Modeling healthy white matter and myelin development: Critical role of early nutrition in infants and young children

Myelination: One of the key neurodevelopment processes

Myelination is essential for normal brain function and is a cornerstone of human neurodevelopment.¹

Myelinated white matter plays an important role in cognitive processing by facilitating high-speed and high-fidelity communication across brain networks.²

Myelin sheath enables the rapid and synchronized information transfer required for coordinated movement, decision-making, and other higher order cognitive, behavioral, and emotive functions.¹

“The most significant period of myelination is from mid-gestation to first two years of life”.

In normal brain development, myelination begins early in the 3rd trimester with the most rapid period of myelination occurring in the first two years of life.³

Myelination begins in the cerebellum and brainstem in utero. Following birth, myelination proceeds caudocranially from the splenium of the corpus callosum, optic radiations and internal capsule by 3–4 months; occipital and parietal lobes by 5–6 months; temporal and frontal lobes by 9–11 months and continues into the second decade of life.⁴

Myelination proceeds caudocranially⁴

- In utero
- Birth
- From the corpus callosum, optic radiations and internal capsule By 3-4 months
- To occipital and parietal lobes By 5-6 months
- To temporal and frontal lobes By 9-11 months

Phospholipids: An important component of myelin

The structure of myelin is rich in lipid and protein, and it is seen in both the central nervous system and peripheral nervous system.⁵ The composition of myelin is approximately 70% lipid and 30% protein, which is in stark contrast to other membranes, which are typically 30–50% lipid.⁶

Phospholipids, which comprise approximately one-third of the total lipids, are vital nutrients that play an important role in brain development.⁵,⁷

Sphingomyelin is the most important phosphosphingolipid. It is the main component of the myelin sheath covering neuronal axons.⁸

Sphingolipids affect:

- Neuronal and glial proliferation, differentiation and apoptosis⁹
- Membrane permeability to Ca²⁺ and K⁺, relevant to the generation and propagation of the nervous impulse and neurotransmitter release⁹
Nutrition in early years: Critical for neurodevelopment

Careful orchestrated delivery of nutrients is important for assembly and maintenance of the myelin sheath. Long-chain polyunsaturated fatty acids (LC-PUFAs), choline, iron, zinc, cholesterol, phospholipids, and sphingomyelin play essential roles in myelin elaboration, as key components of the myelin sheath.

**REFERENCES:**