Nutrition in the First 1,000 Days: Deficiency and Toxicity Prevention for Cognitive Development

PRACTICE TOOL

Nutrition in the first 1,000 days of life is important because much of the brain structure and capacity is developed during this time. The first 1,000 days are defined as the time from conception to the child's second birthday.[1] Adequate nutrition during this time is critical for long-term health outcomes including brain development, healthy growth, and a strong immune system.

The stages of the first 1,000 days include pregnancy, infancy, and early childhood. There are differences in nutritional needs during different stages of development. Often, there are short windows when under or overexposure can have long-term impacts. Malnutrition, which is often understood as undernutrition, can lead to nutritional deficiencies. Conversely, malnutrition also includes overnutrition and overexposure to certain nutrients or contaminants.

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Common Nutrient Deficiencies during Pregnancy, Infancy, and Early Childhood Associated with Cognitive Development Issues

- **Pregnancy:** During pregnancy, a fetus's brain grows at a rate of nearly 250,000 nerve cells per minute. Throughout this critical time, nutrient deficiency, exposure to drugs or alcohol, or other diseases can contribute to a waterfall effect of significant interruptions in development, resulting in birth defects, cognitive deficits, and altered growth. An example of this that most may be familiar with is a lack of folate in the maternal diet during pregnancy contributing to the failure of neural tube closure. Micronutrients such as folate, iron, zinc, choline, iodine, and Vitamin D, as well as macronutrients such as protein and omega-3 and omega-6 fatty acids, play a vital role in building a baby's brain during pregnancy.[1-4]
- **Infancy:** Breast milk is the optimal nutrition for brain development. It contains a variety of nutrients and proteins, as well as growth factors and hormones that cannot be replicated in infant formula, all of which are vital to a baby's brain development.[5] Infant formula is also appropriate nutrition when breast milk is not available. Breastfed infants have increased needs for:[6]
  - Iron and zinc (as breast milk has less iron than iron-fortified infant formula and stores of both zinc and iron deplete during infancy)
  - Iodine and Vitamin B_{12} (if the mother is deficient)
  - Vitamin D (supplement of 400 IU per day)
- **Early Childhood:** Children up to two years of age have growing brains that need nutritious foods rich in iron, zinc, fatty acids, and protein. By 6 months of age, infant iron and zinc stores are depleted, therefore, complementary foods that contain these nutrients should be preferentially offered. Through a balanced diet of a variety of proteins (from meats, fish, and beans), fruits, vegetables, and grains, this is fairly easy to provide. However, if the child is a picky eater, supplementing micronutrients that are found in abundance in only a few food resources, such as calcium, iron, Vitamin K, or some B vitamins is necessary. Growth and development continue to be rapid, and nutrients such as protein, calcium, and Vitamin D are required for the accretion of skeletal mass and to help prevent nutritional rickets.[2]

Prevention: Key Nutrients and Complementary Foods to Include for Children 6-24 Months for Cognitive Development[1]

- **Key nutrients for babies**
  - B-vitamins - Folate, B_6, B_{12}
  - Vitamin A
  - Vitamin D
  - Calcium
  - Iron and zinc
  - Omega-3 fatty acids (optimal ratio for omega-3:omega-6)
  - Choline
  - Iodine

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- **Complementary foods:** The introduction of complementary foods starting around 6 months for most infants, along with the continuation of breast milk and/or FDA-compliant infant formula until 12 months of age, can ensure optimal intake of needed nutrients. Introduction to solids is not necessary for nutrition, but for learning how to eat. By 12 months of age, it is important to focus on nutrient-dense foods as infants transition to solids and should include iron and zinc such as meat, poultry, seafood, eggs, beans, nuts, and iron-fortified cereals.

Key Nutrients for the First 1,000 Days[1,7]

Nutrient	Signs and Outcome Related to Deficiency	Nutrient Intake for Prevention of Deficiency
Vitamin A	Eye damage, poor growth, chance for infections	Prenatal vitamin with Vitamin A for mother; egg yolks, yellow and dark green leafy vegetables, whole milk
Vitamin B_6	Glossitis, muscle weakness, irritability, seizures, depression, difficulty concentrating, rashes	Meat, fish, nuts, beans, grains, fruits, and vegetables
Vitamin B_{12}	Increased risk of birth defects and preterm delivery, poor cognitive function; can affect bones, hair, skin, nails, energy level, mood, and memory	Meat, fish, poultry, milk, eggs, fortified breakfast cereals and breads
Calcium	Rickets, bone fractures, poor tooth development, poor muscle function, cognitive issues, blood clotting issues, heart arrhythmias	Prenatal vitamin with calcium for mother; dairy foods like milk, yogurt and cheese, calcium fortified foods (such as soy products), some leafy green vegetables, canned fish, nuts and seeds
Choline	Negative impact on neural tube closure, memory and learning functions	Meat, poultry, fish, dairy products, eggs, cruciferous vegetables, certain beans, nuts, seeds, and whole grains
Copper	Risk of low birth weight, muscle weakness, anemia, poor growth, neurological issues, risk of infections	Shellfish, seeds and nuts, organ meats, wheat-bran cereals, whole-grain products, and chocolate
Vitamin C	Scurvy, poor bone growth, bleeding gums, anemia	Prenatal vitamin with Vitamin C for mother; citrus fruits, red and green peppers, tomatoes, broccoli, and greens
Vitamin D	Bone diseases such as osteoporosis or rickets, immune dysfunction, muscle and nerve issues	Prenatal vitamin with Vitamin D for mother; egg yolks, saltwater fish, liver, fortified milk, cereal, and yogurt
Folate	Increased risk of neural tube defects and other neurological issues	Prenatal vitamin with folate for mother; meats, green leafy vegetables, beans, bananas, melons, fortified cereals, breads, and pastas
Iron	Impaired cognitive development, fatigue, risk of infections	Meat, eggs, green leafy vegetables, beans, whole grains, fortified breads and cereals. Breast-fed infants may need oral supplement after 4 months of age

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Key Nutrients for the First 1,000 Days[1,7] (continued)

Nutrient	Signs and Outcome Related to Deficiency	Nutrient Intake for Prevention of Deficiency
Iodine	Delayed development, impaired brain function	Prenatal vitamin with iodine for mother; iodized table salt, eggs, dairy products, saltwater fish and seafood
Vitamin K	Impaired blood clotting, delayed growth	Newborns get a shot of Vitamin K soon after they are born. Food sources include green vegetables and dark berries
Long-chain Polyunsaturated Fatty Acids	Impaired brain development, learning difficulties, lower immunity, poor weight gain	Oily cold water fish such as salmon, mackerel, tuna, herring and some seeds and nuts such as walnuts and flax seeds
Protein	Muscle weakness, failure to thrive, poor growth, fatigue, increased risk of infection	Meat, poultry, eggs, fish, legumes, dairy products
Selenium	Poor growth	Nuts, seafood, meat, poultry, eggs, cereals and other grains, and dairy products
Zinc	Increased risk of preterm birth, infection, and poor growth, impaired neurological function	Prenatal vitamin with zinc for mother; meat, fish, poultry, seafood, beans, nuts, whole grains, eggs, dairy products, and fortified breakfast cereals

Key Contaminants with Neurocognitive Development Implications and Industry Initiatives to Safeguard this Population

- Infants, toddlers, and young children are especially vulnerable to the effects of inorganic contaminants such as heavy metals like arsenic, lead, mercury and cadmium. Different types of neurotoxins can be harmful to the developing brain and are linked to problems with learning, cognition and behavior. Infants and children are estimated to take in about 3 times as much food as adults when compared to their body mass. Therefore, their accumulation of toxic element exposure is potentially much greater at least during this relatively short period.[8]
  - This exposure effect is associated with high intake/body weight ratio, high intestinal absorption with lower excretion, and lack of variety in diet.[9]
  - Adverse effects of inorganic contamination exposure to infants and children may include anemia, nephrotoxicity, developmental and reproductive toxicity, lower intelligence quotient, and neurotoxic effects.[9]
- Metals especially have a high affinity for binding in our bodies, and while that can be helpful in some situations such as avoiding iron deficiency, collecting the wrong kind of metal can be harmful to the body, interrupting normal biochemical and physiological functions, such as brain development.
- Many of these chemicals are found naturally in our environment. Heavy metals are not man-made so avoiding them entirely is quite difficult. Raw materials used to produce infant and toddler foods have the potential to contain chemicals with toxic properties.
- Foods that may potentially contain contaminants include:
  - Grains, particularly rice
  - Fruits and vegetables
  - Tap water
  - Predatory fish
- Tips to limit exposure
  - Overall, provide as wide a variety of foods as possible.
  - Limit a pregnant mother's intake of large, predatory fish such as king mackerel, marlin, or swordfish, which often contain higher concentrations of mercury. Instead choose light tuna, salmon, flounder, and cod, which also offer the benefit of higher doses of necessary fatty acids, zinc, selenium, choline and protein for fetal development.
  - Serve a variety of foods including different types of grains. Limit rice which tends to be higher in inorganic arsenic, as well as corn and oats which may be more likely to contain mycotoxins (a form of mold or fungus).

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- Serve a variety of fruits and vegetables, not just root vegetables
- Read labels (look for ingredients such as brown rice syrup)
- Limit fruit juices
- Check local water readings
- Address lead hazards in home

- What infant and toddler food companies are doing to safeguard against exposure:
  - Having products tested and certified by independent non-governmental organizations such as The Clean Label Project which tests products for purity.[10]
  - FDA's Closer to Zero: Reducing Childhood Exposure to Contaminants from Foods.[11] Infant food companies can stay up to date with FDA's continued efforts and initiatives to reduce childhood exposure to contaminants.
- Agricultural chemicals such as pesticides are also of concern. These are used by growers to protect their products from insects, weeds, fungi, and other pests, and their residues sometimes remain on food. The U.S. Department of Agriculture maintains a Pesticide Data Program (PDP), a national pesticide residue database program. PDP data are used by Federal agencies, academic institutions, food producers, food processors, chemical manufacturers, environmental interest groups, and food safety organizations to examine pesticide residue issues that may affect agricultural practices and domestic and international trade.[12]

Resources:

- ThousandDays.org. The First 1,000 Days: Nourishing America's Future. (https://rb.gy/mteg82)
- Office of Disease Prevention and Health Promotion. US Department of Health and Human Services. Build a Healthy Eating Routine When You're Pregnant or Breastfeeding. (https://rb.gy/sv3tbt)

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