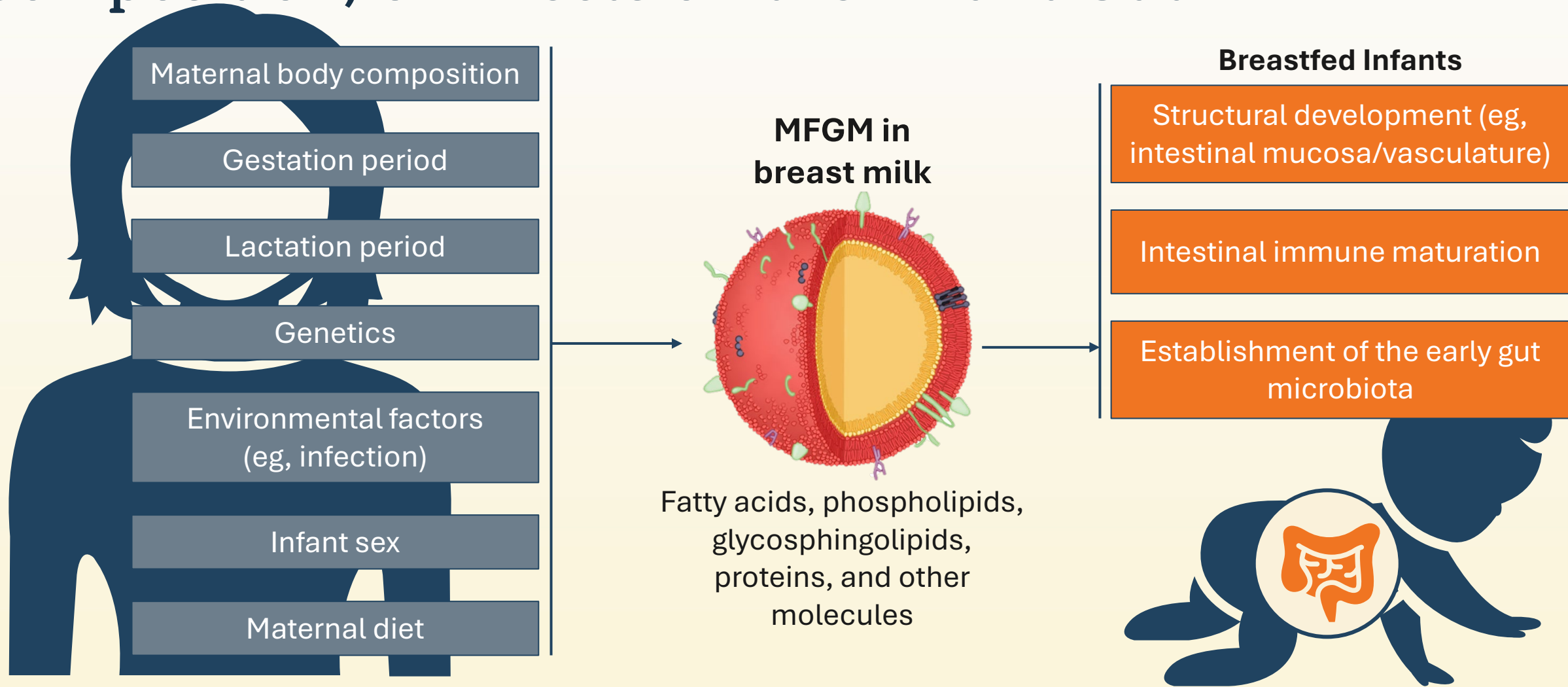


Mechanisms of Action of MFGM on Health

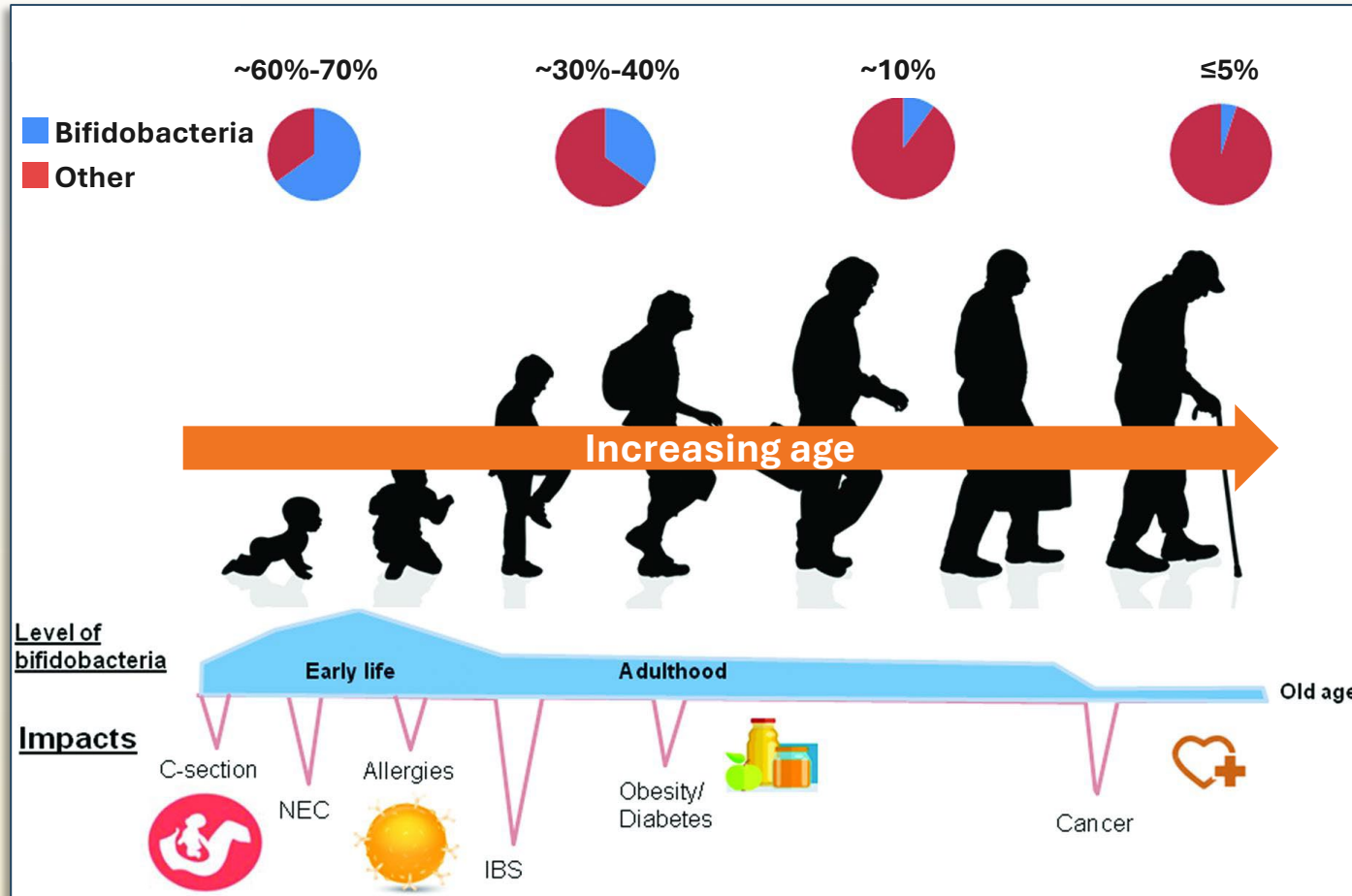
The Gut Microbiome



Maternal & Environmental Factors, MFGM Composition, & Effects on the Infant Gut



Bifidobacteria Populations Decline With Age



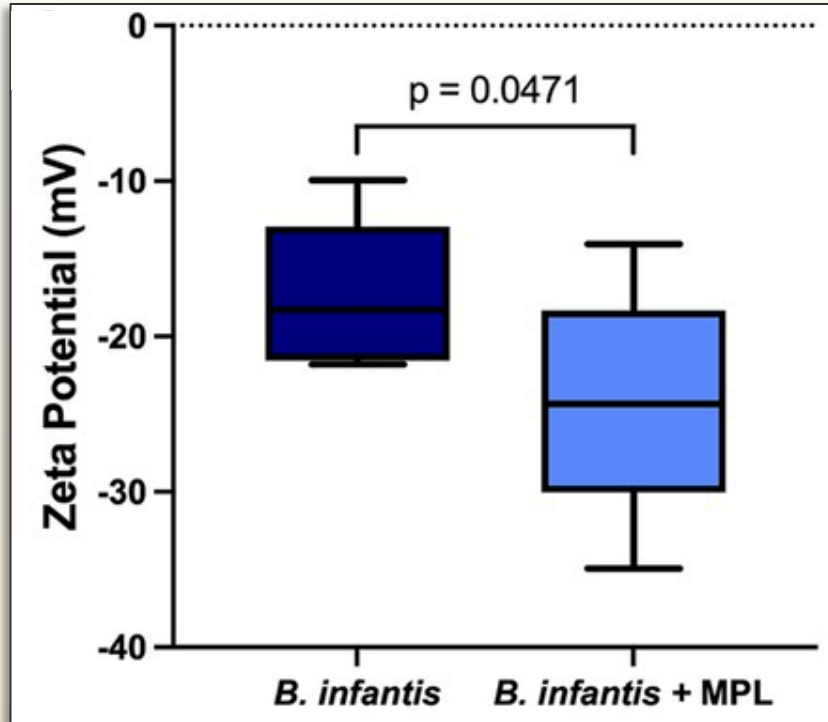
- Predominant genus in the gut microbiome of healthy breastfed infants
- May be beneficial for health across age ranges

How can we promote Bifidobacteria persistence?

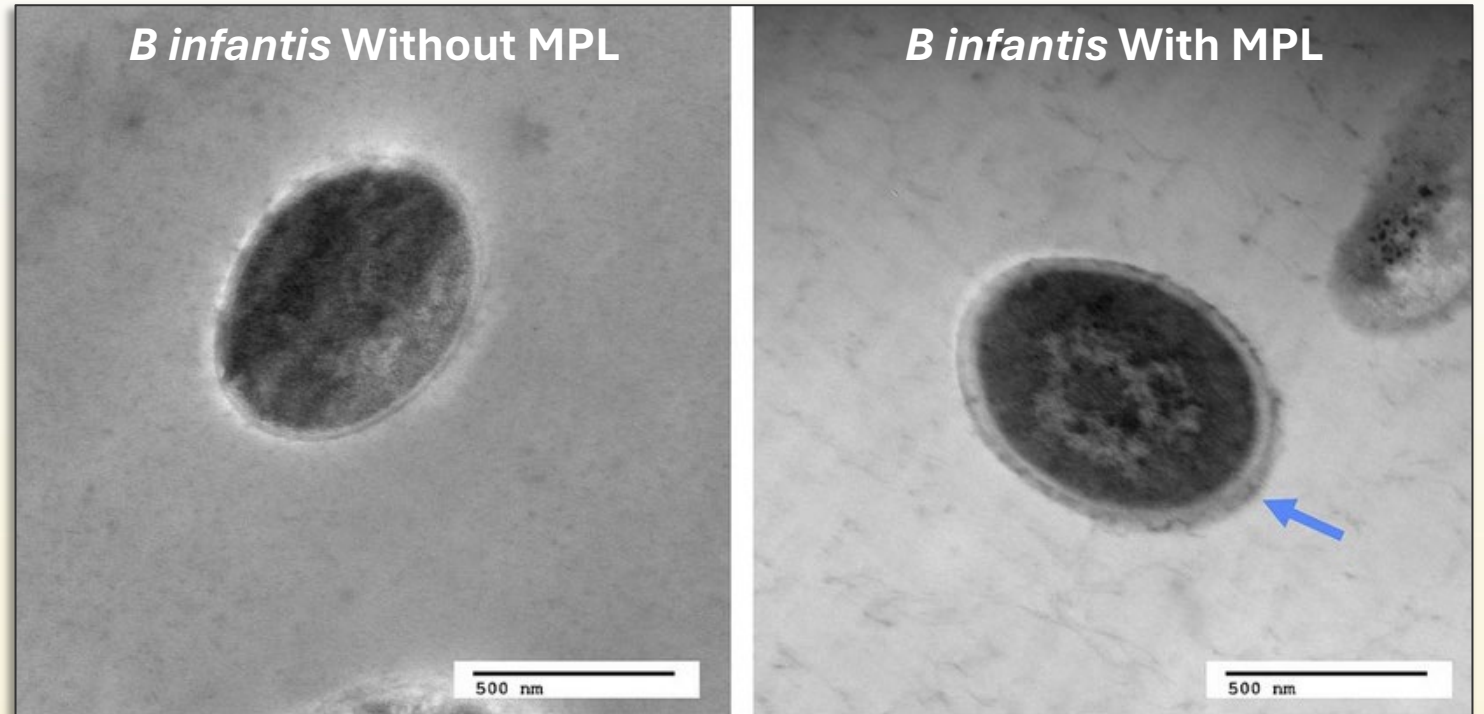
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Milk Phospholipid Protection of *Bifidobacterium longum* ssp *infantis* During In Vitro Digestion



Decreased surface charge of *B. infantis* with milk phospholipids



Thicker outer surface layer due to increase in bound polysaccharides in the presence of milk phospholipids

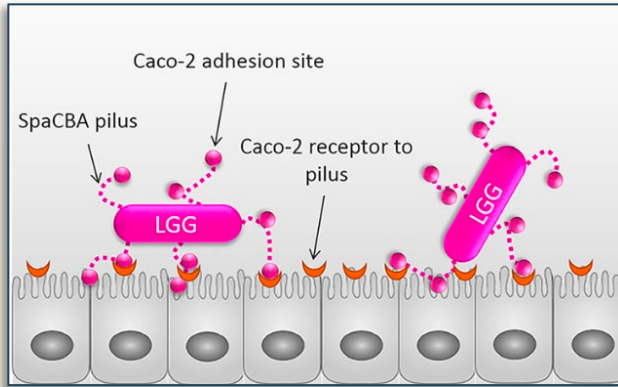
MPL, milk phospholipid

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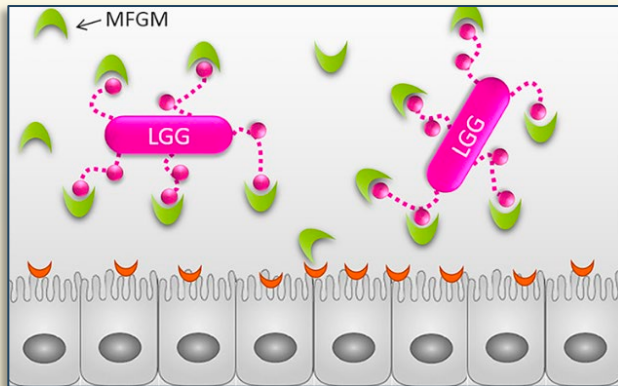
MFGM Modifies LAB Surface and Adhesive Properties

LGG in the GI Tract Without MFGM¹



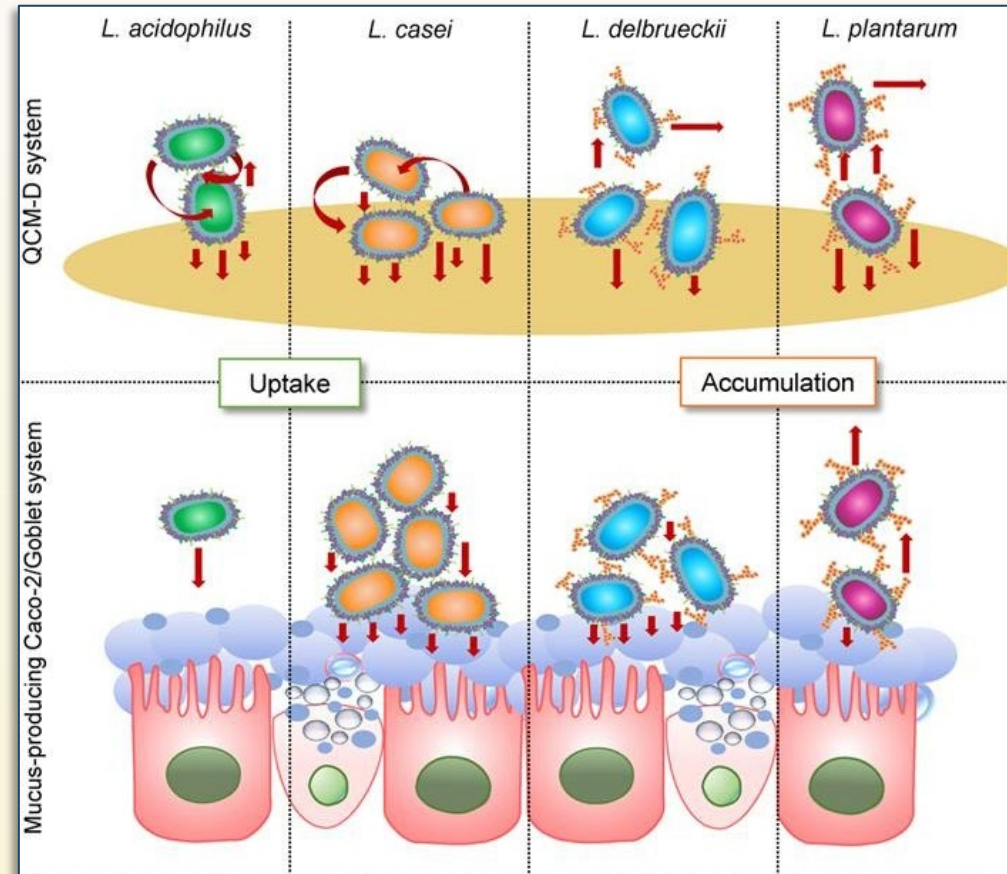
Bacterial adhesion to Caco-2 TC7 intestinal cells

LGG in the GI Tract With MFGM¹



Inhibition of bacterial adhesion to Caco-2 TC7 intestinal cells

Differential Adhesion Behavior After Treatment With MFGM²



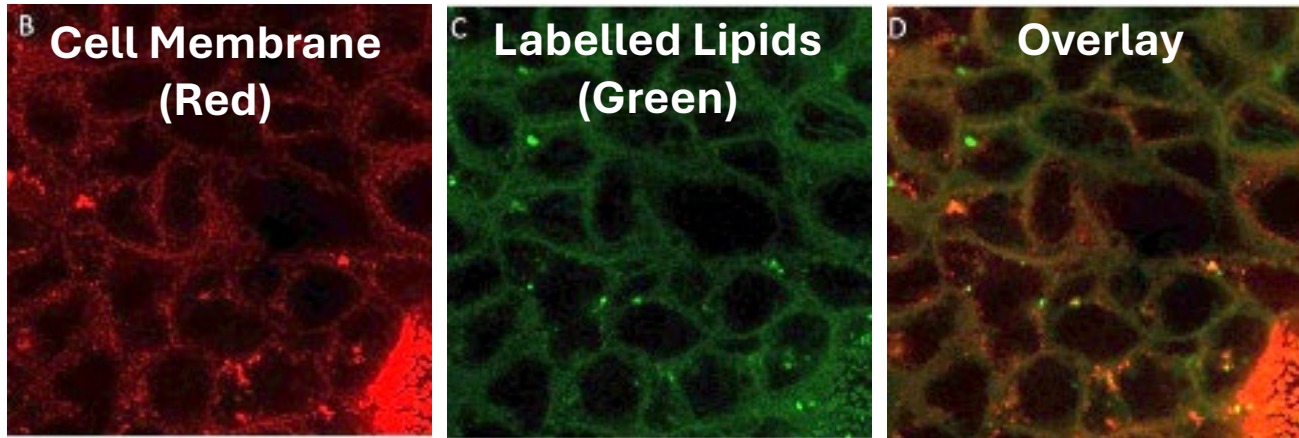
Strain-dependent effects of milk phospholipids on bacterial surface properties and subsequent adhesion

LAB, lactic acid-producing bacteria; LGG, *Lactobacillus rhamnosus* GG; QCM-D, quartz crystal microbalance with dissipation monitoring.



MFGM Phospholipids and the Intestinal Epithelial Barrier

Caco-2 Cells After Incubation With Labelled MFGM



Evidence of fusion between the intestinal cell plasma membrane and the phospholipids in MFGM

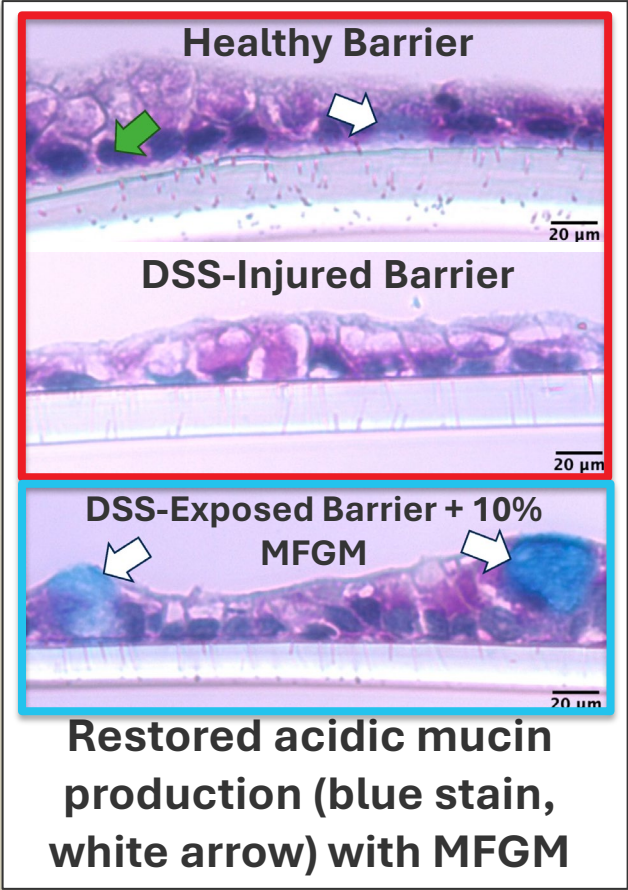
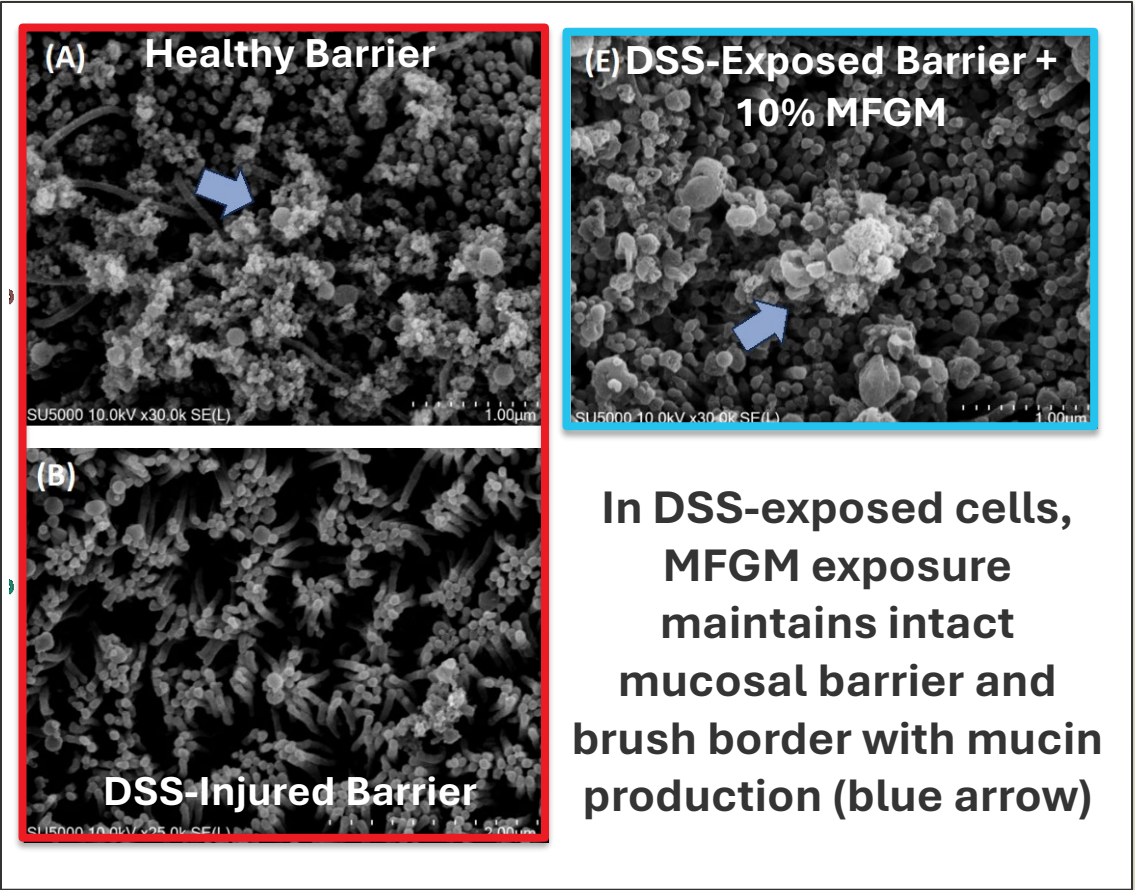
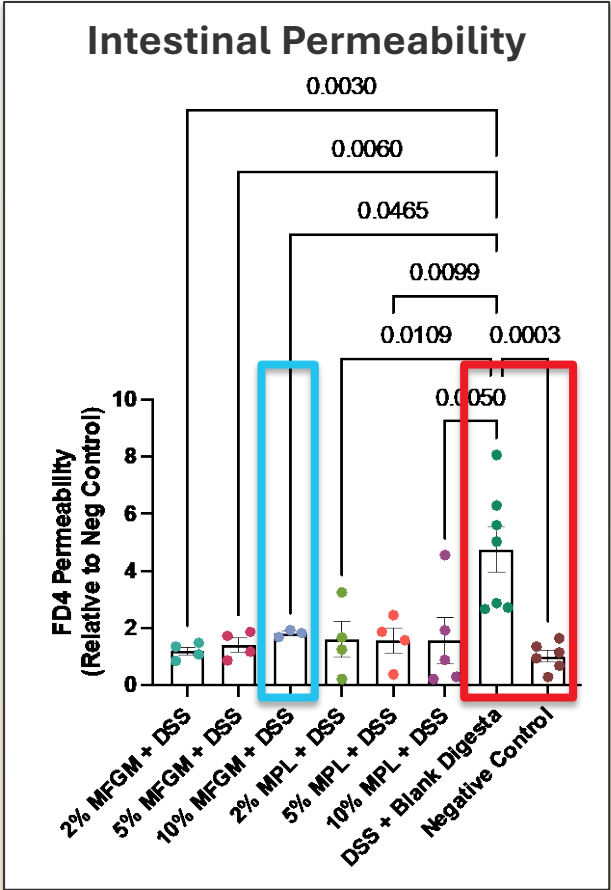
After incubation with MFGM, Caco-2 cells had significant changes in lipid composition:

- ↑ Triacylglycerols (TAG)
- ↑ Phosphatidylcholine
- ↓ Cholesterol esters

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MFGM Facilitates Maintenance of the Intestinal Barrier Integrity



DSS, dextran sodium sulfate
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Mechanisms of Action of MFGM on Health

The Gut-Brain Axis



The Gut-Brain Axis: Mediating the Effects of MFGM

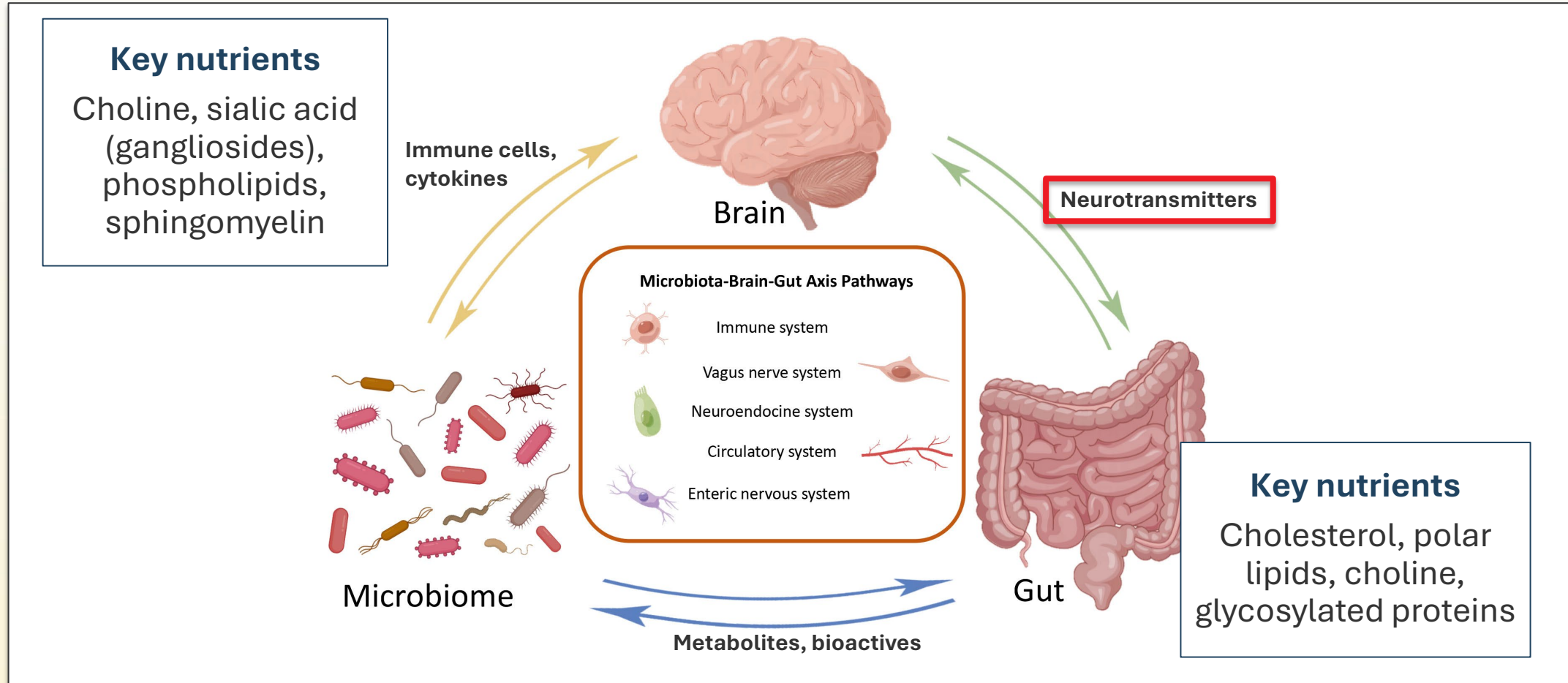
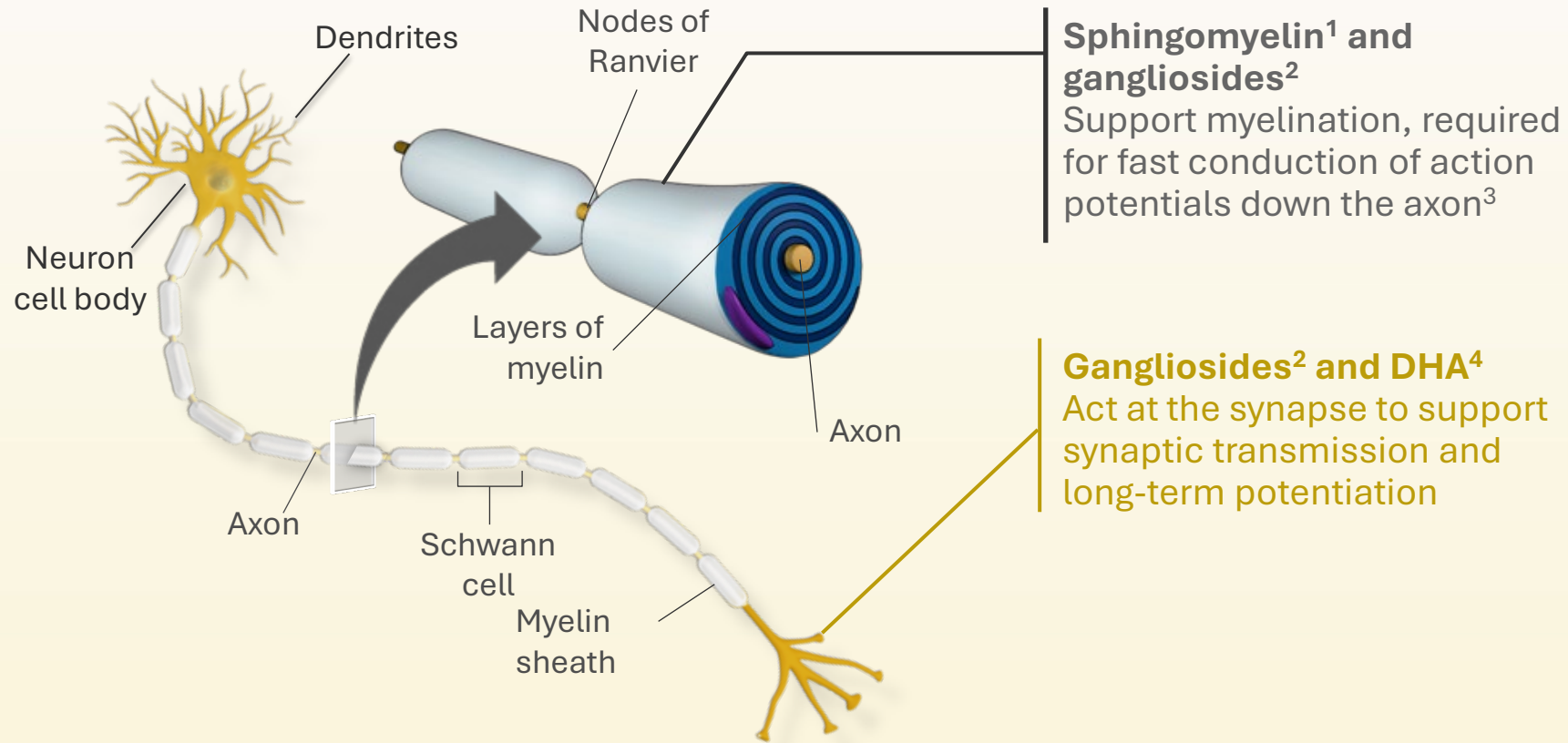


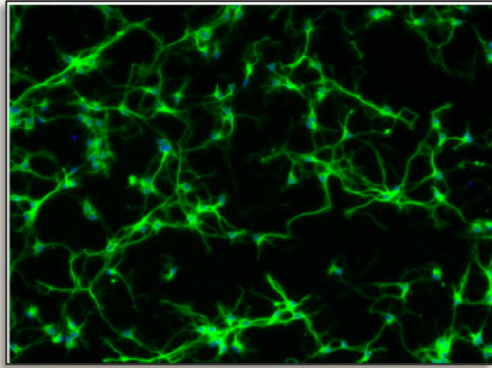
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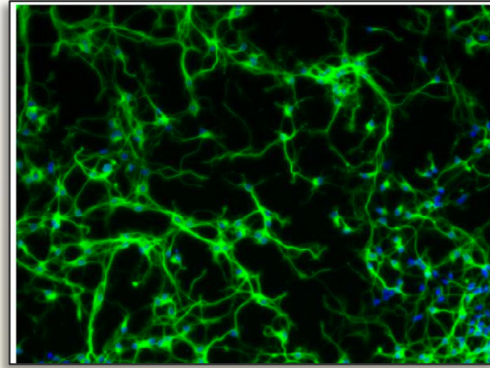
MFGM Components Support Nerve Myelination and Synaptic Transmission



Dairy Phospholipids Support Cortical Neuron Growth & Stimulation

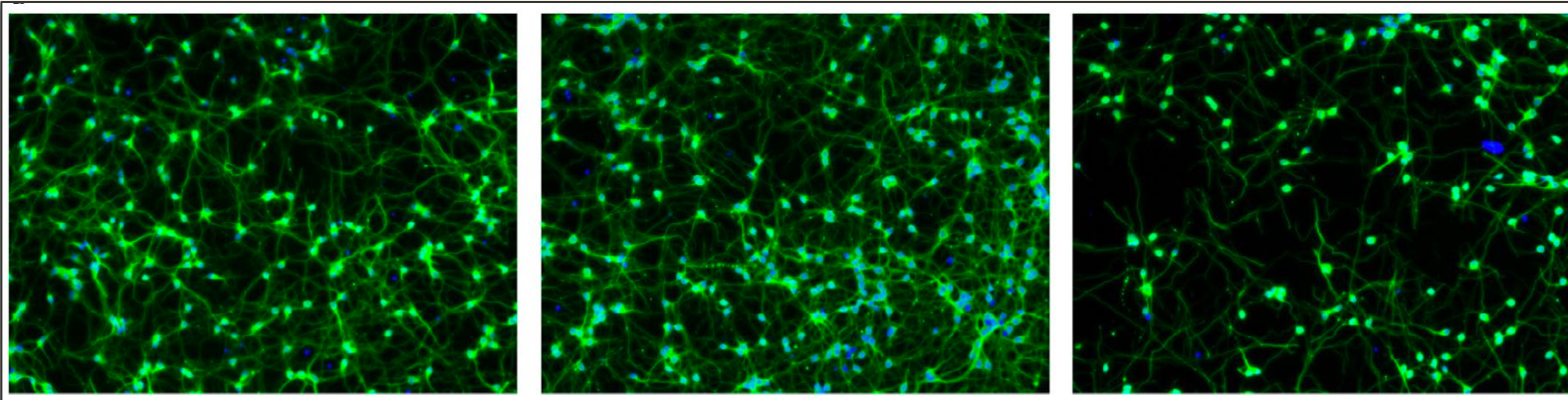


Untreated neurons
Negative control



FCS-treated neurons
Positive control

Increasing phospholipid extract concentration



Cortical neuron outgrowth increases after incubation with phospholipid extract

FCS, fetal calf serum



Key Takeaways

- MFGM is a complex structure enveloped by a lipid trilayer containing bioactive lipids, proteins, and carbohydrates
- MFGM has an important role in the health outcomes of the developing infant
- MFGM and its lipid constituents:
 - Fortify the mucosal barrier to protect against intestinal barrier disruption through mucin regulation
 - Facilitate healthy gut microbiota
 - Play a role in the gut-brain axis, likely via the intestinal neuronal system



Gracias!



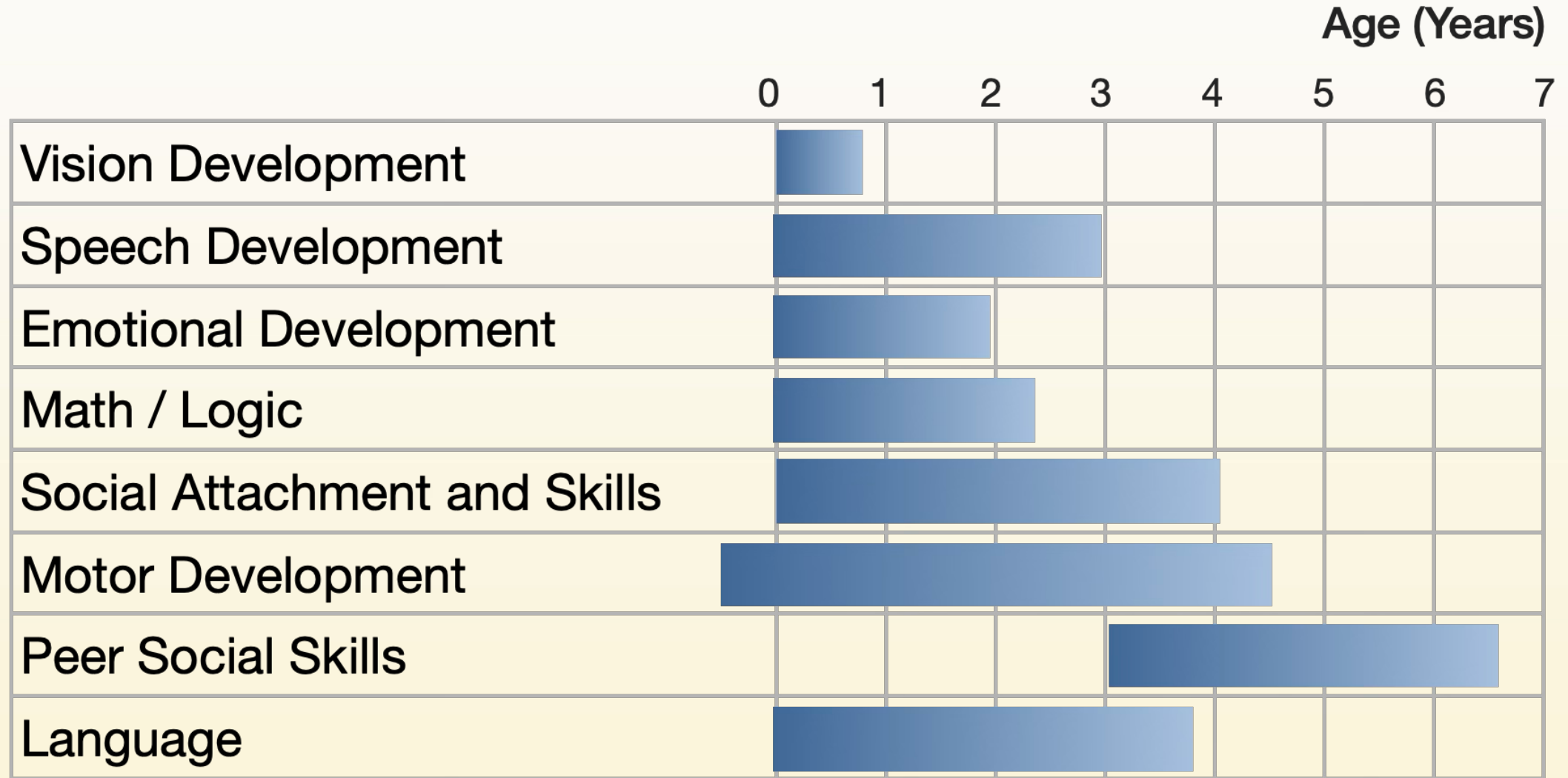
MFGM & the Developing Brain

Early Brain Development

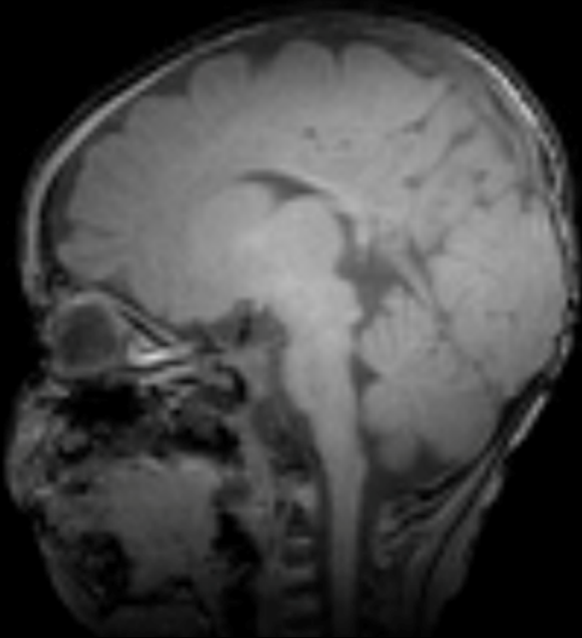
Sean Deoni, PhD



Early Cognitive and Behavioral Development



Early Brain Development



3 months

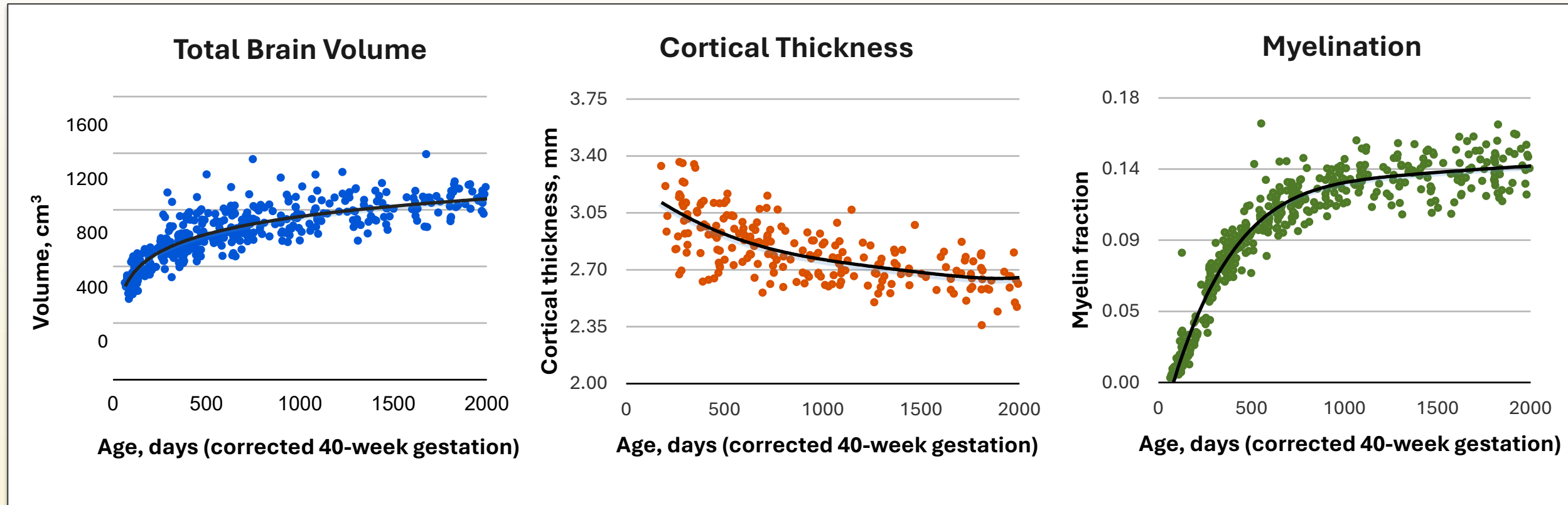


12 months

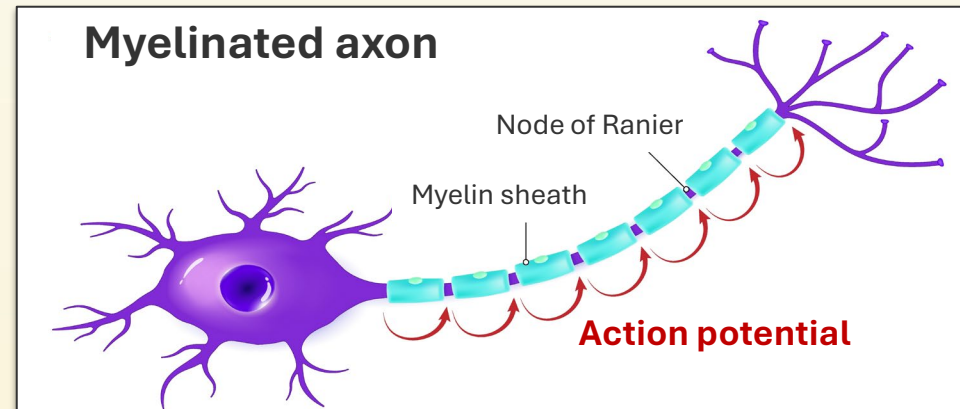
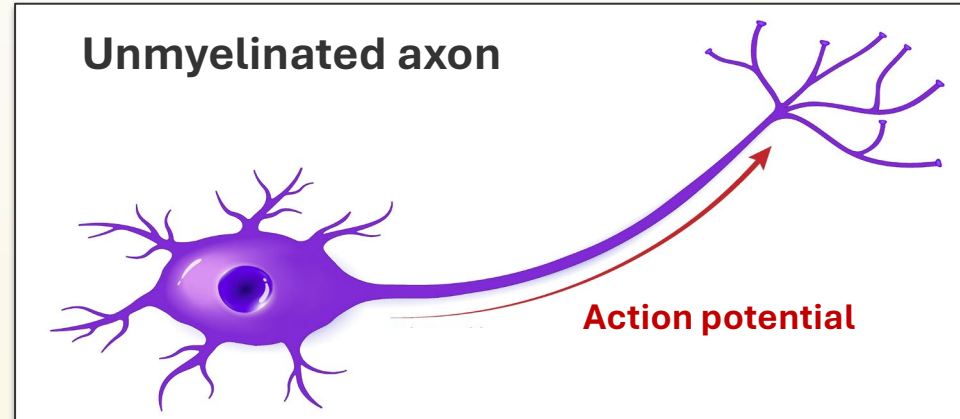


24 months

Measures of Neurodevelopment With Age



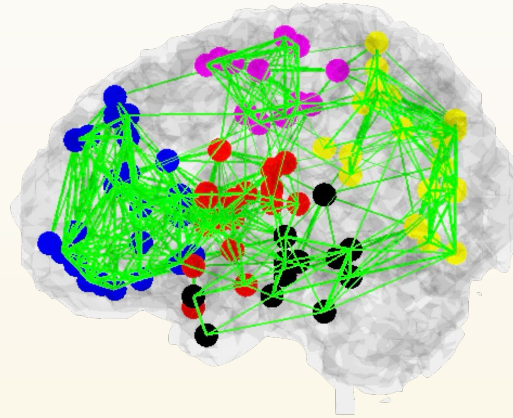
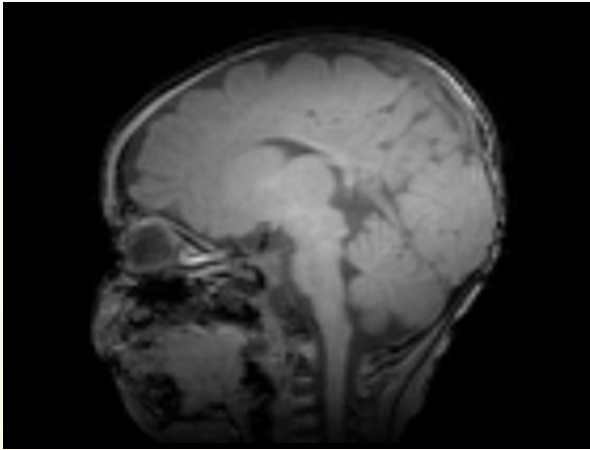
Myelination in the Developing Brain



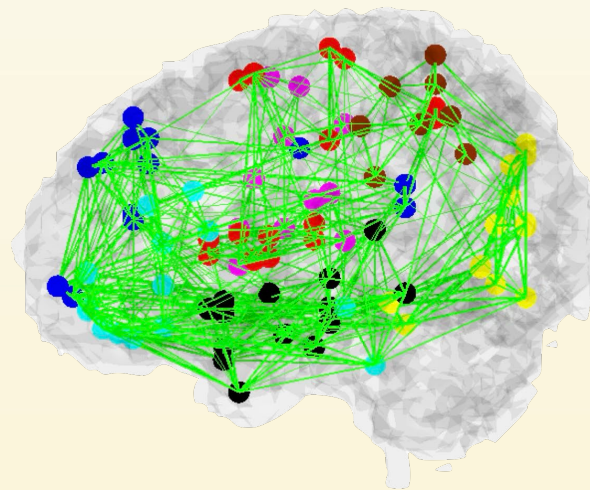
Myelin protects the axon, speeds information transfer, and facilitates brain connectivity & function



Myelination in the Developing Brain



Simplistic behaviors and
primary cognitive abilities



Complex behaviors and
coordinated cognitive skills



MFGM & the Developing Brain

Nutrition, Human Milk, & Neurodevelopment



Nutritional Needs for the Developing Brain

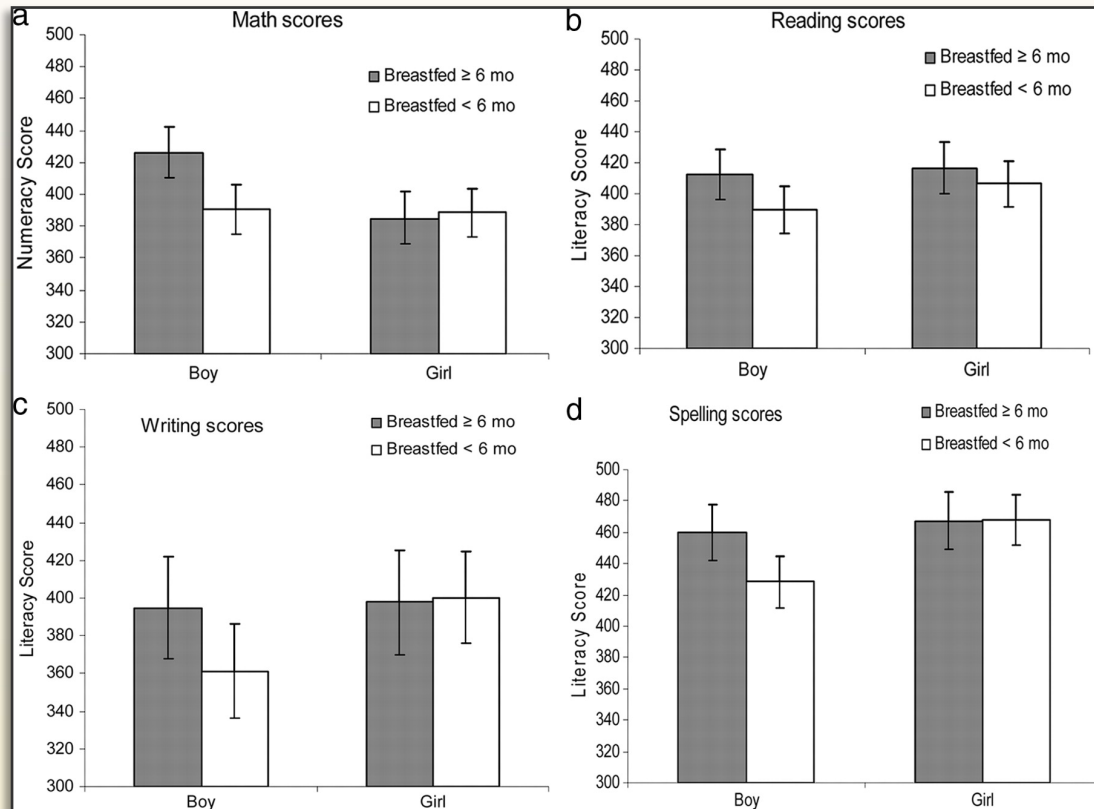
Lipids & Fatty Acids	Minerals	Vitamins	Micronutrients
LC-PUFAs (eg, DHA, ARA) - Promote healthy neural growth and development - Regulate membrane function - Involved in lipid biosynthesis and myelination ~20% of the fatty acid content of the brain Phospholipids (eg, phosphatidylcholine) ~10% of the lipid weight of myelin Sphingolipids (eg, sphingomyelin) - Critical components of the myelin sheath Cholesterol - Essential constituent of myelin - Necessary for myelin membrane synthesis	Iron - Utilized by oligodendrocytes (myelin-producing cells) Zinc - Helps bind myelin basic proteins to the myelin membrane	B12 - Helps convert L-methylmalonyl coenzyme A into succinylcholine coenzyme A - Required for synthesis of myelin phospholipids Vitamin K - Can increase sulfatides, which are incorporated into the myelin sheath to maintain structure and function	Choline Promotes oligodendrocytes and their precursors, influencing myelination and remyelination

Breastmilk provides all of these nutrients – with the exception of iron – at the right time and in the ideal amount.



Breastfeeding & Child Neurodevelopment

Studies consistently show improved cognitive development and academic outcomes in individuals who were breastfed as infants; enhanced as a function of breastfeeding duration.



Original Article

May 2008

Breastfeeding and Child Cognitive Development New Evidence From a Large Randomized Trial

Michael S. H

» Author A

Arch Gen Ps

Research | [Open access](#) | Published: 29 September 2020

Associations between breastfeeding and cognitive function in children from early childhood to school age: a prospective birth cohort study

[Kyoung](#)

[Internat](#)

Effect of Breastfeeding Duration on Cognitive Development in Infants: 3-Year Follow-up Study

[Hyungmin Lee](#)¹, [Hyewon Park](#)², [Eunhee Ha](#)³, [Yun-Chul Hong](#)⁴, [Mina Ha](#)⁵, [Hyesook Park](#)³, [Bung-Nyun Kim](#)⁶, [Boeun Lee](#)⁷, [Soo-Jeong Lee](#)⁸, [Kyung Yeon Lee](#)⁹, [Ja Hyeong Kim](#)⁹, [Kyoung Sook Jeong](#)¹⁰, [Yangho Kim](#)^{11,✉}

» Author info

PMCID: PMC4

Breast-feeding and cognitive development: a meta-analysis * 2

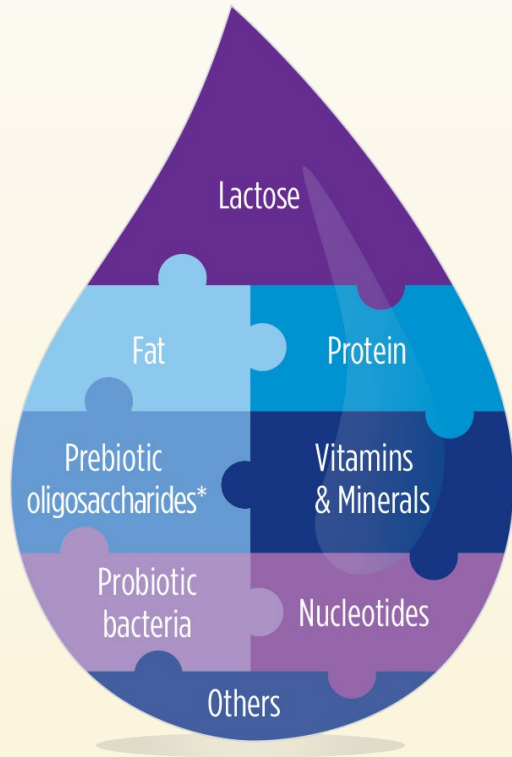
[Anderson James W](#)¹ ✉, [Johnstone Bryan M](#)¹, [Remley Daniel T](#)¹

[Show more](#) ✓

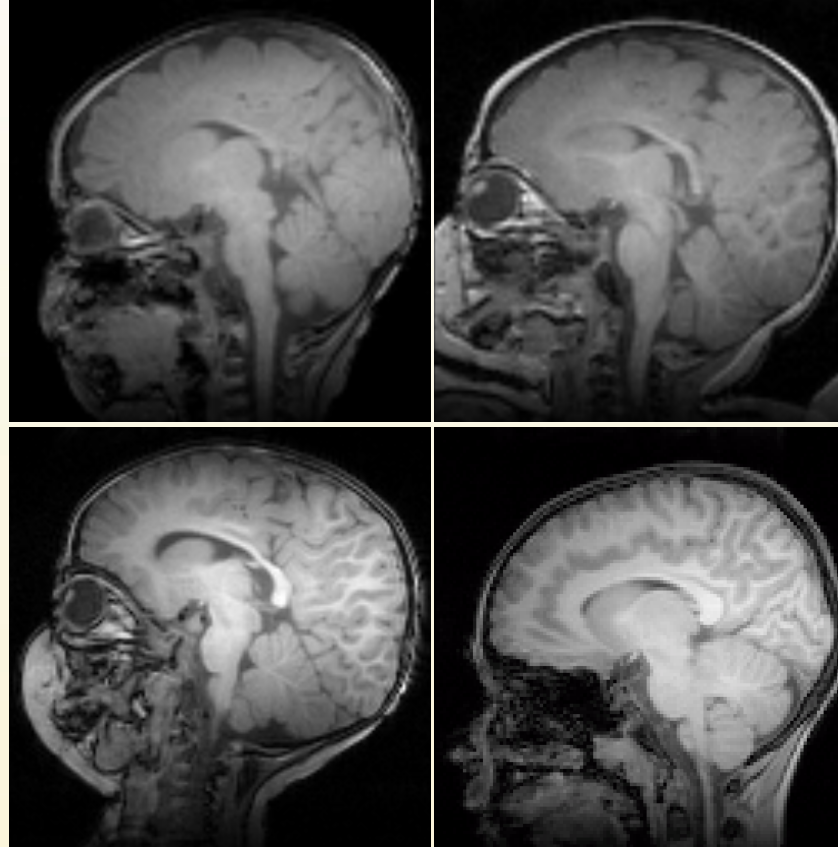


Potential Underlying Biological Mechanism

Human Milk Nutrients



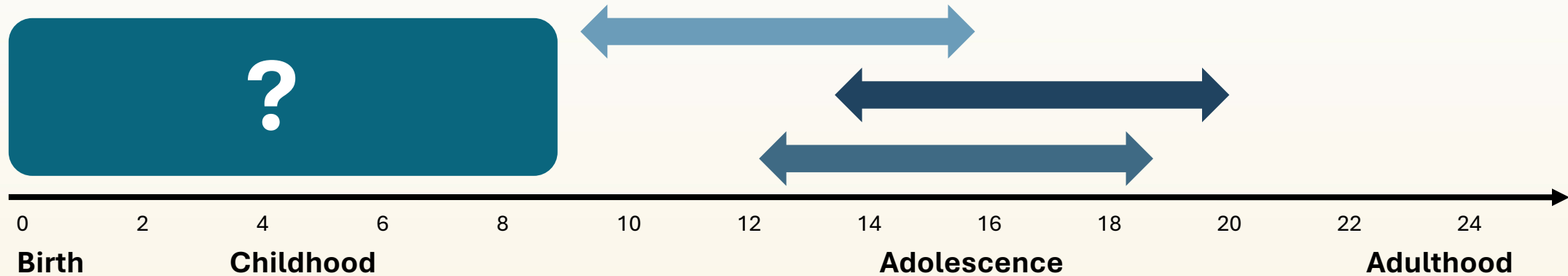
Brain Development



Cognitive Development



Nutrition & Early Neurodevelopment



Duration of breastfeeding associated with:¹

- Cortical thickness in the superior and inferior parietal lobes
- Performance IQ

Percentage of breast milk in diet associated with:²

- Verbal IQ
- White matter volume

Relative to formula-fed infants, breastfed infants had:³

- Higher IQ scores
- Larger total gray matter, and subcortical gray matter volumes

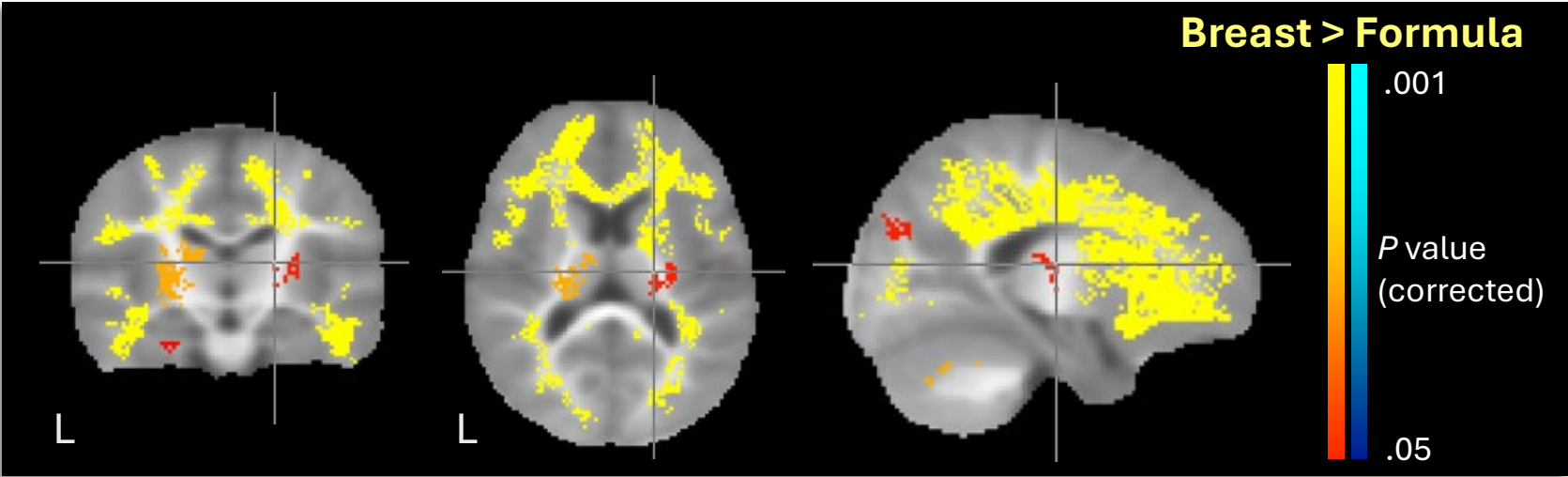


The Challenges of Pediatric MRI



Breastfeeding & Neurodevelopment (Cross-Sectional Study)

Matched cohort study of toddlers (6-60 months of age) who were exclusively breastfed (n = 62) or formula fed (n = 38) for at least 3 months.

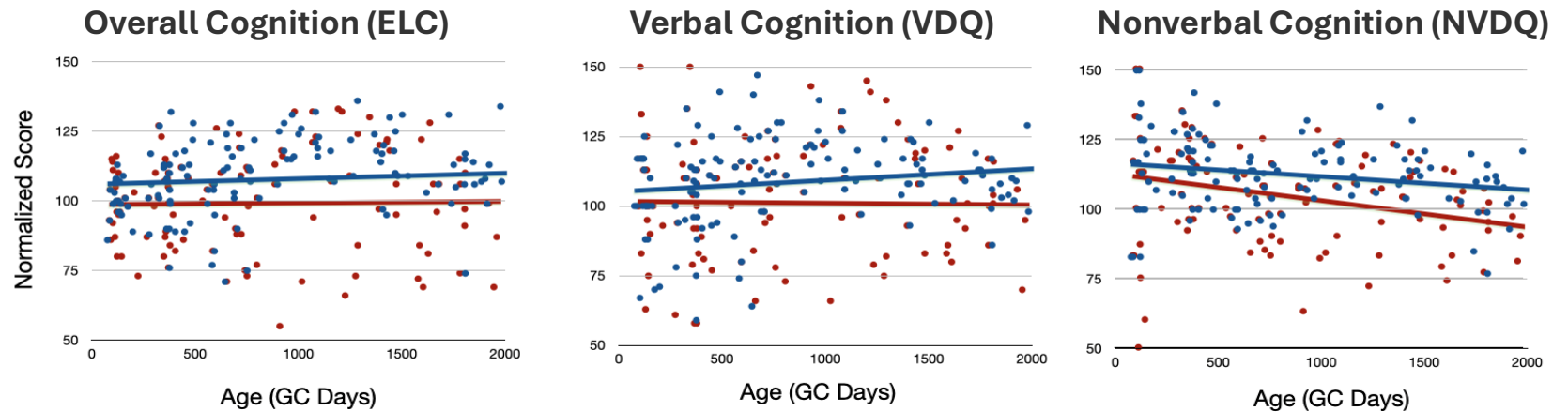
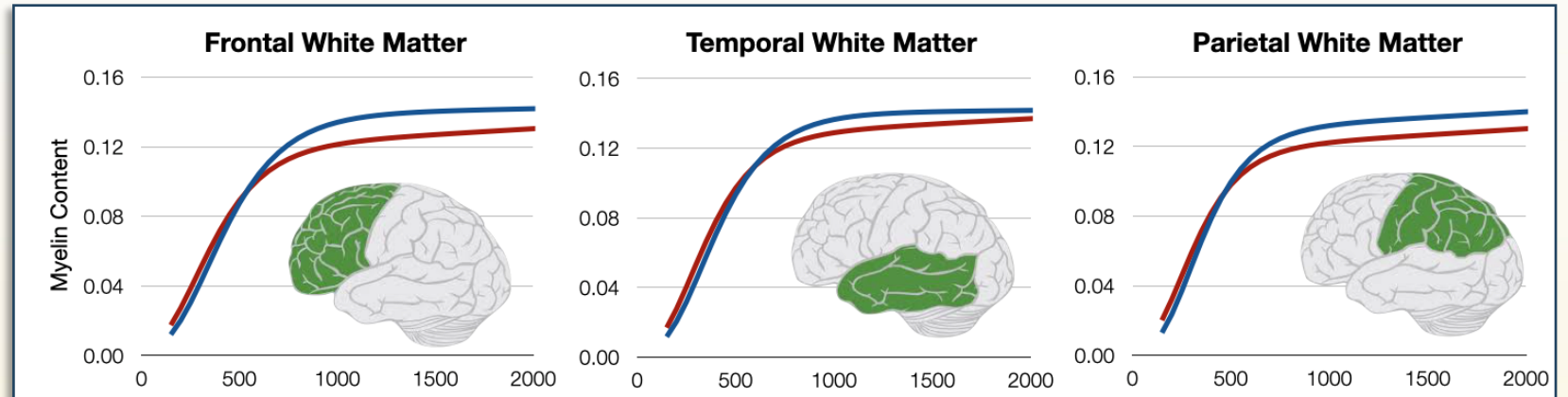


	Exclusively breastfed	Exclusively formula fed	P value
Fine motor	64.8 ± 10.9	56 ± 7.7	<.0001
Visual reception	56.2 ± 8.7	51.3 ± 10.8	.0085
Receptive language	61.9 ± 7.7	49.3 ± 12.5	<.0001
Expressive language	50.5 ± 13	43.3 ± 13.3	.0063



Breastfeeding & Neurodevelopment (Longitudinal Study)

Matched cohort study of toddlers (2-76 months of age) who were exclusively breastfed (n = 62) or formula fed (n = 88) for at least 3 months.

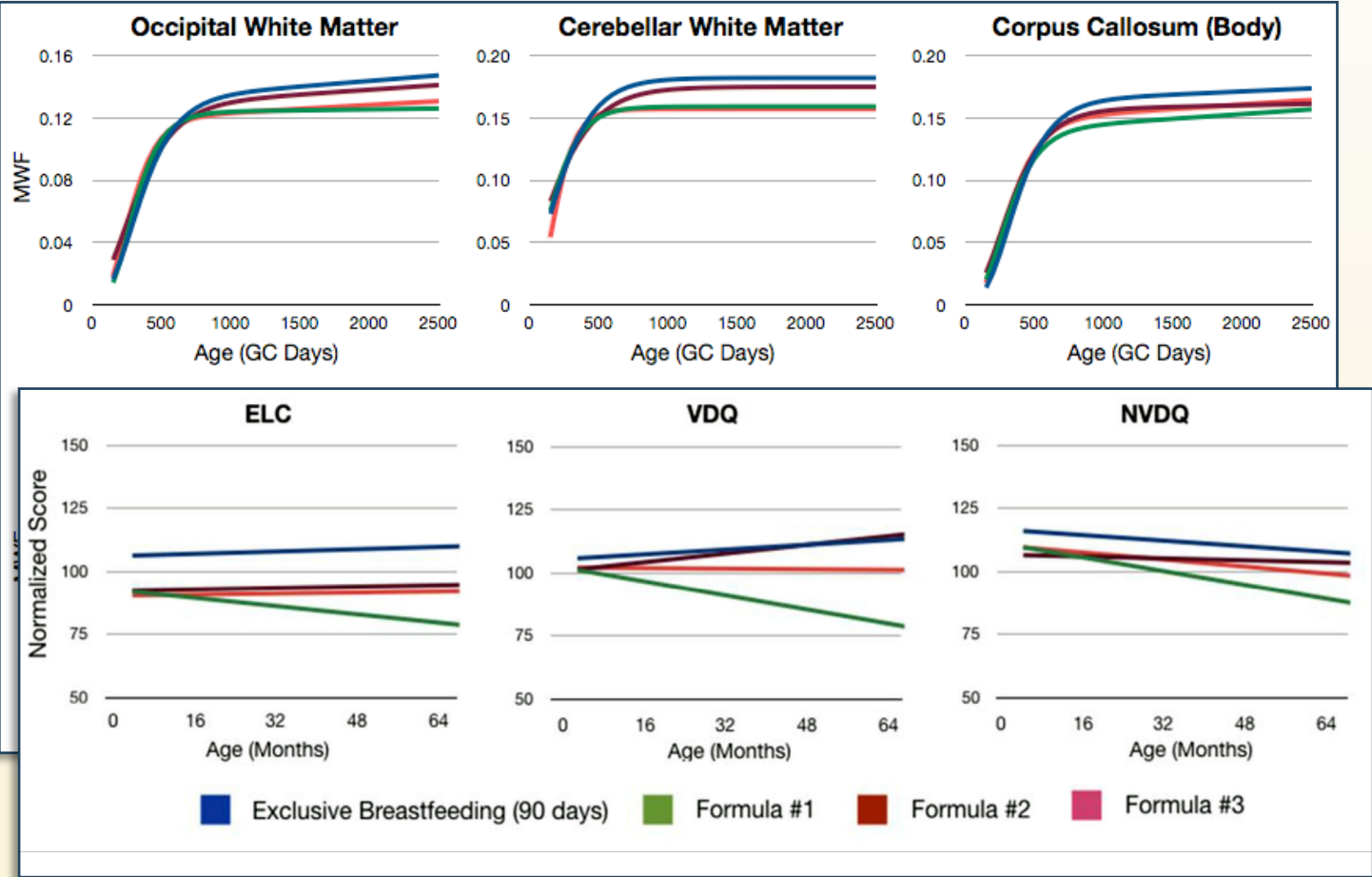


*Significant differences in all growth model parameters between groups **Breastfed** **Formula fed**



Influence of Nutrition Intake

Nutrient	Formula 1	Formula 2	Formula 3	% Difference (Min-Max)
ARA (mg/L)	173	238	255	32
DHA (mg/L)	62.2	117	120.6	48
Folic Acid (µg/L)	304	232	146.2	52
Phosphatidylcholine (mg/L)	85	58	60	29
Sphingomyelin (mg/L)	28.1	62	28.1	55
Iron (mg/100g)	10.6	8.42	11.65	28
Choline (mg/100)	170	92.5	144	46

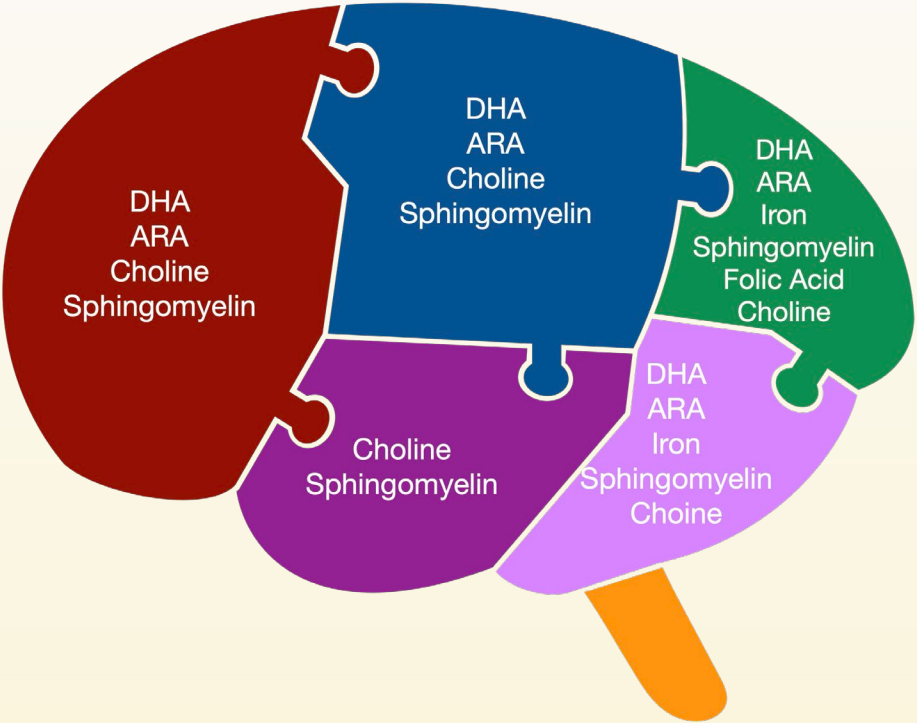


*Significant differences in intercept and slope between **formula #1** and **breastfeeding** and other formulas;
*General difference in intercept of each formula and **breastfeeding** in ELC scores

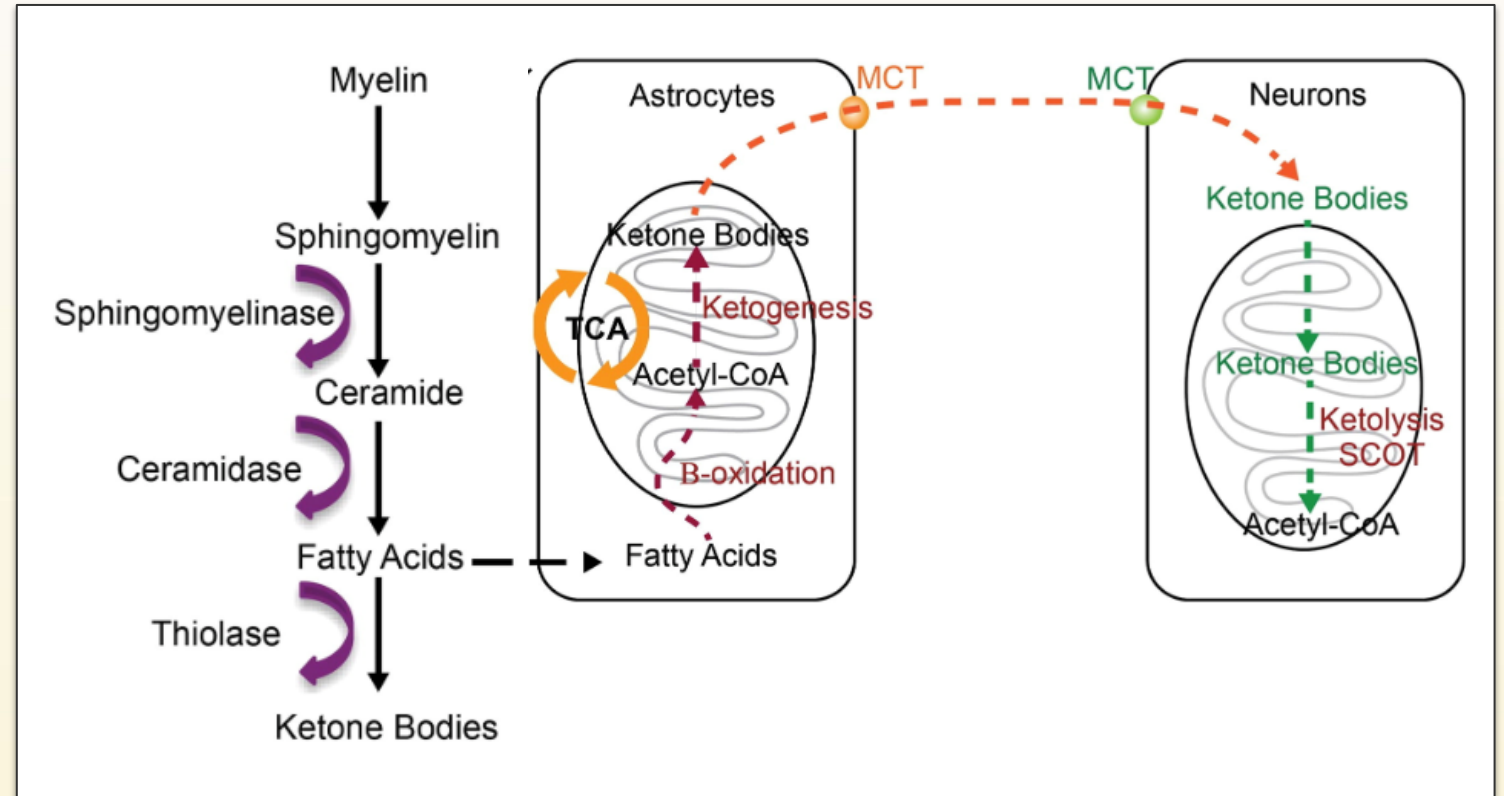
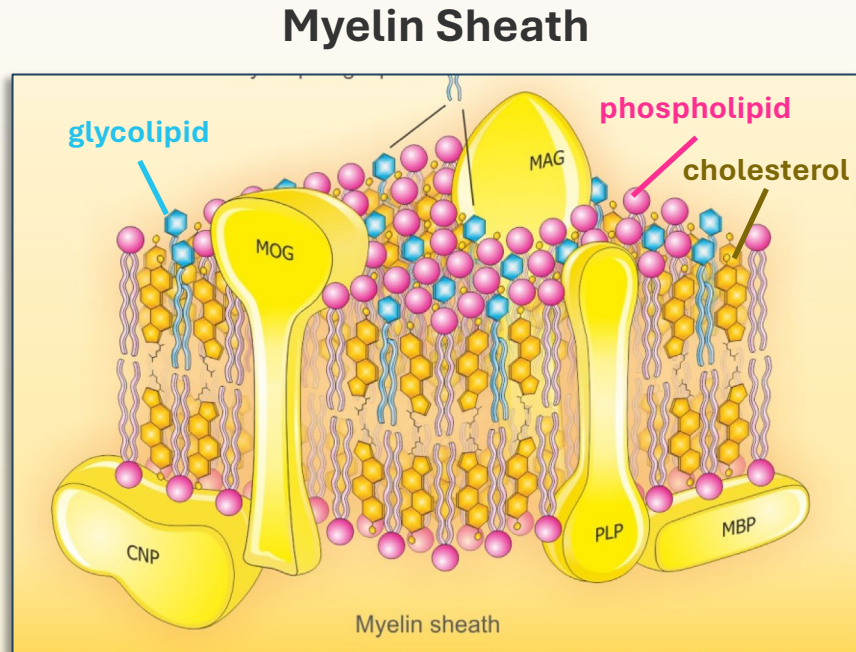


Nutrition Differentially Impacts Regional Growth

Region	ARA	DHA	Folic acid	Phosphatidylcholine	Sphingomyelin	Iron	Choline
Frontal WM	.002	.002	.030	<.0001	<.0001	.150	.004
Temporal WM	.040	.030	.170	.004	.002	.340	.260
Parietal WM	<.0001	<.0001	.005	<.0001	<.0001	.080	.080
Occipital WM	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	.006
Cerebellar WM	<.0001	<.0001	.013	<.0001	<.0001	<.0001	.020
Corpus callosum (body)	.003	.020	.450	<.0001	<.0001	.280	.076
Corpus callosum (genu)	.090	.150	.630	<.0001	<.0001	.270	.430
Corpus callosum (splenium)	.050	.020	.760	<.0001	<.0001	.560	.860

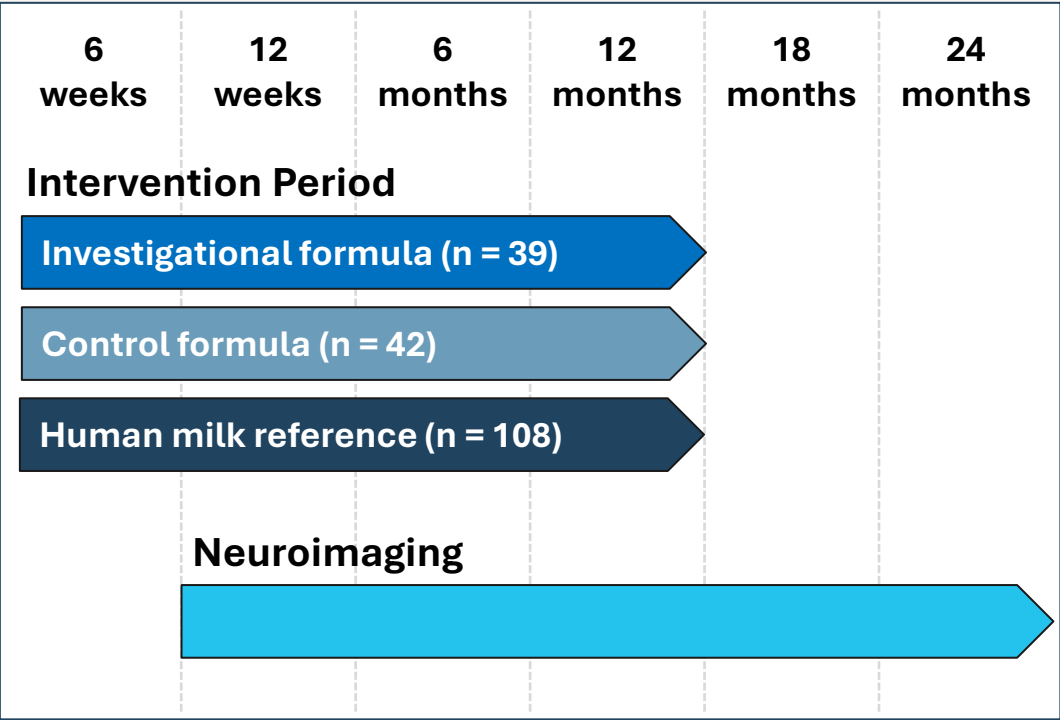


Nutrition Differentially Impacts Regional Growth



Testing the Role of Sphingomyelin and Other Nutrients in Neurodevelopment

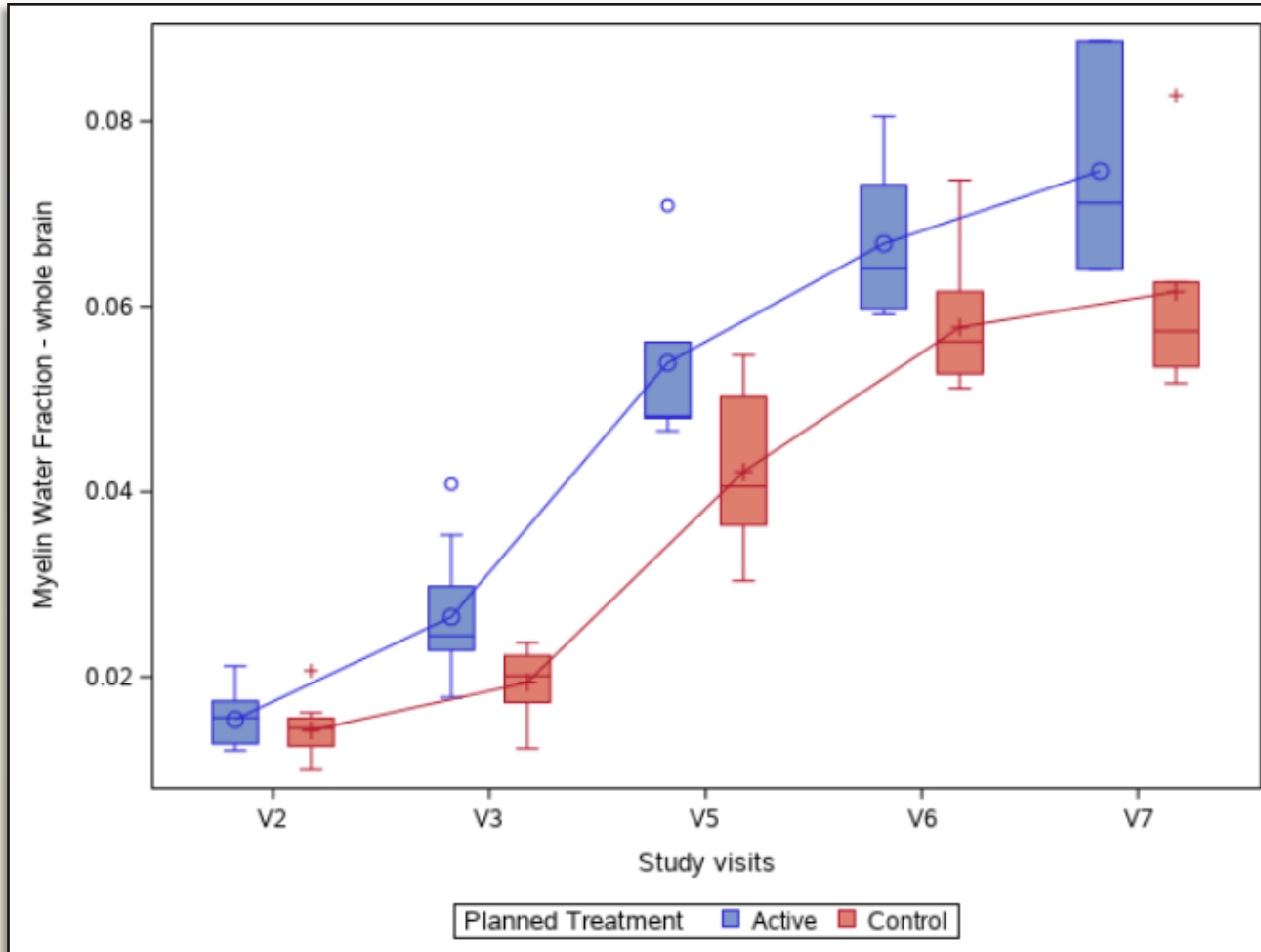
Design of a Nutritional RCT Investigating Sphingomyelin Intake and Myelination



Nutrients	Investigational Formula	Control Formula	Human Milk Reference ^a
Energy, kcal/200 mL	132	132	
Myelin blend			
Sphingomyelin (mg/L)	105	22	86.7
DHA (mg/L)	132	71	89.8
ARA (mg/L)	132	71	172.0
Iron (mg/L)	8.6	4.0	0.3
Folate (µg/L)	219	85	24.5

a. 3- and 6-month average

Longitudinal Patterns of Myelination



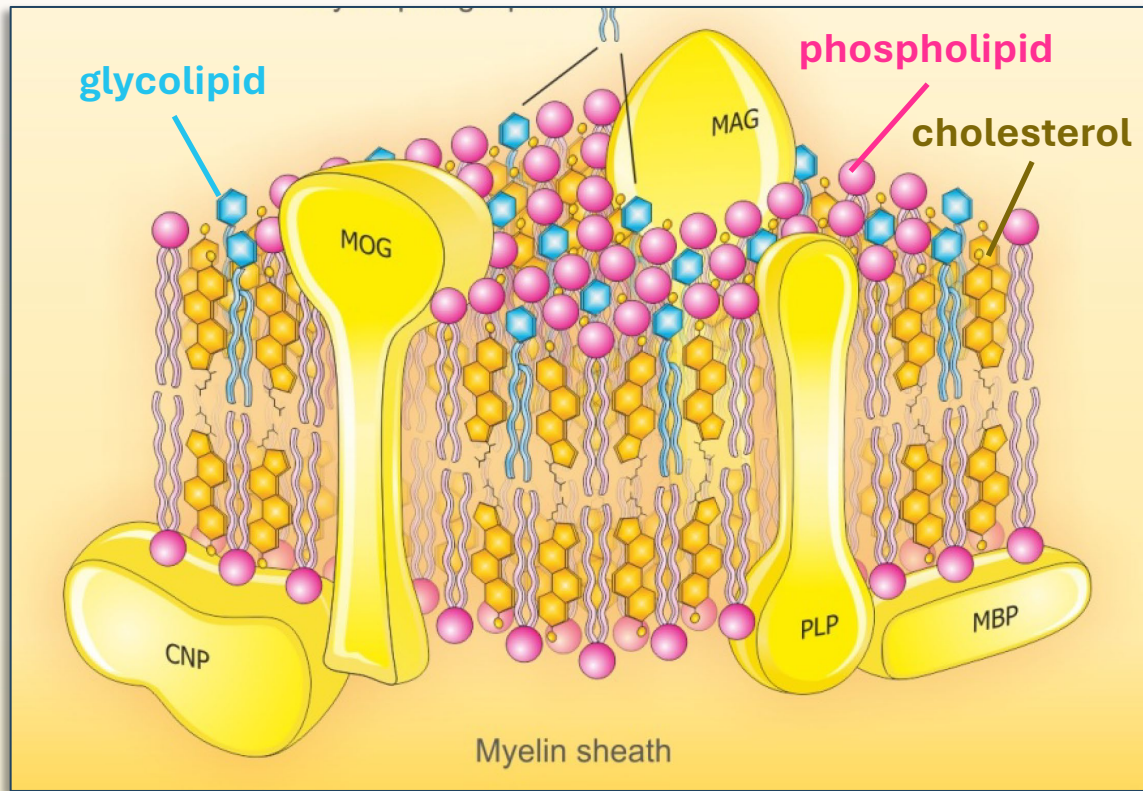
Compared with infants fed the control formula, those fed the interventional formula had:

- Significantly increased brain myelin content at 3, 6, 12, and 24 months of age
- Significantly increased rate of myelination throughout the first year of life

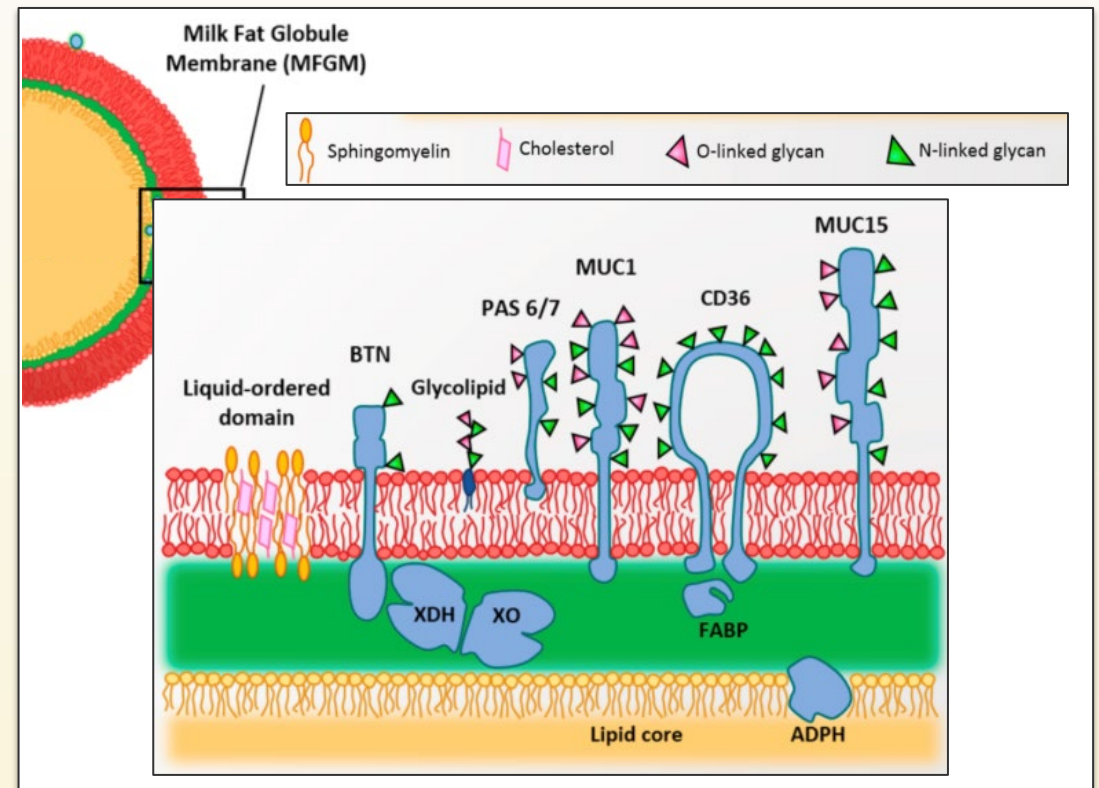


MFGM As a Source of Myelin Nutrients

Myelin Sheath



MFGM



MFGM As a Source of Myelin Nutrients

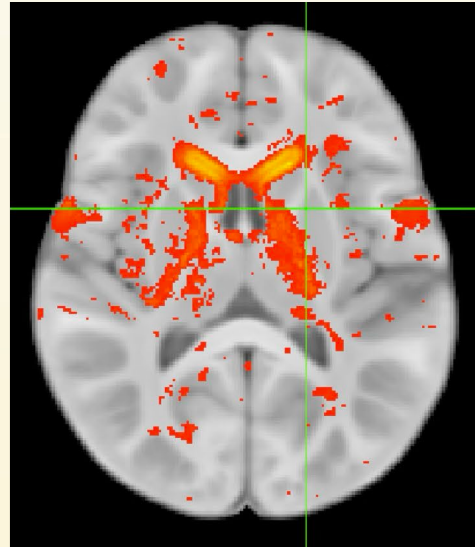
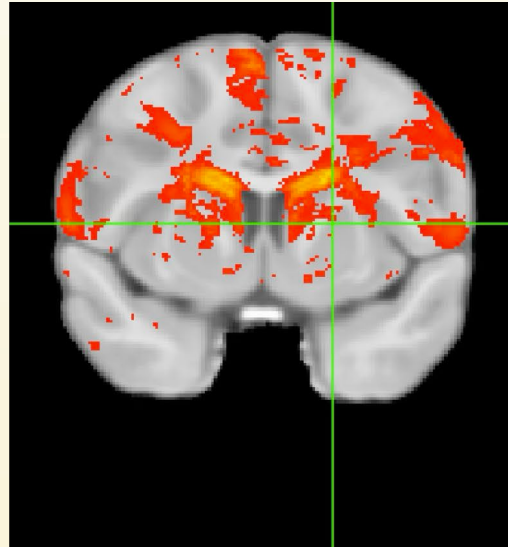
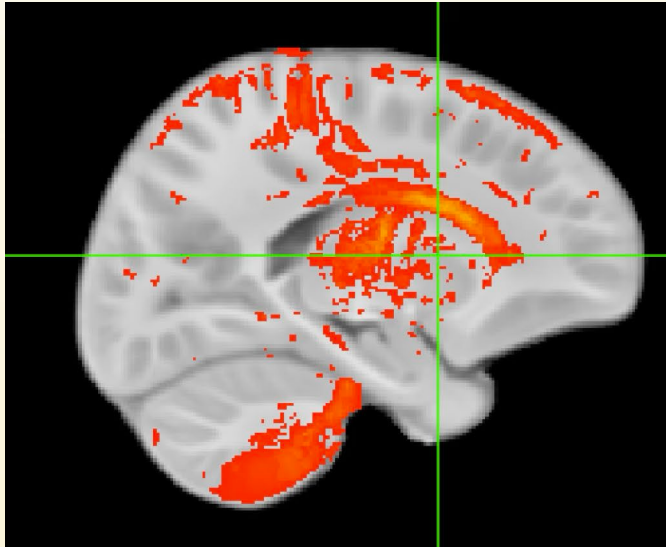
BAMBAM Study of Health Neurodevelopment

2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

**Infants who received formula without added bovine MFGM
(n = 28)**

**Infants who received
formula with added
bovine MFGM (n = 43)**

Healthy term infants who received $\geq 90\%$ formula for the first 3 months of life without a family history of learning or psychiatric disorders (excluding maternal MDD during pregnancy)

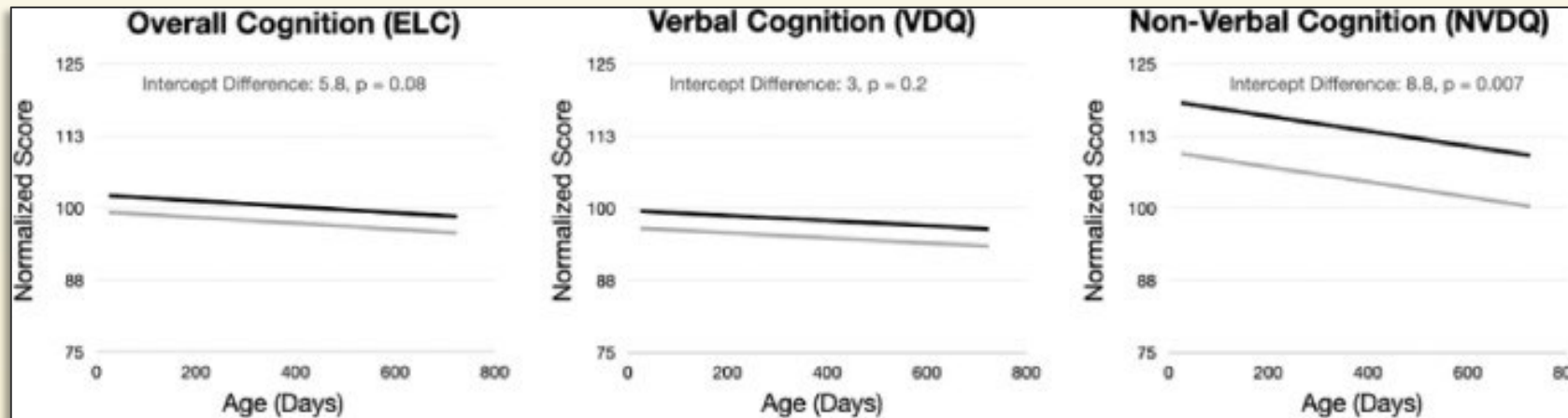
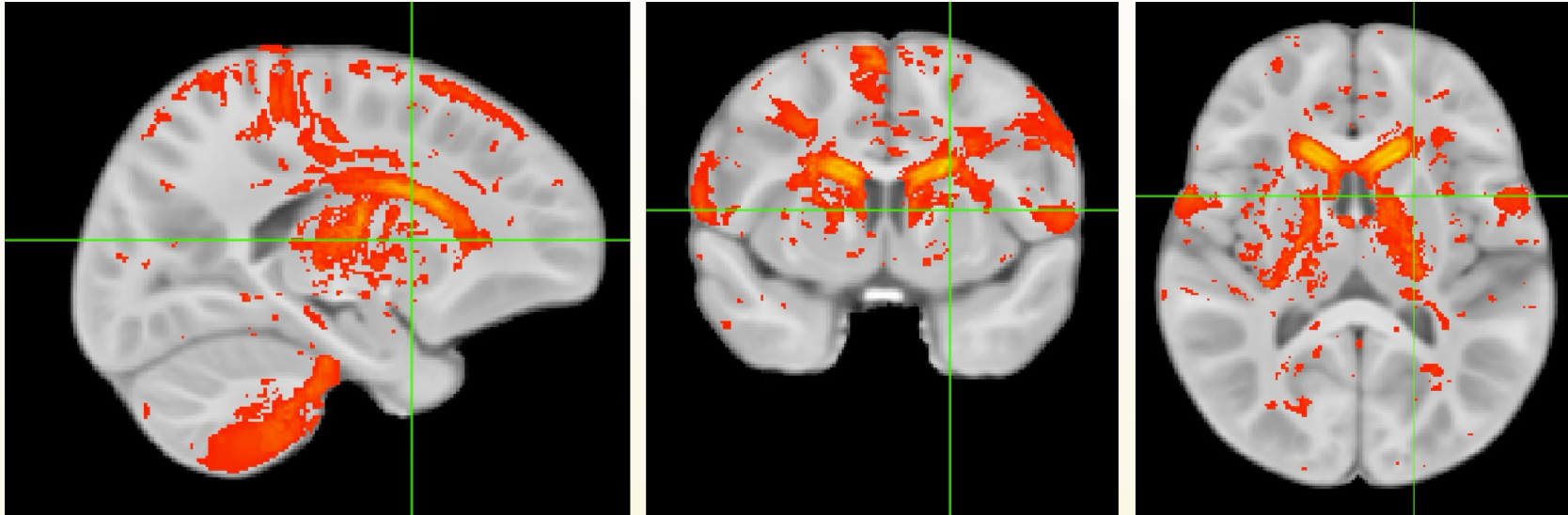


**Infants who received the
formula with added
MFGM had:**

- Significantly increased brain myelin content over the first 2 years of life throughout motor related regions.



MFGM As a Source of Myelin Nutrients



Infants who received the formula with added MFGM had:

- Significantly increased brain myelin content over the first 2 years of life throughout motor related regions.
- Significantly increased motor skill development.



Key Takeaways

- Nutrients, including folic acid, iron, cholesterol, LC-PUFAs, and sphingomyelin are important for white matter development and brain connectivity
- These nutrients are amply provided in human milk and partially explain observed cognitive differences between breastfed and formula-fed infants
- Formulas with supplemental DHA and sphingomyelin appear to promote improved myelination and brain maturation
- Observational and RCT findings suggest we can improve infant neurodevelopment through improved nutrition, even in a generally healthy child population
- Nutrition is only one of many factors that influence a child's development: love, read, and play with your child!



Advanced Baby Imaging Lab



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BILL & MELINDA
GATES *foundation*

Nestle Research



Supplemental MFGM & Neurodevelopmental Outcomes

Assessing Cognitive Outcomes

John Colombo, PhD

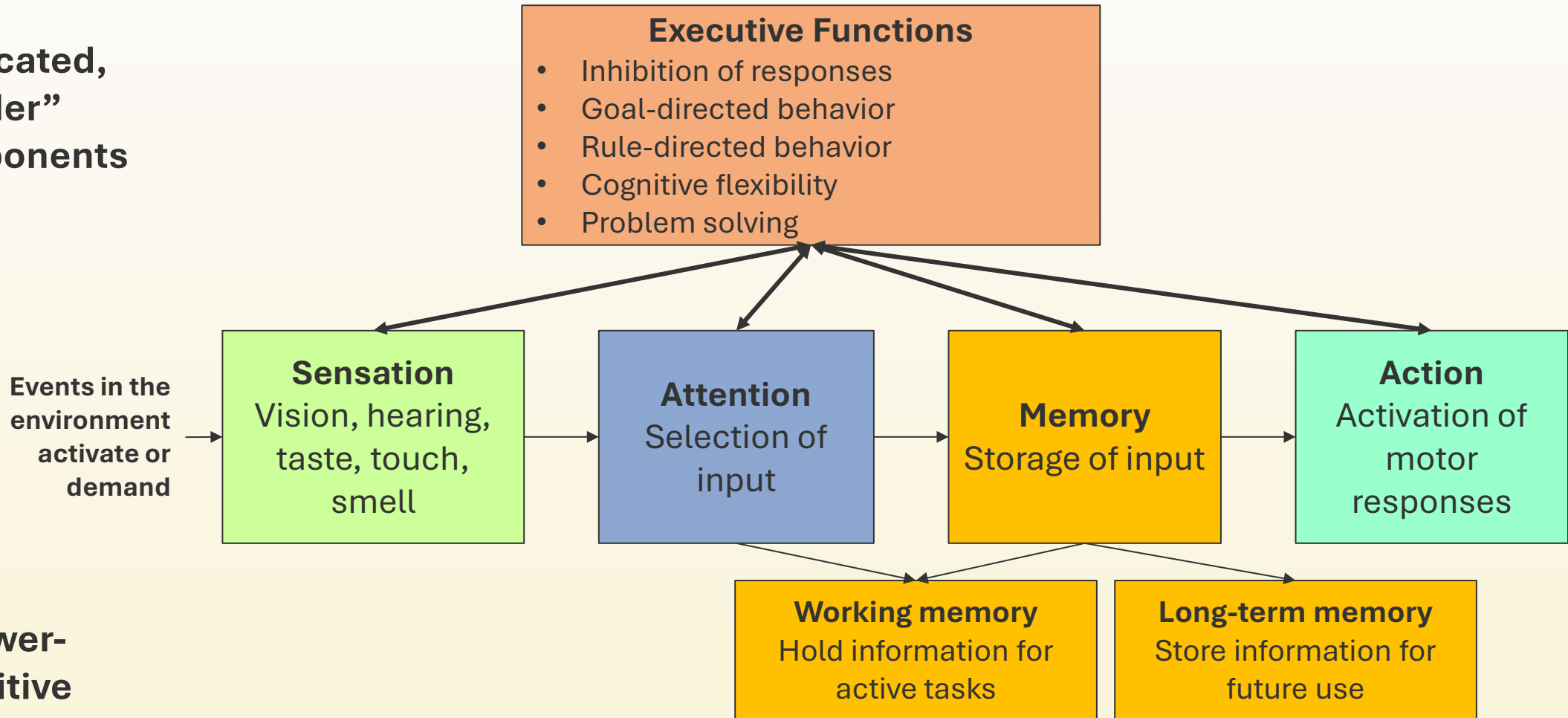


Specific Cognitive Functions

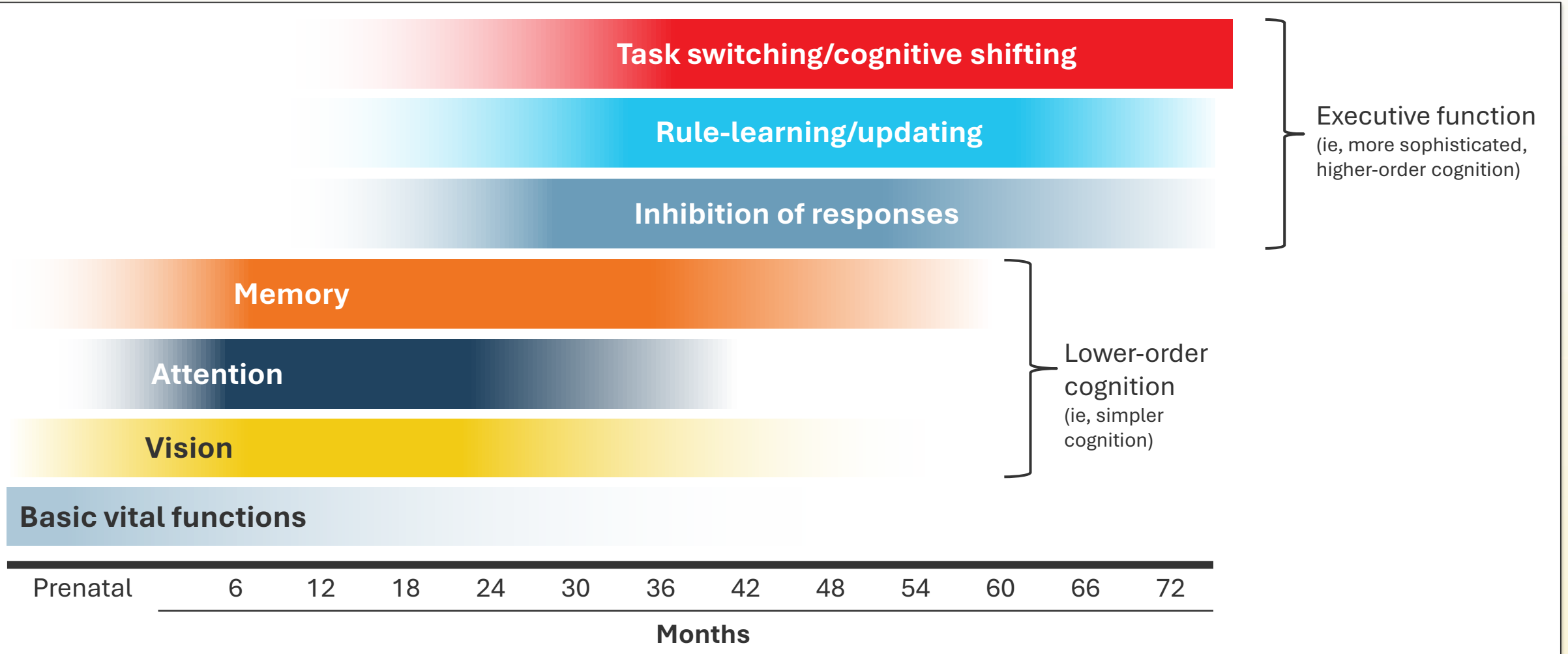
More sophisticated,
“higher-order”
cognitive components



Simple, “lower-
order” cognitive
components



Developmental Course of Cognitive Functions



Clinical Trial Outcomes to Measure Brain Development

When designing a clinical trial, identifying outcomes to effectively evaluate the treatment is critical.

Options for measuring neurodevelopment include:

- Screening assessments
- Parent report measures (questionnaires)
- Standardized global developmental measures
- Tests of specific cognitive skills



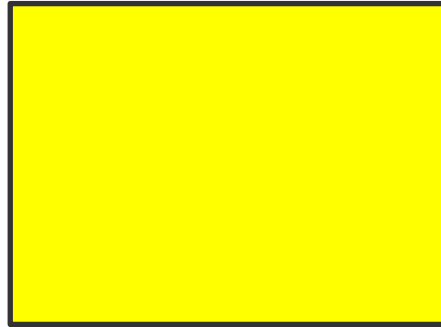
Measuring Executive Function: Modified Stroop Task^{1,2}

- **Test:** asks children to respond to a stimulus based on a nonintuitive rule
- **Cognitive process measured:** inhibitory control, rule-learning and strategy, and working memory
- **Age group:** ≥30 months

Color Task Variant

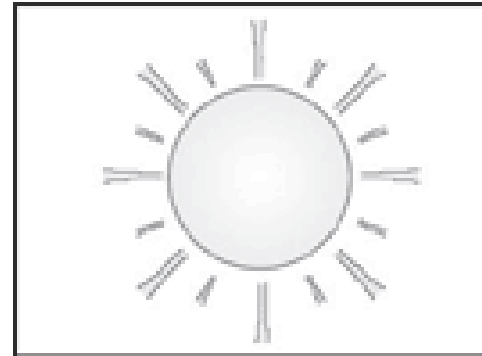


“Yellow”
(or “Banana”)



“Red”
(or “Apple”)

Day/Night Task Variant



“Night”

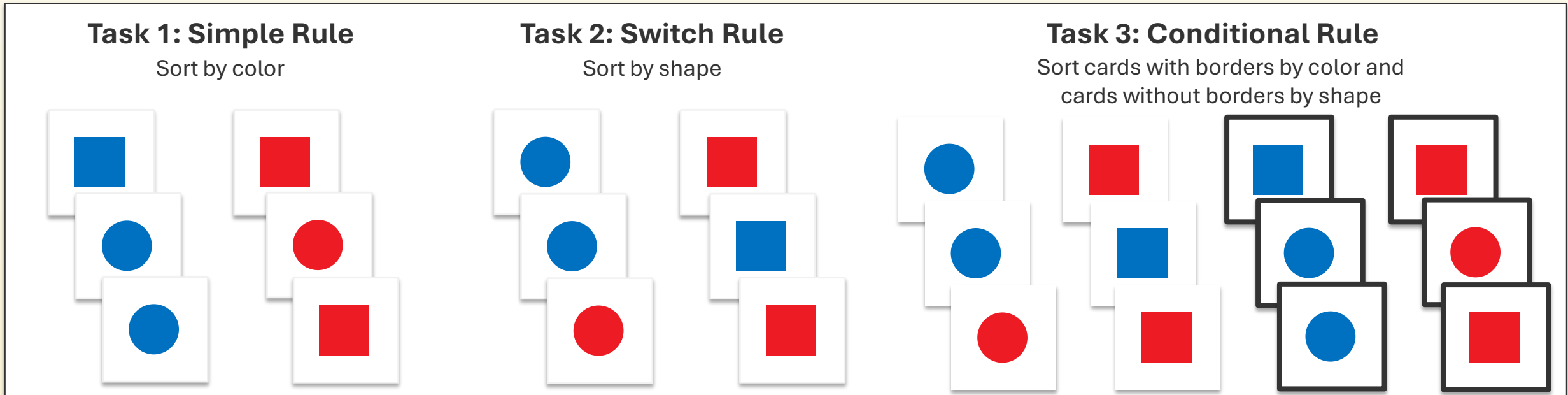


“Day”



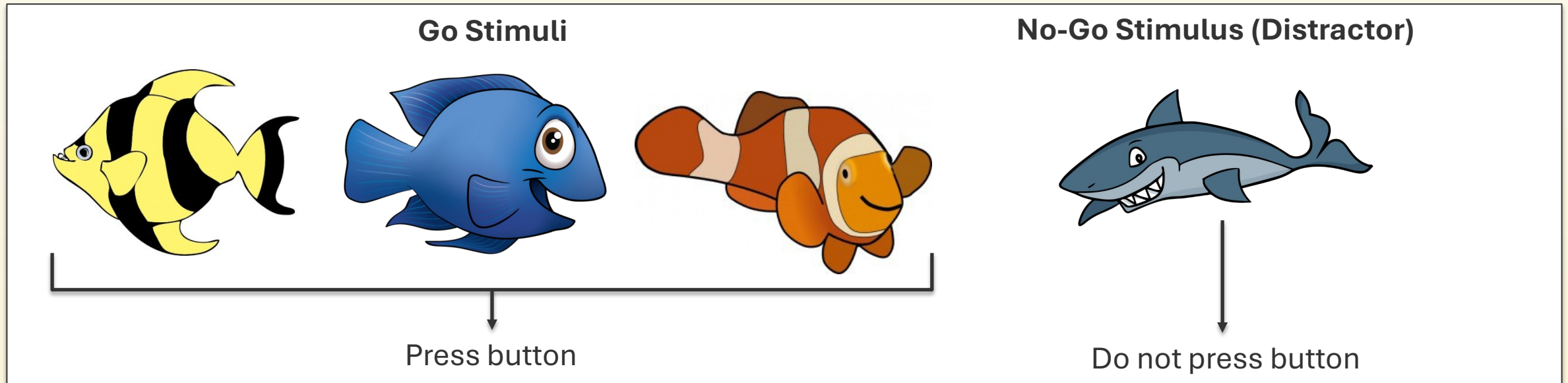
Measuring Executive Function: Dimensional Change Card Sort (DCCS) Task¹⁻³

- **Test:** asks children to sort cards into boxes based on a specific characteristic (eg, color) and then asks them to *switch* and sort cards based on a different characteristic (eg, shape) and then again based on a conditional rule
- **Cognitive process measured:** rule-learning and cognitive flexibility
- **Age group:** ≥30 months



Measuring Executive Function: Go/No-Go Task

- **Test:** asks children to perform a quick motor response when specific stimuli are displayed (ie, “go” stimuli) and withhold this response for other stimuli (ie, “no-go” stimuli or distractors); often used in conjunction with event-related brain potential (ERP) recording¹
- **Measures:** inhibitory control¹
- **Age group:** usually ≥ 60 months, but has been used in younger children with some success²

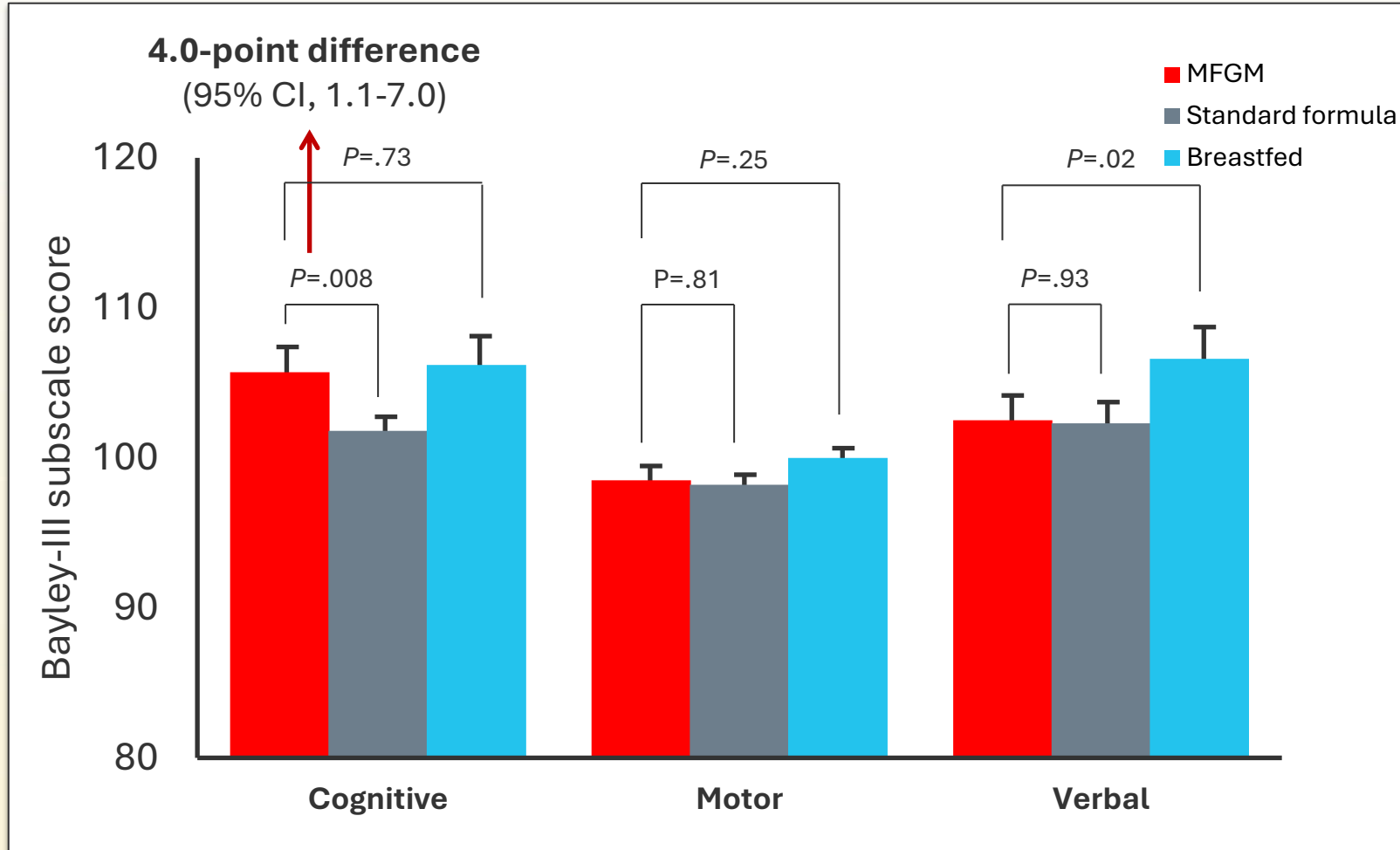


Supplemental MFGM & Neurodevelopmental Outcomes

Effects of MFGM Supplementation



Swedish MFGM Study: Neurodevelopment at 12 Months



- Randomized, controlled study
- 160 healthy formula-fed infants were randomized to receive:
 - Standard formula until 6 months of age (n = 68)
 - Standard formula supplemented with MFGM (4% wt:wt) until 6 months of age (n = 73)
- A breastfed reference group was also recruited from the same hospital (n = 72)



Studying the Benefits of MFGM Supplementation in Infant Formula: the Lighthouse MFGM Clinical Trial

- **Study design**

- Prospective double-blind randomized controlled trial (RCT)
- Enrolled **451 infants** who were randomized to 12 months of feeding with:
 - » Standard cow's milk-based formula (control)
 - » Standard cow's milk-based formula with added bovine MFGM (5 g/L) and lactoferrin (0.6 g/L) (MFGM+LF) (intervention)

- **Primary outcome:** difference in Bayley Scales of Infant Development, 3rd edition (Bayley-III) cognitive composite scores at 12 months

- **Secondary outcomes:** tolerability/safety, growth/anthropometrics, and other measures of development



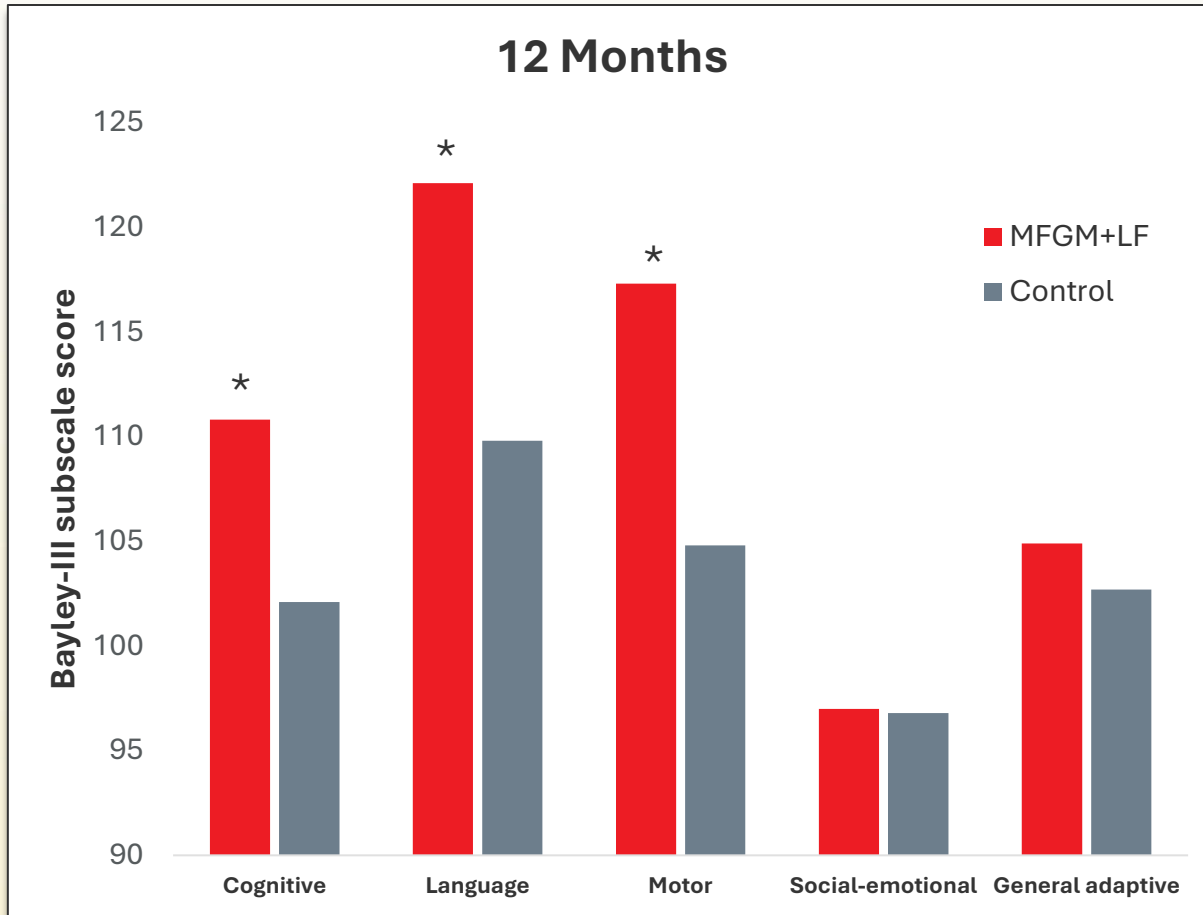
The Lighthouse MFGM Clinical Trial: Ages and Stages Questionnaire Outcomes

ASQ Domain Scores (Repeated Measures Analysis), Mean ± SE

Domains	Day 120		Day 180		Day 275		P value for study group
	Control (n = 187)	MFGM + LF (n = 187)	Control (n = 185)	MFGM + LF (n = 183)	Control (n = 167)	MFGM + LF (n = 166)	
Communication	49.1 ± 0.5	51.4 ± 0.5	50.8 ± 0.5	51.5 ± 0.5	51.5 ± 0.6	52.5 ± 0.6	.010
Gross motor	49.7 ± 0.6	52.3 ± 0.6	48.6 ± 0.6	49.5 ± 0.6	46.2 ± 0.7	47.1 ± 0.7	.010
Fine motor	46.6 ± 0.6	49.5 ± 0.6	52.0 ± 0.6	52.9 ± 0.6	53.4 ± 0.6	54.6 ± 0.6	.002
Problem solving	49.7 ± 0.6	52.1 ± 0.6	49.5 ± 0.6	51.1 ± 0.6	51.9 ± 0.6	52.7 ± 0.6	.003
Personal/social	46.5 ± 0.6	50.2 ± 0.6	47.1 ± 0.6	48.4 ± 0.6	50.0 ± 0.6	51.0 ± 0.6	<.001



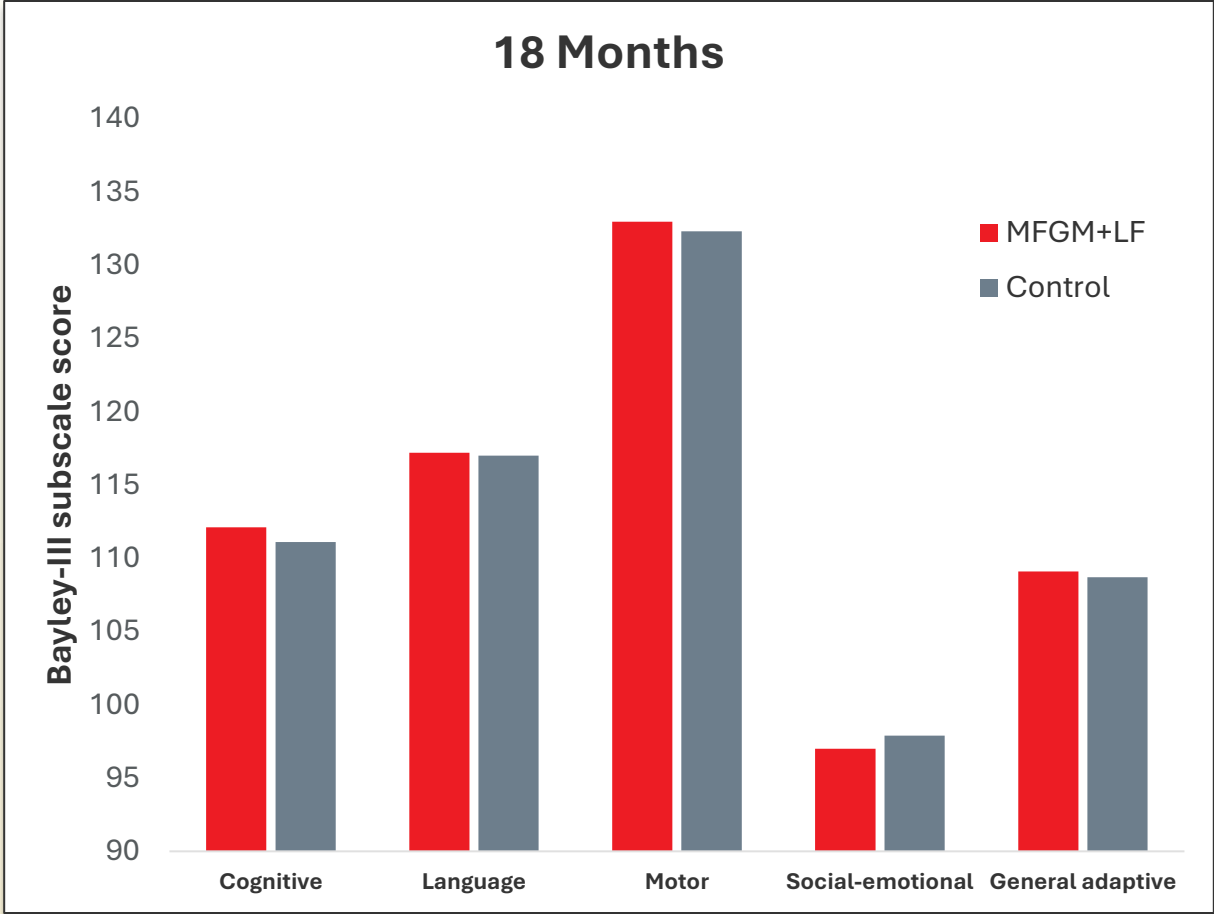
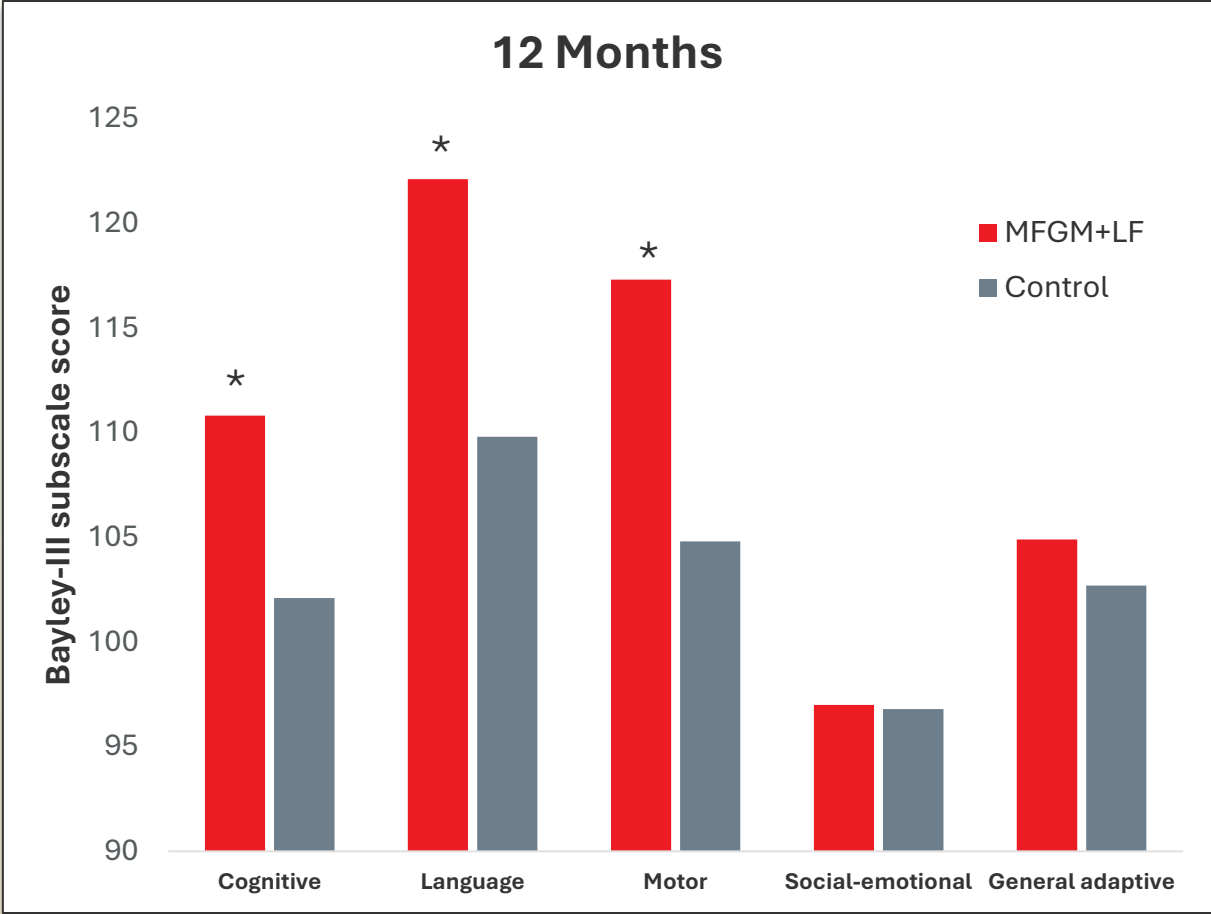
The Lighthouse MFGM Clinical Trial: Bayley-III Outcomes at 12 Months



*P < .001



The Lighthouse MFGM Clinical Trial: Bayley-III Outcomes at 18 Months



* $P < .001$



The Lighthouse MFGM Clinical Trial: Long-Term Follow-Up

- **Follow-up study design**

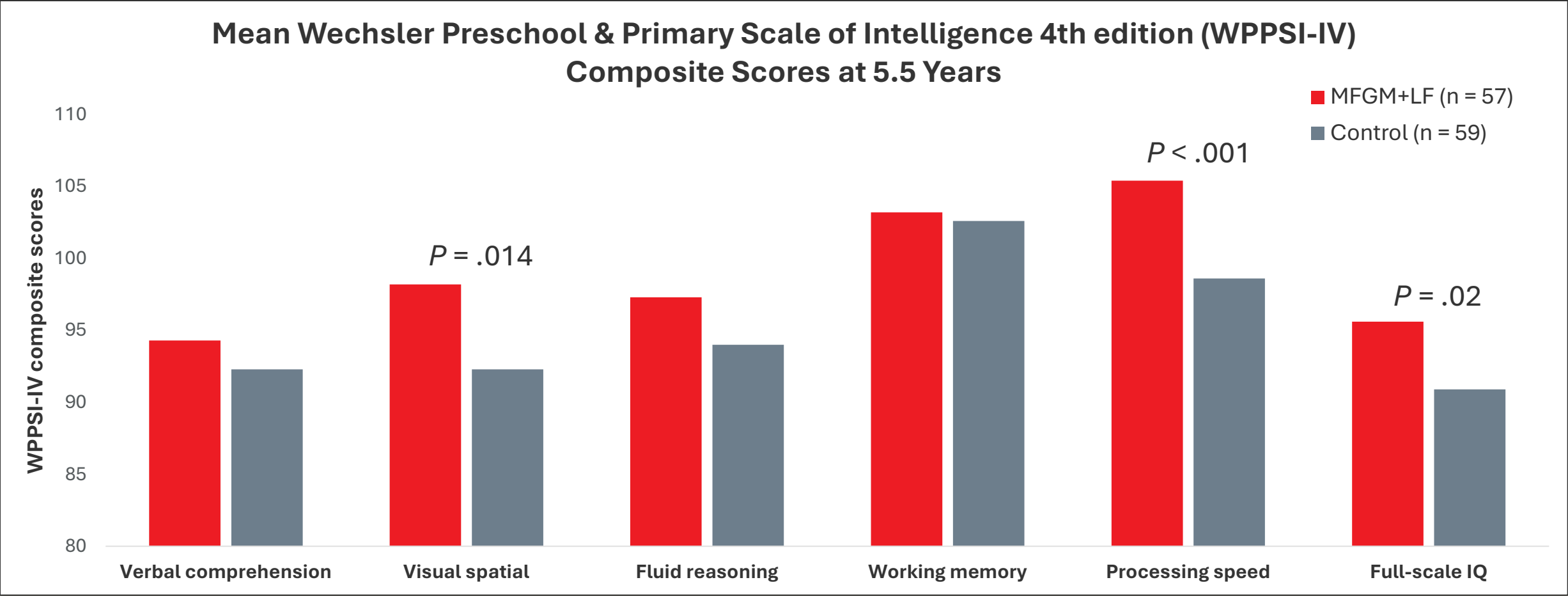
- Enrolled trial participants who completed 12 months of the assigned study feeding who were 5.5 years (± 2 months) at the time of follow-up testing
- **116 of 292 participants** meeting eligibility criteria were enrolled
 - » No differences in demographic characteristics between those who did or did not participate in the follow-up study

- **Primary outcome measures**

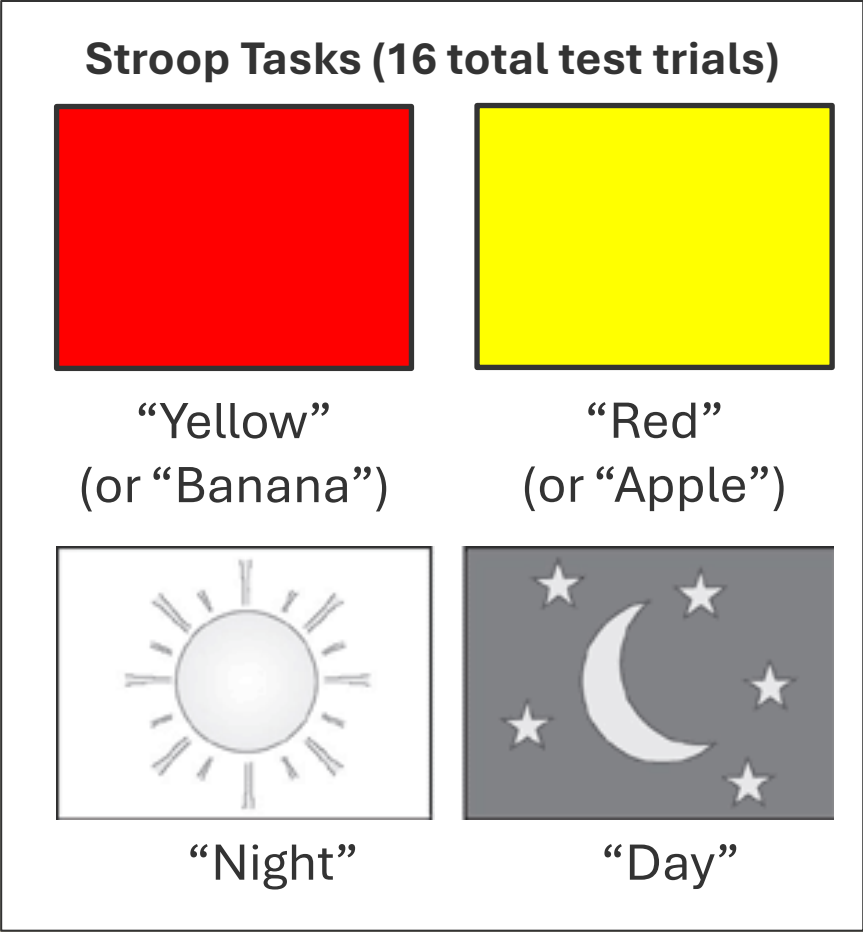
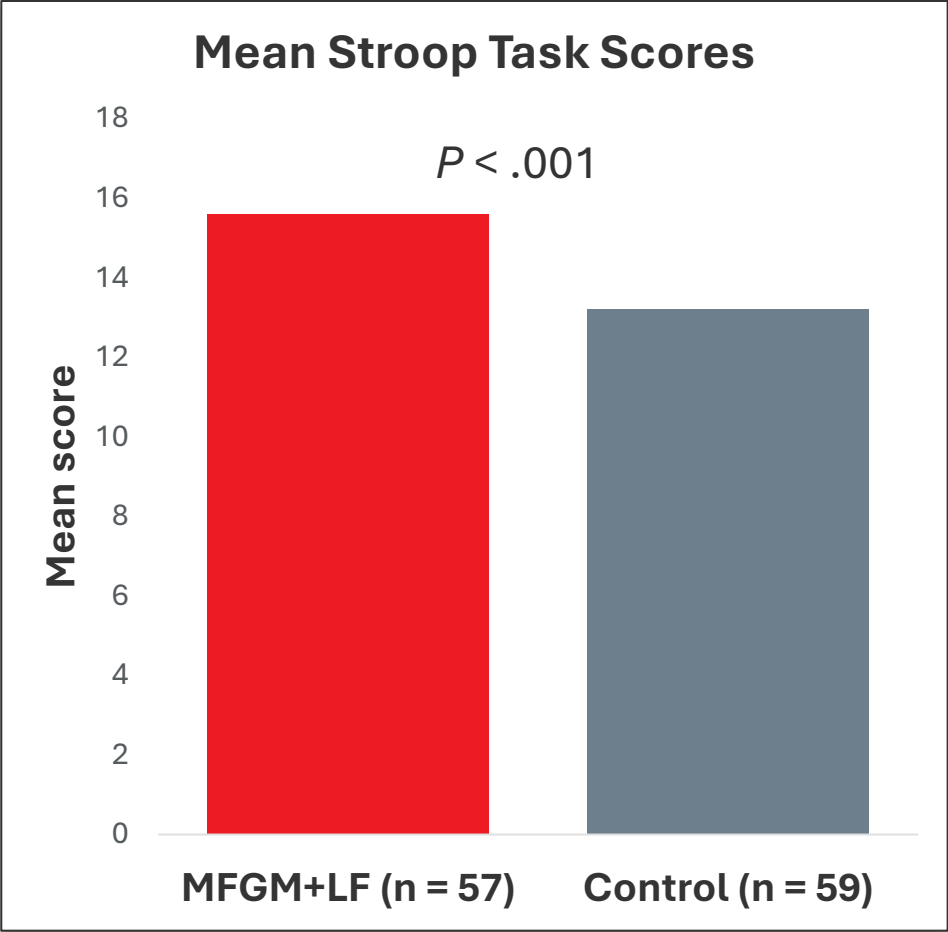
- WPPSI-IV Full-Scale IQ (a measure of overall intellectual ability)
- 5 primary WPPSI-IV indices (measures of the domain-specific abilities of verbal comprehension, visual spatial, fluid reasoning, working memory, and processing speed)



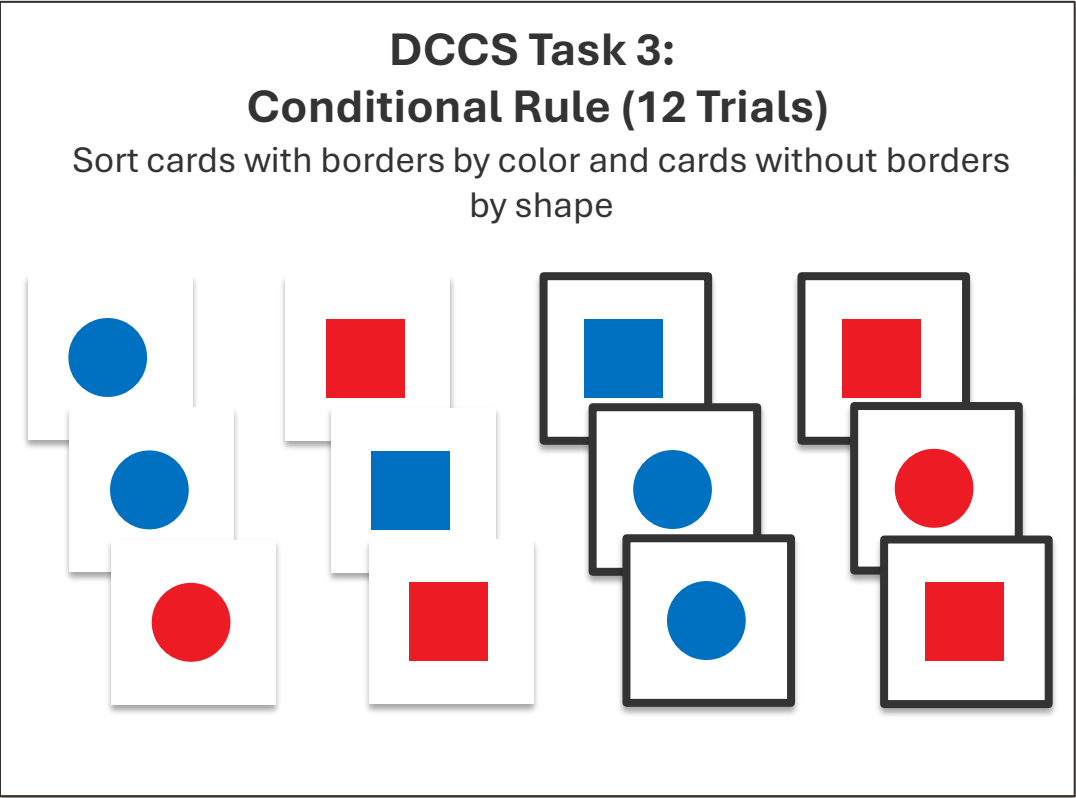
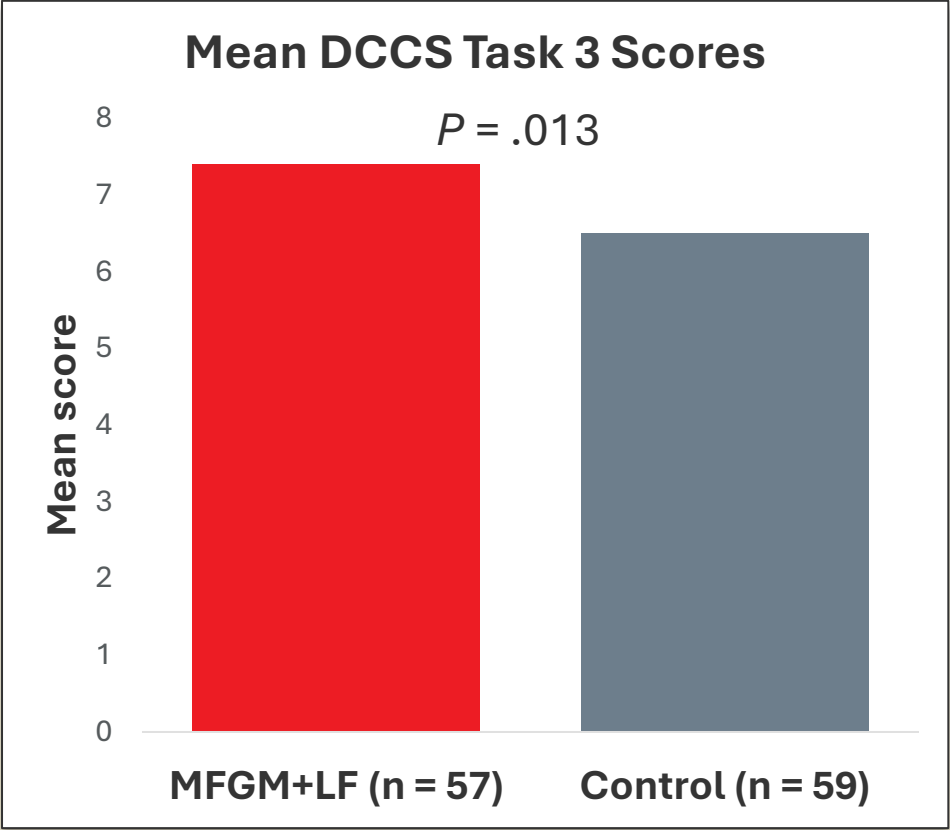
The Lighthouse MFGM Clinical Trial Long-Term Follow-Up: Outcomes at 5.5 Years



The Lighthouse MFGM Clinical Trial Long-Term Follow-Up: Stroop Task at 5.5 Years



The Lighthouse MFGM Clinical Trial Long-Term Follow-Up: DCCS Task at 5.5 Years



Note: There were no between-group differences in the DCCS task 1 (simple rule) or task 2 (switch rule) scores.



Studying the Benefits of MFGM Supplementation in Infant Formula: the COGNIS Clinical Trial

- **Study design**

- Prospective double-blind randomized controlled trial (RCT)
- Enrolled **170 infants** who were randomized to 18 months of feeding with:
 - » Standard cow's milk-based formula (control)
 - » Standard cow's milk-based formula with added functional compounds, including MFGM, synbiotics, and LC-PUFAs (intervention)

- **Primary outcome:** difference in neurocognitive development measured by Bayley-III scores and other assessments at 4 and 6 years

- **Secondary outcomes:** tolerability/safety, growth/anthropometrics, infections, and other measures of development



COGNIS Clinical Trial: Neurocognitive Outcomes at 6 Years of Age

K-BIT domain	Standard formula (n = 37)	Intervention formula (n = 39)	Breastfed reference (n = 32)	Adjusted <i>P</i> value (standard vs interventional formula)
Vocabulary	107.91 ± 13.44	113.16 ± 13.31	103.73 ± 14.26	.022
Matrices	111.51 ± 12.07	113.21 ± 12.00	111.78 ± 11.07	.113
IQ	109.64 ± 11.67	113.46 ± 11.50	105.54 ± 12.40	.031



Key Takeaways

- In randomized trials, MFGM supplementation in infant formula has been associated with improved short- and long-term cognitive outcomes, including:
 - Language
 - IQ
 - Executive function
- The effects of early nutrition persist well beyond the period of feeding and into early childhood
 - These nutrients may play a role in the programming of brain structure and function in infancy and early childhood



Questions?

The Early Nutrition Journey and MFGM: Evidence for Improving Cognitive Outcomes

Questions

Please submit your questions
using the question cards
found on your table



A baby with dark skin and curly hair is sitting on a grey carpet, playing with several colorful plastic blocks (yellow, red, green, blue). The baby is wearing a white long-sleeved shirt. In the background, there are blue, spiky virus-like particles.

To claim credit for participation, go to:

cequiz.org

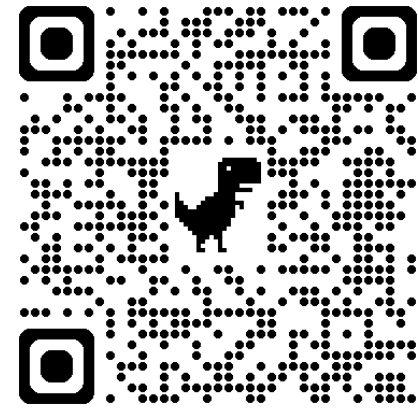
Credit Designations:

1.5 AMA PRA Category 1 Credits™ for physicians

1.5 ANCC contact hours for nurses

1.5 CA-BRN contact hours for California nurses

**1.5 CDR contact hours for registered dietitians
and dietetic technicians**





Thank you for
joining us.