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Commentary

Impact of Early Nutritional Interventions on Cognitive Development in Preterm Infants

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DESCRIPTION

Preterm birth, defined as delivery before 37 completed weeks of gestation, remains a significant global health concern, especially in high-income countries where advanced neonatal care has improved survival rates substantially. However, surviving preterm infants face multiple challenges, particularly concerning neurodevelopmental outcomes. Cognitive impairments, including difficulties in attention, executive function and academic performance, are prevalent among preterm survivors. A growing body of evidence suggests that early nutritional interventions can profoundly influence the trajectory of brain development in this vulnerable population. The brain of a preterm infant undergoes critical growth and maturation during the third trimester, a period often interrupted by premature birth. This early disruption predisposes these infants to neurodevelopmental delays, as their immature brains are highly sensitive to environmental factors such as nutrition. Early nutritional status, therefore, emerges as a modifiable factor with the potential to optimize cognitive outcomes.

In high-income settings, the focus has shifted toward tailoring nutritional strategies to meet the unique needs of preterm infants. These strategies include fortified breast milk, early initiation of parenteral nutrition, enriched enteral feeding protocols and supplementation of critical nutrients such as Long-Chain Polyunsaturated Fatty Acids (LCPUFAs), iron and vitamins. Studies demonstrate that adequate provision of protein and energy during the early postnatal period correlates positively with brain volume and white matter integrity, important markers for cognitive development. Breast milk, recognized as the sunveil

tandard for infant nutrition, provides bioactive components that support neurodevelopment. In preterm infants, breast milk fortification is often necessary to meet their higher nutritional demands. Evidence suggests that infants receiving fortified breast milk exhibit better cognitive scores at follow-up compared to those receiving unfortified milk or formula alone. Moreover, supplementation with LCPUFAs like DocosaHexaenoic Acid (DHA) has been linked with improved visual and cognitive outcomes, underscoring the importance of targeted nutrient support.

Another important aspect is the timing and adequacy of nutritional intervention. Early initiation of parenteral nutrition within the first hours after birth can lightening nutritional deficits and promote brain growth. Delayed or insufficient nutritional support, conversely, has been associated with poorer neurodevelopmental outcomes. Optimizing energy and protein intake during the first weeks is critical as this period represents a window of heightened neuroplasticity. Despite these advances, challenges remain. Variability in nutritional protocols across Neonatal Intensive Care Units (NICUs) and differences in individual responses complicate the establishment of standardized guidelines. Furthermore, long-term studies linking early nutrition with cognitive outcomes extending into school age and beyond are relatively limited but essential for understanding the full impact of these interventions.

Recent Randomized Controlled Trials (RCTs) and cohort studies in high-income countries have highlighted potential results but also caution against overfeeding, which may lead to metabolic complications. This delicate balance underscores the necessity of individualized nutrition plans informed by ongoing monitoring of growth parameters and metabolic status. Integration of multidisciplinary approaches including neonatologists, dietitians and developmental specialists is key to optimizing nutritional care. Additionally, parental involvement and support in feeding practices, especially promoting breast milk use, form an integral part of comprehensive neonatal care.

CONCLUSION

The impact of early nutritional interventions on cognitive development in preterm infants is unequivocally significant. In high-income countries, where resources and technologies facilitate advanced neonatal care, attention must now turn to refining nutritional strategies to support optimal brain growth and function. Early, adequate and customised nutritional support encompassing fortified breast milk, targeted nutrient supplementation and timely initiation of parenteral and enteral

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feeding offers a practical and effective means to improve neurodevelopmental outcomes. However, the complexity of preterm infant care demands continued research to define precise nutritional requirements and develop standardized protocols that balance growth promotion with metabolic safety. Longitudinal studies tracking cognitive and behavioural outcomes into later childhood will further clarify the lasting benefits of early nutrition. Ultimately, a holistic, individualized approach that combines scientific evidence with clinical expertise and family-cantered care will be essential to harness the full potential of nutrition in shaping the cognitive future of preterm infants.