

Complementary Feeding, Micronutrients and Developmental Outcomes of Children

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The period of complementary feeding (from 6 to 24 months of age) can be a challenging and vulnerable time for infant nutrition, with a high incidence of malnutrition and nutrient-specific deficiencies [1]. Infant nutritional requirements are high due to their metabolic rate, rapid developmental processes and limited gastric capacity. Additional foods supplement breast milk provisions to meet the increasing needs of the infant. However, barriers to adequate foods include lack of access to nutritious complementary foods, such as due to poverty or environmental availability, and poor infant feeding practices, such as early or late introduction of complementary foods or replacement of breast milk feeds [1].

The 6- to 24-month period is a time of genetically preprogrammed rapid growth and development. An infant's brain will grow from 25 to 80% of its adult size, and a dependent immobile newborn will grow into an active, mobile toddler capable of basic memory, speaking two-word sentences and feeding themselves [2]. These abilities emerge as the relevant areas of the brain that undergo intense periods of rapid myelination (creation of the myelin sheath around neuronal axons to increase the speed of electrical impulses travelling along it) and synaptogenesis (creation of communication channels between neurons) [2]. Nutrition is considered the most influential nongenetic determinant of growth and development during the 6- to 24-month period. Developmental processes such as myelination and synaptogenesis have high energy and nutrient requirements, and once formed, synapses need energy for maintenance. Key nutrients needed for infant brain development include iron (required for oxygen provision to metabolize energy), fatty acids (to make cellular membranes and myelin) and protein (for structural support, such as in myelin).

Inadequate nutrition during infancy can result in deficits that can be difficult to compensate for later in childhood, even when nutritional status

is corrected [3]. Observational studies have consistently demonstrated links between nutrient deficiencies and impairments in intellectual abilities, work capacity, behavioral functioning and even delayed mental and motor development [3]. Yet, results from a number of interventions using food, individual nutrients or multiple micronutrients with child development assessments are mixed [3]. Many of these studies included infants with deficiencies or poor growth, with some reports of improvements after interventions. Limitations of the current evidence around nutritional interventions during the complementary feeding period and child development outcomes include the broad intervention periods of many studies extending from pregnancy to mid-childhood (with a lack of interventions specifically targeting the 6- to 24-month period). Sample sizes in many studies were small ($n < 150$), attrition was high, and there was a mix of nutrient-sufficient and -deficient conditions between and within studies. Additionally, blinding was unlikely in many studies, and, as reported by a recent Cochrane review of food supplements in early childhood, there was evidence of leakage (when the child does not consume the prescribed amount of the intervention) when the intervention was supplied at the home, as opposed to at a child care center [4]. Importantly, child development outcomes were not the primary outcome of the majority of studies but rather a secondary outcome, and, as with a Cochrane review of multiple micronutrient powders for infants under 2 years, there are many trials that did not assess cognitive or motor development [5]. As with the observational studies, most of the randomized controlled studies were conducted in developing countries where food security is often poor and nutritional deficiencies are common. Given the perceived importance of adequate nutrition between 6 and 24 months of age for both early development and long-term outcomes, further high-quality intervention studies are warranted in the complementary period.

References

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