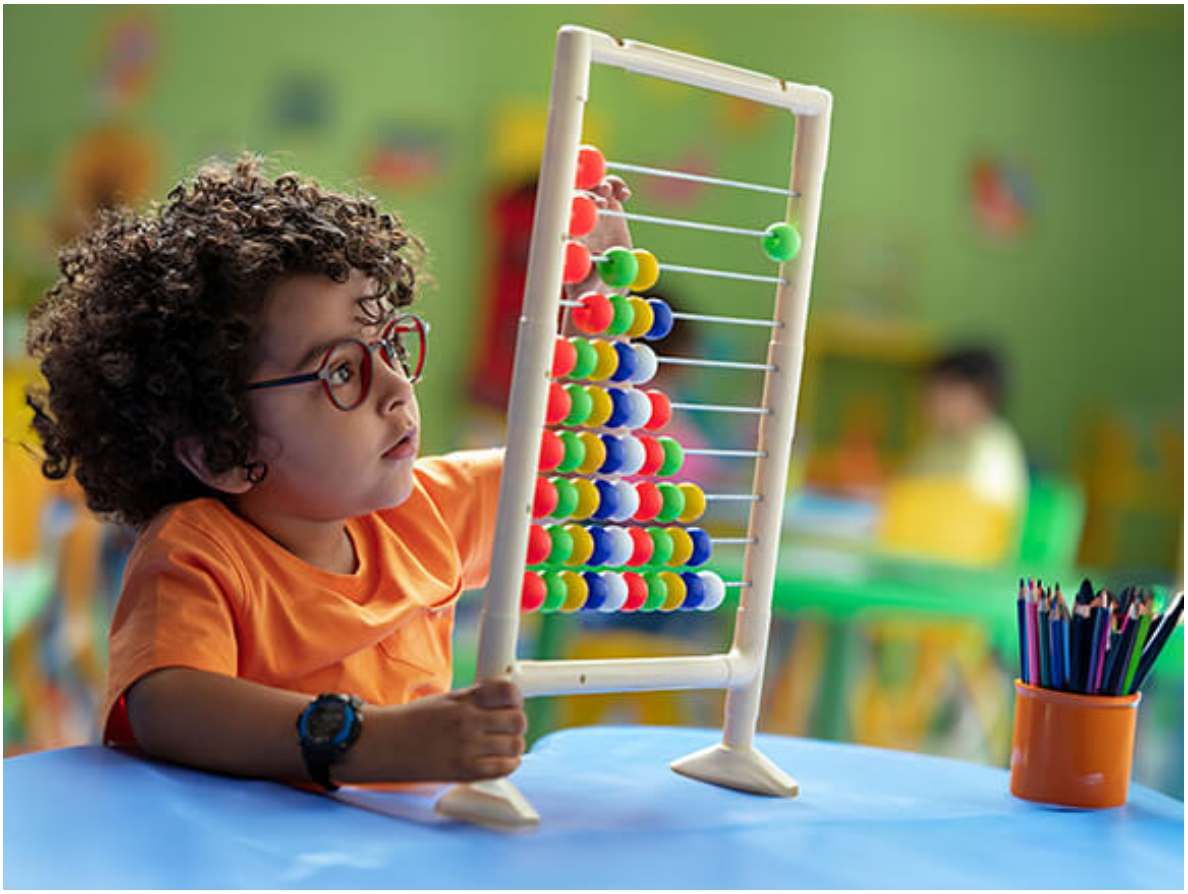

ARTICLE

Cognitive development in children under six years: role of iron, iodine, vitamin B12

5 mins read

Cognitive development in children under 6 years old is a vital stage in which they develop fundamental learning, thinking, and problem-solving abilities. The brains of children in this stage develop rapidly and gain the ability to understand and interact with the world. During the initial years (0-6 years), sensory experiences, relationships, and surroundings impact children's cognitive development.

The key stages of cognitive development include the sensorimotor stage (0-2 years) and the pre-operational stage (2-7 years). The sensorimotor stage includes seeing, hearing, moving, touching, testing, etc. On the other hand, in the pre-operational stage, children’s thinking is governed by what is seen rather than by logical principles.

Proper nutrition is essential for proper brain development, especially in the first few years of life. Deficiencies in essential nutrients, including iron, iodine, vitamin B12, and potassium, can hinder cognitive development.

What role does Iron play in children's cognitive development?

Iron is an essential component for brain metabolism and contributes to normal cognitive development in children up to 3 years. Children under seven years of age are most vulnerable to iron deficiency. Infants who are born prematurely, with low birth weight, or whose mothers are deficient in iron are particularly susceptible to iron deficiency due to their high iron needs driven by their rapid development. Full-term infants also have a higher risk of becoming iron deficient between 6 and 9 months of age.

Its deficiency can have profound and long-term effects on brain development in children 0–2 years of age. It can also negatively impact learning and academic performance later in life.

When iron levels are low in such children, neurotransmitters like serotonin, dopamine, and norepinephrine production eventually decrease, resulting in symptoms of depression, anxiety, and schizophrenia. Moreover, myelin production, synaptogenesis, and basal ganglia function decline.

Does iodine affect children's cognitive development?

Iodine is one of the most critical micronutrients in the early stages of brain development in children aged 0–2 years. Its deficiency impairs children’s cognitive and motor development, affecting their ability to learn and intellectual properties, and sometimes is the main cause of brain damage. Iodine deficiency can be severe in certain circumstances. According to agencies such as UNICEF and GAIN, nearly 19 million newborns are at risk of brain damage every year due to its deficiency. However, iodine supplementation in iodine-deficient children can help children attain their full intellectual potential. For children aged 1-3, 90 mcg of iodine per day is advised for both the baby genders.

How does vitamin B12 affect children’s cognition?

Vitamin B12 is important for brain development, neural myelination, and cognitive function among children 0-6 years of age. The deficiency of vitamin B12 in the early stages of childhood can negatively impact the cognitive performance of the affected children years later. In the case of brain development, the deficiency may lead in causing neurological defects like corpus callosum thinning, myelination retardation, and cortical atrophy. Other health issues may include weakness, tiredness, and slowed growth and development. To avoid such cognitive impairments and health issues, parents are advised to provide their children with proper supplementation of vitamin B12 in their daily diet.

How to introduce iron, iodine, and vitamin B12 into children’s diets?

According to the Centers for Disease Control and Prevention (CDC), iron-fortified baby formula is advised for children under 12 months of age who are not primarily breastfed. For full-term infants that are either exclusively or mainly breastfed, the American Academy of Pediatrics suggests a 1 mg/kg daily intake of

iron beginning at age 4 months until they begin eating iron-containing complementary foods. The academy also recommends 2 mg/kg/day iron intake for such babies aged 0-1 years. Other than iron-fortified baby formula, iron-fortified baby cereal, beans, pureed meats, spinach, fish, etc., should be served based on children's age groups.

Similar approaches can be perceived for iodine supplementation. Children aged 6 months or less should receive iodine either from breast milk or through supplementary formula milk with appropriate iodine content. Children between 7 months and 2 years who have insufficient iodine intake should receive iodine from supplements (formula milk, complementary foods, seafood, yogurt, bread, etc.).

To avoid vitamin B-12 deficits in children aged 0 to 6, include vitamin B12-rich foods, fortifying foods, and supplements such as micronutrient powders, dispersible tablets, drops, soft gel/pastes, liquids, drops, and more in children's diets.

Final thoughts: Tips for parents to ensure proper nutrient intake for cognitive development

A balanced diet supports children's brain development since it directly impacts cognitive function and overall brain health. Essential nutrients such as iron, iodine, vitamin B-complex, potassium, zinc, etc., usually support the growth of healthy brain cells, enhancing neural connections and improving the child's concentration and learning ability.

Parents need to ensure that their children receive the proper nutrition for cognitive development through various nutrient-dense foods in their daily diet. Encourage children to eat fruits, vegetables, whole grains, and lean protein foods. Incorporating baby formula milk or nutritious milk powder for children aged 2-6 years that contains the essential nutrients discussed above can help children have healthy and progressive cognitive development.

List of references:

1. Ghirri P, Lunardi S, Boldrini A. Iodine Supplementation in the Newborn. *Nutrients*. 2014;6(1):382-390. doi: 10.3390/nu6010382
2. Gordon RC, Rose MC, Skeaff SA, Gray AR, Morgan KM, Ruffman T. Iodine supplementation improves cognition in mildly iodine-deficient children12. *The American Journal of Clinical Nutrition*. 2009;90(5):1264-1271. doi:10.3945/ajcn.2009.28145
3. Hasbaoui BE, Mebrouk N, Saghir S, Yajouri AE, Abilkassem R, Agadr A. Vitamin B12 deficiency: case report and review of literature. *Pan Afr Med J*. 2021;38:237. doi:10.11604/pamj.2021.38.237.20967
4. Neumann D, Peterson ER, Underwood L, Morton SMB, Waldie KE. The development of cognitive functioning indices in early childhood. *Cognitive Development*. 2021;60:101098. doi:10.1016/j.cogdev.2021.101098
5. Pivina L, Semenova Y, Doşa MD, Dauletyarova M, Bjørklund G. Iron Deficiency, Cognitive Functions, and Neurobehavioral Disorders in Children. *J Mol Neurosci*. 2019;68(1):1-10. doi:10.1007/s12031-019-01276-1
6. Velasco I, Bath SC, Rayman MP. Iodine as Essential Nutrient during the First 1000 Days of Life. *Nutrients*. 2018;10(3):290. doi:10.3390/nu10030290
7. Venkatramanan S, Armata IE, Strupp BJ, Finkelstein JL. Vitamin B-12 and Cognition in Children123. *Adv Nutr*. 2016;7(5):879-888. doi:10.3945/an.115.012021
8. Office of Dietary Supplements - Iron. Accessed November 25, 2024. https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/
9. Office of Dietary Supplements - Vitamin B12. Accessed November 25, 2024. https://ods.od.nih.gov/factsheets/VitaminB12-HealthProfessional/
10. (PDF) Early childhood development and cognitive development in developing countries: A rigorous literature review. ResearchGate. Accessed November 23, 2024. https://www.researchgate.net/publication/321026156_Early_childhood_development_and_cognitive_development_ir

11. WHO guidance helps detect iron deficiency and protect brain development. Accessed November 23, 2024. https://www.who.int/news/item/20-04-2020-who-guidance-helps-detect-iron-deficiency-and-protect-brain-development
12. Iron and normal cognitive development | EFSA. July 26, 2013. Accessed November 23, 2024. https://www.efsa.europa.eu/en/efsajournal/pub/3335
13. (PDF) Theory Of Cognitive Development By Jean Piaget. *ResearchGate*. Published online October 22, 2024. doi:10.52622/joal.v2i2.79