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THE LEARNING LEAD
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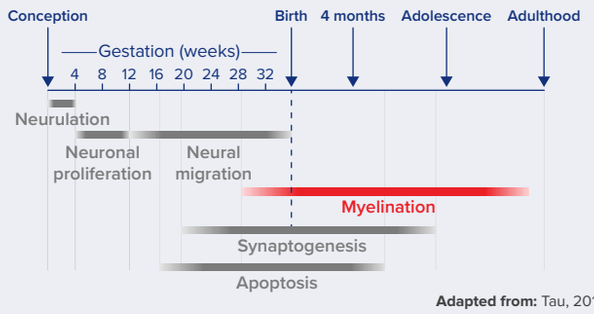
Wyeth Nutrition SCIENCE CENTER

Can Early Life Nutrition Influence Myelination in Healthy Formula-Fed Infants?

Conception and early life are important periods to establish the basis for lifetime brain function in infants.[1] Most importantly, the third trimester of pregnancy can be marked by multiple brain development phenomena such as myelination, neuronal proliferation, growth and differentiation, and synaptogenesis (Figure 1).[2,3] During early life, the brain's structural and functional growth are at their peak, forming >1 million neural connections every second that establish the foundation for future cognitive and behavioural development.[1,4] Thus, this period harbours the greatest opportunity to provide optimal nutrition for normal development and it is also the time of the greatest brain vulnerability to any nutrient deficits.[2]

Figure 1: Critical window of myelination development.[3]



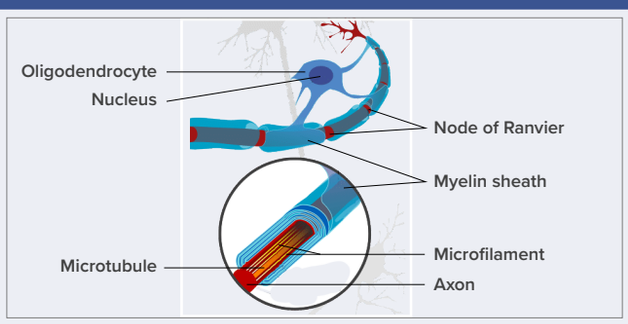
Adapted from: Tau, 2010.

Myelination: A Critical Component of Brain Development

Brain growth is very rapid in the first few years of life, including the process of rapid myelination and myelin maturation. After 2–3 weeks of life, brain volume is around 35% of adult brain volume, doubles in size in the first year of life, and increases to approximately 80% of adult size in the second year.[5]

Myelination is amongst the fundamental processes of early brain development and is positively associated with cognitive ability throughout postnatal development (~6.5–16 months) as well as in children and even up to adulthood (Figure 1).[6] Myelination is mediated by a type of brain cell, oligodendrocyte, which wraps the axons of neurons with a substance called myelin (Figure 2).[7]

Figure 2: Myelin production by oligodendrocytes during the third trimester of pregnancy to coat axons of neurons.[7]



Myelin is an essential component of the brain that is needed to facilitate brain cell (neuron) connections and is rich in lipids.[8,9] Additionally, myelin is involved in controlling the speed of information processing and brain connections, which are critical for optimal learning and cognitive performance, such as reading ability, language, and memory.[10]

Link Between Early Nutrition and Myelination

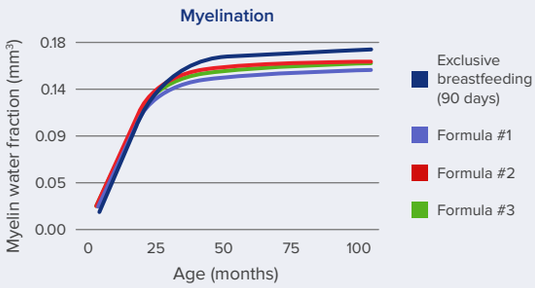
Early life nutrition is an important and modifiable factor that can shape myelination. Studies have shown that early life nutrition may influence myelination and cognition.

Evidence: Nutrition's effects on early brain and cognitive development were examined in a longitudinal observational research by Deoni *et al.*[11] The study recruited exclusively breastfed (n=62) and exclusively formula-fed (n=88) infants for at least the first 3 months of life and assessed their myelination and early learning composite (ELC) scores.[11]

Study key findings:

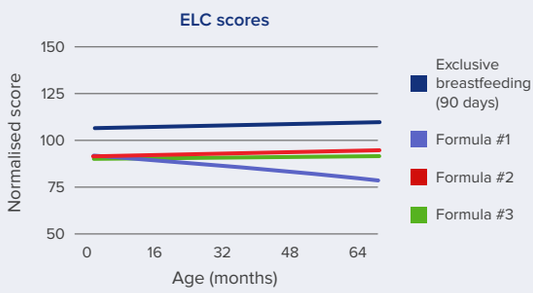
1. Infants who were exclusively breastfed showed higher levels of myelin (Figure 3a) and better ELC scores (Figure 3b) compared with infants who were exclusively formula-fed.[11]

Figure 3a: Longitudinal myelin curve for the corpus callosum brain region between different formula compositions. Breastfeeding data is shown for reference.[11]



2. Variability in formula composition was linked with differences in myelin trajectories (Figure 3a) and ELC scores (Figure 3b).

Figure 3b: Comparison of longitudinal maturation curves between children who received different formula compositions.[11]



Therefore, this study provides a significant insight into early life as a window of opportunity to boost myelin development and cognitive outcomes in formula-fed infants.

Role of Key Nutrients in Enabling Brain Development

All nutrients are crucial for brain growth and function, but an adequate supply of certain key nutrients such as docosahexaenoic acid (DHA), arachidonic acid (ARA), folic acid (vitamin B9), iron, sphingomyelin (SM), vitamin B12, choline, and phospholipids (PLs) have a significant impact that supports optimal early neurodevelopment.[11,12]

The study shows that infants who received formula composition with a higher proportion of nutrients such as DHA, ARA, folic acid, iron, SM, vitamin B12, choline, and PLs are significantly associated with early myelination trajectories (Figures 3a and 3b).[11]

Therefore, this adds to the growing understanding that these myelin-associated nutrients are essential for early neurodevelopment and subsequent cognitive outcomes.[11]

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The First Paediatric Nutritional Neuroimaging Study Demonstrating the Efficacy of a Unique Myelin Blend on Developmental Myelination in Well-Nourished, Term Infants[13]

A multicentre, double-blind, randomised, controlled clinical CONNECT study in healthy infants with a 12-month intervention duration and 2-year follow-up.

Objective: To examine the impact of important nutrients on brain myelin content using MRI and cognitive development for up to 24 months.

Study participants: 81* infants were randomly assigned to receive an investigational (n=42) or control formula (n=39) in the first 5 weeks of life. A reference group of breastfed infants (N=108) was recruited in parallel.

Intervention: A myelin blend-containing formula: A uniquely processed alpha-lactalbumin PL/SM-enriched whey protein concentrate, DHA, ARA, vitamin B12, folic acid, and iron vs. standard formula.

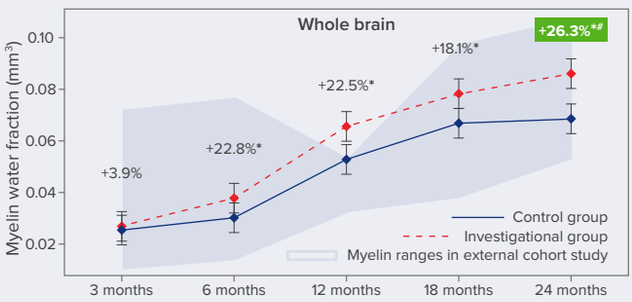
*The full analyses set comprises N=67 infants with N=35 in the investigational group and N=32 in the control group.

CONNECT Study Results

1. **Infant formula with a unique nutrient blend enhances brain architecture by increasing myelination and grey matter volume.**

- Myelination was observed to be increased by 26% at 24 months in the investigational group compared to the control group (Figure 4).

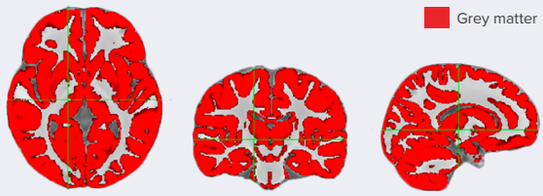
Figure 4: Increased myelination up to 24 months of life.[13]



*Statistically higher myelin for the investigational group compared to the control group.
#Significantly higher myelin in the investigational group compared to the breastfed group but within breastfed ranges.

- The increase in myelination was observed in the specific brain region involved in sensory, motor, and language functions at 3, 6, 12, and up to 24 months.
- Increased myelin content in the frontal lobe at 12, 18, and 24 months is important for complex/higher cognitive abilities, including executive functions.
- Additionally, the investigational group showed an increase in grey matter volume at 24 months, which is important for cognitive performance (Figure 5).

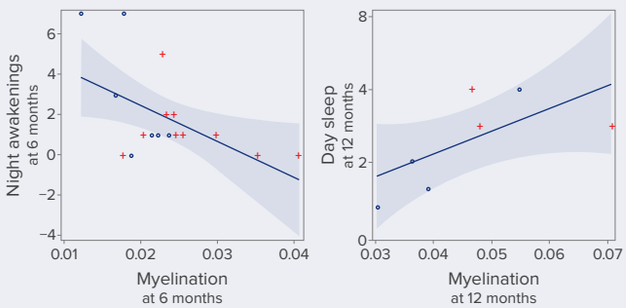
Figure 5: Increased grey matter volume at 24 months.[13]



2. **Impacts on infant and toddler learning and behaviours to support cognitive abilities:**

- Myelination in fine and motor brain regions at 6 months was correlated with the development of motor skills at 12 months.
- The investigational group showed a significant reduction in night awakenings at 6 months compared to the control group and an increase in day sleep at 12 months (Figure 6).

Figure 6: Higher whole brain myelin levels linked to improved reduction in night awakenings and increased duration of day sleep.[13]



- Additionally, the investigational group showed a significant decrease in the social fearfulness subscale of the Toddler Behaviour Assessment Questionnaire at 24 months (p=0.046).

Key Takeaways

- Overall, findings imply that healthy newborns and young children's brain development, particularly myelin and grey matter development, is influenced by nutrition, which may be foundational for later cognitive and learning outcomes.
- First-of-its–kind research that demonstrates that a formula supplemented with a unique myelin blend has a positive impact on myelination development in healthy term infants.

In conclusion, this study highlights the opportunity to enhance developmental myelination for later cognitive outcomes and provides new avenues for future research.

MRI: Magnetic resonance imaging.

References

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