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Infant Nutrition: The First 12 Months of Life
By Christina E. Schmidt Wood, MS, NE

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The first 12 months of life is a crucial period for infant growth and development. Knowing the delicate interplay between nutrients and physiological maturation, the timing of solid food introduction, and the potential need for certain supplements is vital to ensure optimal health, encourage the acceptance of a variety of foods, and guard against risk of chronic diseases such as diabetes and obesity as well as food intolerances.

Breast-Feeding
Much of the first year of infant nutrition doesn't involve solid foods. Breast milk or infant formula provides a complete source of energy and nutrients needed for normal growth and development in healthy newborns.

The American Academy of Pediatrics (AAP) and the World Health Organization (WHO) recommend exclusive breast-feeding for the first six months of life, with continued breast-feeding through 1 year of age along with solid weaning foods such as iron-fortified cereals, puréed meats, vegetables, and fruits.[1] Formula should be administered to breast-fed newborns still in the hospital only when medically necessary, such as for low birth weight infants, premature infants, or those with extreme allergies, gastrointestinal infections, or malabsorptive conditions.[2]

Despite these recommendations, only 13% of infants in the United States are exclusively breast-fed for six months. Additionally, data from the Infant Feeding and Practices Study II illustrate that nearly one-half of breast-fed infants were needlessly supplemented with formula in the hospital, increasing the risk of future breast-feeding complications.[2]

The nutritional composition of breast milk and its provision of immunomodulatory and immunoprotective benefits to infants give it an advantage over commercial infant formulas. Women who can breast-feed normally with an adequate milk supply don't need a further source of nutrition for normal, healthy infants during the first six months of life.[1,3-5]

The composition of human milk varies depending on the stage of lactation, maternal diet, and timing of feeding. Its more than 200 components continue to be identified in laboratory analyses.[5] Macronutrients include lactose, human fat, and three classes of proteins: mucins, whey, and casein. The whey and casein concentrations vary, ranging from 80:20 whey to casein in first 35 to 40 days during early lactation to 50:50 in the following 50 to 100 days during late lactation.[4]

Milk lipids contain a high concentration of long-chain polyunsaturated fatty acids (PUFAs), which serve as building blocks for prostaglandins, prostacyclins, the brain, and retinal membranes.[6]

Human milk contains numerous subclasses of proteins that play important roles in growth and development, nutrient absorption and utilization, immune defense, and possibly prebiotic activity.[4,7] Lactoferrin, for example, is involved in iron uptake, defending against pathogenic bacteria, gut *Bifidobacteria* growth, and cytokine production and release. ß-casein and casein phosphopeptides support calcium and zinc absorption. Immunoglobulins such as secretory immunoglobulin A transfer immunity acquired by the mother to the infant, offering innate protection against bacterial pathogens and viruses. Growth factors such as insulinlike growth factor-1 and peptide hormones support the maturation of the infant gastrointestinal tract.[4,6,8]

Nonpeptide bioactive factors in human milk also play important roles in infant health. Oligosaccharides are the third largest component of human milk, acting as prebiotics to promote growth of the gut microflora and possibly inhibiting pathogens from adhering to epithelial tissue.[8,9] Hormones such as thyroid hormones, cortisol, progesterone, and estrogen also have been identified in breast milk.[6] Strains of probiotics such as *Bifidobacteria*, lactic acid bacteria, and Streptococci from the maternal gut pass to the infant through human milk, and these bacteria serve to boost infant health and immunity.[7]

Maternal diet influences the amount of certain micronutrients in breast milk as well as a breast-fed infant's initial acceptance of certain foods. The quantity of most minerals in breast milk, such as iron and zinc, is fairly resistant to women's dietary changes, with the exception of iodine and selenium. Vitamins A, B_{12}, C, D, E, and K; thiamine; folate; riboflavin; niacin; pyridoxine; biotin; and pantothenic acid are more sensitive to dietary intake. Fatty acids such as DHA in breast milk also are affected by maternal diet.[5,10] Additionally, if a mother's diet routinely includes a certain flavor or food, a breast-feeding infant is more likely to accept it on initial introduction as a solid.[11]

As research unravels the complex nutrient composition of human milk, strong correlations between breast milk and positive health outcomes have been revealed. Breast-feeding is associated with significant risk reductions for acute otitis media, respiratory and gastrointestinal tract infections, asthma, cow's milk allergy, and atopic dermatitis in infants at high risk of atopic disease.[3,12-14] Longer periods of breast-feeding also appear to decrease the risk of overweight or obesity in adolescence.[12,15,16]

Results from studies assessing the impact of breast-feeding on the risk of type 1 and type 2 diabetes and cognitive performance are less conclusive. Some studies link higher IQ and developmental performance with breast-feeding while others show no benefit. Confounding factors such as maternal IQ and home environment exist. Though some studies do indicate lower risk of type 1 and type 2 diabetes in breast-fed infants, few of them rule out confounders such as birth weight, genetic risk, maternal body size, and socioeconomic status.[3,12,17,18]

Infant Formula

A woman who needs to supplement breast-feeding, stop breast-feeding before her infant is 1 year old, or is unable or chooses not to breast-feed should be guided by a medical professional such as an RD in choosing an appropriate infant formula.

Mothers' inadequate milk supply or infants needing enhanced caloric or nutrient intake are possible indicators for formula feeds. Insufficient milk production may be heralded by the lack of breast growth during pregnancy, maternal diabetes, or pituitary deficiency. Alternatively, an infant may display atypical oral-motor function resulting in the inability to extract milk, which also leads to a decrease in milk supply. Women returning to work and managing career demands also may resort to feeding their babies formula during the first year.[5]

Multiple types of infant formula are available for term and preterm infants. Term formulas include the most common cow's milk–based, as well as more specialized choices of soy, lactose-free, protein hydrolysate, elemental or amino acid, and antireflux formulas. Preterm or enriched formulas are designed to facilitate catch-up growth in premature and low birth weight infants. They contain additional protein, calories, vitamins, and minerals and may be used in feedings until the infant reaches a weight of 2.5 to 3.6 kg (roughly 5.5 to 8 lbs).[5,19]

Soy formulas are free of cow's milk protein and lactose. These formulas may be appropriate for families practicing a vegan lifestyle and for infants with congenital lactase deficiency or galactosemia, an inborn error of metabolism that causes the inability to metabolize the sugar galactose, a breakdown product of lactose. Soy formulas aren't indicated for infants with milk allergy, acute gastroenteritis, or colic. About 50% to 60% of infants with nonimmunoglobulin E (IgE) cow's milk protein intolerance also will react to soy.[5,19,20]

Many parents express concern that the phytoestrogens and isoflavones in soy will have estrogenic effects on their infants. In nearly 50 years of use and after extensive research, no observations or statistical differences of abnormal hormone effects on infants have been found.[5,19,20]

Lactose-free formulas also may be used for infants with galactosemia and congenital lactase deficiency as well for those with primary lactase deficiency. Lactose intolerance is extremely rare in infancy.[19]

Protein hydrolysate hypoallergenic formulas consist of partially or extensively hydrolyzed whey or casein and are used for infants with milk protein allergy or intolerance, soy allergy, a strong family history of allergy or atopic disease, or malabsorption diseases. Partially hydrolyzed formula shouldn't be used for infants with cow's milk allergy, though, because it contains cow's milk peptides.[5,13,19,21]

Evidence suggests that extensively hydrolyzed formula may help to delay or prevent atopic dermatitis for infants at high risk of atopic disease who aren't exclusively breast-fed for the first four to six months of life or who are formula-fed. Extensively hydrolyzed casein-based formula appears to offer further protective benefits compared with other hydrolysates.[13]

Research hasn't shown that hypoallergenic formulas offer any benefits for irritable, colicky, or sleepless infants.[5] Infants who remain symptomatic after a trial period on a hypoallergenic formula or who have severe protein hypersensitivity may improve with a nonallergenic amino acid–based formula. However, these formulas haven't been studied for atopy prevention.[5,13]

In an effort to make infant formulas more similar to breast milk, manufacturers have fortified them with certain supplements shown in multiple scientific studies to provide certain health benefits. For example, iron-fortified formulas should be used for all formula-fed infants to maintain adequate iron stores to support growth and prevent iron-deficiency anemia. Older infants and young children experience rapid growth, increasing the demand for iron and, as a result, susceptibility to iron deficiency. Iron deficiency is the most common nutrient deficiency in the United States, and prior to the availability of iron-fortified formulas and increased awareness for extended breast-feeding, childhood iron deficiency was a public health issue.[5] The AAP strongly discourages the use of low-iron formulas and has recommended they be discontinued from manufacture. Despite speculation that iron-fortified formulas cause gastrointestinal issues such as constipation, there's no scientific evidence to support this claim, and they have shown to be as well tolerated as low-iron formulas.[5,19]

More recently, commercial formulas have become available that are supplemented with probiotics and prebiotics as well as the omega-3 long-chain fatty acid DHA and the omega-6 long-chain fatty acid arachidonic acid (ARA). Formulas supplemented with prebiotics and probiotics are intended to boost immune protection and support normal growth. While current research indicates these formulas are safe and well tolerated, there isn't enough evidence to suggest their routine use for preventing allergy, diarrhea, or other bacterial infections despite some studies indicating benefits in these areas.[22-24]

Some studies show that formulas supplemented with prebiotics may protect against eczema, and formulas containing probiotics, particularly *Lactobacillus rhamnosus*, reduce clinical eczema in infants at high risk of allergy. Other research indicates that probiotic formulas result in less frequent antibiotic use for bacterial infections during infancy, though breast-feeding fewer than three times per day was included in the data calculations. Allowing breast-feeding potentially increases the supply of beneficial bacteria to the infant and may have skewed research results. These inconsistencies in research point to the need for additional study.[24-28]

Formulas supplemented with the long-chain fatty acids DHA and ARA are promoted to support eye and brain development. Both fatty acids are found in breast milk in variable amounts. DHA and ARA are the major omega-3 and omega-6 fatty acids in neural tissues, and DHA is an integral component of retinal membranes.

One large randomized controlled clinical trial looked at how various concentrations of DHA in formula affected infant visual acuity at 12 months old and cognitive function at 18 months old. Significant improvements in both of these end points were met with a formula DHA concentration of 0.32% of total fatty acids.[29,30]

Another randomized controlled clinical trial assessing DHA- and ARA-supplemented formulas fed to infants starting from birth to 12 months old found lower heart rates and longer attention spans in infants receiving supplemented formula. Long-chain PUFAs have been associated with lower heart rate and improved cardiovascular health in adults; however, the effect in infants requires clarification from further research. The effect on heart rate was not dose responsive; however, the improved distribution of attention was seen with the 0.32% and 0.64% DHA formula.[31]

Cochrane reviews conclude that, based on conflicting overall results for cognitive benefit from randomized clinical trials, DHA- and ARA-supplemented formulas shouldn't be recommended. Though other reviewers concur with this assessment for cognitive improvement, they point out that studies measuring visual attention were consistently positive.[32]

Supplements

Though breast-feeding is considered the best nutrition for infants, certain vitamin and mineral supplements may still be necessary for breast-fed and some formula-fed infants. These include vitamins D and K, iron, and fluoride.

A single intramuscular vitamin K injection (0.5 to 1 mg) is recommended for all newborns, regardless of which feeding type is used, to prevent hemorrhagic disease secondary to vitamin K deficiency. Iron supplementation, generally in drop formulation, may be required after 6 months of age for exclusively breast-fed infants if complementary iron-rich foods aren't introduced at that time. The AAP suggests iron-fortified formulas for all other infants.[5,20]

Fluoride supplementation of 0.25 mg/day is necessary after 6 months of age for infants consuming nonfluoridated water, a local water supply containing fewer than 0.3 ppm of fluoride, or commercial ready-to-feed formulas. These infant formulas aren't made with fluoridated water.[5]

A large body of evidence from recent research has led the AAP to recommend a vitamin D supplement of 400 IU/day to maintain 25-hydroxyvitamin D concentrations of greater than 50 nmol/L (the amount proven to prevent and treat rickets caused by vitamin D deficiency) for all infants shortly after birth and through adolescence. This is an increase from the previous recommendation of 200 IU/day from 2 months old through adolescence. Vitamin D supplements, usually in drop formulation, should be given to all breast-fed infants; all infant formulas already are fortified with vitamin D. After 12 months of age, infants should be weaned to vitamin D-fortified milk.[33]

The recommendation for universal vitamin D supplementation for breast-fed infants throughout the United States has been somewhat controversial. Vitamin D content in breast milk may be elevated but only with maternal supplementation in large doses ranging from 4,000 to 6,000 IU/day. Some studies suggest deficiency occurs only in certain populations in certain geographical areas or seasons.[5,34-36] Infants living at northern latitudes and in urban settings, during the winter season, having dark skin, or wearing concealing clothing due to cultural/religious beliefs were thought to be vulnerable to vitamin D deficiency and rickets. However, the bulk of research indicates that infants, regardless of skin pigmentation and even those living in sunny latitudes may be vulnerable to vitamin D deficiency. Health recommendations to minimize sun exposure for infants, limited dietary sources of vitamin D, and the high doses of vitamin D supplements for lactating women necessary to increase breast milk content may be factors in the documented widespread deficiency.[33,36,37]

Additionally, in adults, vitamin D has been shown to play a role beyond supporting bone integrity. Research links vitamin D to bolstering innate immunity and protecting against chronic diseases such as cancer, type 2 diabetes, and autoimmune diseases. Also, supplementation during infancy and early childhood may lower the occurrence of type 1 diabetes.[33]

Additional supplements may be necessary for breast-fed infants raised in households practicing vegetarianism or veganism. These diets require vigilance to maintain the plant-based intake of certain key nutrients that are found mostly in animal and fish protein sources. Both vegetarian and vegan diets are healthful and may be developed to meet the needs of growing infants and children.[20]

Since exclusively breast-fed infants' nutrition varies somewhat depending on maternal diet, vegan/vegetarian breast-feeding mothers' dietary intake should include adequate sources of iron and vitamins B_{12} and D. Vegan diets involve avoiding all animal products, so mothers following this type of diet may be more likely to require supplementation. If the mother doesn't supplement or her diet is inadequate, the infant should receive B_{12} supplementation from birth and iron supplementation after 4 months of age.[5] All breast-fed infants, regardless of dietary practices, should receive vitamin D supplements.[33]

Once complementary foods are introduced, fortified cereals, grains, and tofu fortified with calcium, B_{12}, iron, and zinc are appropriate choices in addition to fruits, vegetables, and legumes. Because vegan/vegetarian diets include high-fiber, low-calorie foods that tend to increase satiety, care should be taken to ensure these infants and toddlers consume nutrient dense foods with adequate calories to meet their needs for growth.[5,38]

Introduction of Complementary Foods

It's crucial for an infant's long-term health to understand the appropriate time window for introducing complementary foods and recognizing suitable first food choices.

Prior to 4 months of age, solid foods aren't necessary for infant growth and development and, if given, potentially expose an infant's immature immune system to pathogens.[5,8] Breast milk offers immunologic benefits to infants that food can't replace.

While the AAP and WHO stress that exclusive breast-feeding is the best way for infants to obtain energy and nutrients through 6 months of age, the organizations acknowledge that infants may be developmentally ready for solid foods at 4 months of age.[2,5] Research has shown that in food-secure environments, timing the introduction of complementary food at 4 to 6 months of age neither benefits nor detracts from infants' overall healthy growth.[39]

However, the timing of the introduction of solid foods may affect an infant's growth trajectory. For example, one study noted slower and lower growth trajectories for infants who began solid foods after 22 weeks of age.[40]

Based on overall research, the AAP and other experts agree that the period between 4 and 6 months of age is the appropriate time for infants to begin first foods, at which point their nutrient needs exceed the amounts that breast milk or formula can provide.[5]

Healthy term infants are born with an endowment of iron bestowed by their mothers. These iron stores, which consist of hemoglobin iron, storage iron, and functional tissue iron, become depleted by the first four to six months of life. Iron deficiency is the most common trace mineral deficiency in the world, and currently 2% to 3% of children in the United States have iron deficiency anemia; 9.2% have iron deficiency without anemia.[5,41]

Iron deficiency and iron deficiency anemia correlate with irreversible cognitive, behavioral, and motor impairments.[5,41] Maternal iron intake has little impact on levels in breast milk. The amount of iron in breast milk, though easily absorbed, is extremely low (0.2 to 0.4 mg/L) and insufficient to meet a growing infant's needs beyond 6 months of age.[10,41,42] Studies indicate that low birth weight, premature birth, male sex, a shorter span of breast-feeding, and faster growth and weight gain in the first six months of life increase the risk of iron deficiency and iron deficiency anemia. These infants are candidates for iron supplementation to decrease the risk of iron deficiency anemia.[43-45]

Following solid food introduction, breast milk or formula should be continued until the infant is 1 year old. Introducing cow's milk before age 1 significantly increases the infant's risk of low iron.[43,46] Breast-fed infants older than 6 months require additional iron and are at risk of iron deficiency if their diets don't include iron-fortified cereals, plant-based iron-rich foods, meats, or regular iron supplementation.[47,48] Evidence suggests that a developmental change may occur in the regulation of iron absorption in infants between 6 and 9 months of age. This may allow some infants to adapt to lower iron intakes during the ages of 6 to 12 months.[49]

While delaying the introduction of solid foods beyond 6 months of age may pose risks of nutrient deficiencies and growth abnormalities, introducing them prior to 4 months of age may pose a different set of problems. Infants who are fed formula or those perceived as fussy are more likely to be offered solid foods before they are 4 months old.[50,51] Not only are these infants developmentally unprepared for solid foods, early feeding may increase their risk of developing type 1 diabetes, obesity, and certain allergies.

Several studies examining infant populations with genetic susceptibility to type 1 diabetes point to the significantly greater risk of developing type 1 diabetes, characterized by beta cell autoimmunity, when infants are fed complex proteins such as gluten or cow's milk proteins, fruits, berries, and root vegetables before they are 4 months old. One birth cohort revealed an increased risk of type 1 diabetes with both early feeding of cereals between ages 0 to 3 months and late feeding at 7 months and beyond.[16,52-56] Short-term breast-feeding has also been implicated as a risk factor for beta cell autoimmunity, but this association hasn't been repeated in other studies.

Feeding cow's milk protein to infants prior to 4 months of age also may increase their risk of developing cow's milk allergy and possibly allergy to other foods.[5] Very early feeding of solid foods has been associated with an increased incidence of atopic dermatitis in children up to age 10.[57,58] Though some allergies and type 1 diabetes are associated with early feeding, exposure to gluten prior to 4 months old hasn't been linked to developing autoimmunity associated with celiac disease. However, one large cohort study found an elevated risk of celiac disease with delayed gluten introduction after 6 months of age.[51,52,59]

Research also has shown that early feeding increases the odds of obesity in children. Infants introduced to solid foods after 4 months of age exhibit a lower risk of obesity and are more likely to have a healthy weight. This result has been noted even when infants aren't breast-fed, though combined breast-feeding with food introduction after 4 months old further reduces the risk of obesity.[16,56] Based on research and expert recommendations, health professionals should encourage solid food introduction to infants during the period between 4 and 6 months of age.

Once infants are ready for complementary foods around 6 months of age, solid foods increasingly provide the necessary nutrients that breast milk or formula alone cannot supply. In general, infants require about 40% to 50% of their calories from fat, 7% to 11% from protein, and the remaining amount from carbohydrate. The types of foods selected and how they're introduced are vital both to infant growth and their acceptance of food and flavors. By 10 months of age, infants transition from approximately 20% to 50% reliance on foods for energy intake.[5]

First foods should be nutrient dense, ideally containing plentiful amounts of iron and zinc, whose endowments from birth are exhausted by roughly 6 months of age. Some studies estimate more than 90% of the iron and zinc required by a 9- to 11-month-old infant needs to be supplied by complementary foods.[10] The AAP Committee on Nutrition recommends fortified infant cereals and puréed meats to meet these criteria but doesn't single out breast-fed infants as those particularly vulnerable to deficiency.[2] The WHO and the Pan American Health Organization specify meat, poultry, fish, or eggs as beneficial first foods for breast-fed infants to meet iron and zinc needs, stating that plant-based foods are inadequate. These foods also ensure adequate sources of vitamins B_6 and B_{12}.[10]

Studies have shown puréed meats to be as well tolerated and accepted by 6-month-old infants as infant cereals. Total daily zinc absorption is higher from puréed meats as well, regardless of higher absorption efficiency from foods low in zinc, such as cereals and legumes.[10] Despite national guidance by the AAP to introduce iron- and zinc-rich foods early, the Feeding Infants and Toddlers Study highlighted data showing that less than 10% of 7- to 11-month-olds in the United States consumed meats or poultry. Most, however, were eating infant cereals, fruits, and vegetables.[60]

Some experts argue that red meat isn't a necessary first food to provide adequate iron to infants and point out that the incidence of iron deficiency anemia isn't higher among vegetarian adults and children.[5] A large body of research suggests that dietary habits such as red meat intake begin in childhood and endure through adulthood. Regular, long-term red meat consumption is potentially deleterious to health and has been associated with various cancers, cardiovascular disease, type 2 diabetes, and premature death.[48]

Recent studies show plant-based (nonheme) iron has an independent absorption mechanism and doesn't compete with other sources of iron, thus supplying an adequate amount of dietary iron.[40] Nonheme iron absorption is enhanced by vitamin C, retinols, and other carotenes, nutrients that are present in high amounts in fruits and vegetables. Nonheme iron is found in meat, poultry, eggs, dairy, and plants. Both the AAP and Academy of Nutrition and Dietetics state that diets excluding red meat can provide necessary nutrition for infancy and beyond.[5,48,61]

Since healthy eating patterns begin early in life, it's important to encourage acceptance of healthful foods and exposure to a variety of flavors when introducing first foods in the later stages of infancy. Studies evaluating fruit and vegetable intake among infants showed that repeated exposure to a certain vegetable significantly encouraged its acceptance. In addition, increasing the variety of vegetables, fruits, and flavors offered facilitated acceptance of a novel food.[62]

Infants may exhibit facial expressions in response to tasting some foods that could be interpreted as dislike. These responses are innate and not indicative of food rejection. Infants should be given repeated opportunities to try the food to encourage acceptance.[11,62,63]

Beginning at the stage of complementary food introduction, infants may be offered a wide variety of fruits, vegetables, meats, or grains, providing they have an appropriate smooth, semiliquid consistency. Nutrient-dense foods rich in healthful fats, such as avocado; proteins such as meat, fish, eggs, or soy; and vitamins and minerals common in fruits, vegetables, and fortified infant cereals are excellent choices.

Food Allergy and Prevention

While expert guidance suggests feeding each new food separately to infants for two to three days to watch for intolerance reactions, the AAP no longer recommends delaying the introduction of common allergenic foods beyond the common age of beginning solids at 4 to 6 months to prevent the development of atopic disease. On the contrary, recent research suggests offering these foods early, along with other first foods, around 6 months old may promote tolerance, and delaying allergenic food introduction increases risk of food allergy and eczema.[64]

Current guidelines endorse exclusive breast-feeding for at least 4 and up to 6 months of age, recommend introducing solid foods around 6 months old, and postpone whole cow's milk until 1 year old. Foods containing cow's milk protein may be offered along with other solid foods at 4 to 6 months of age.[13]

High-risk infants, or those with at least one parent or sibling with an allergic disease, don't require dietary intervention, a departure from previous advice for at-risk infants to avoid eggs until age 2 and peanuts, nuts, and fish until age 3. If atopic symptoms are already present, however, dietary manipulation may be necessary and should be handled on an individual basis.[13]

The most prevalent allergenic foods are cow's milk (including all dairy), eggs, peanuts, tree nuts, fish, shellfish, soy, and wheat. The incidence of cow's milk allergy is 1% to 2% during infancy, but along with egg, soy, and wheat allergies, it tends to resolve during childhood as the immune system matures. Peanut, tree nut, shellfish, and fish allergies, however, are rarely outgrown.[5,13,14] Common symptoms of food allergy are urticaria, atopic dermatitis, laryngeal edema, wheezing, coughing, abdominal pain, diarrhea, or vomiting.

While most food allergies are IgE mediated, food protein enterocolitis and food protein enteropathy are gastrointestinal allergies that are immunologically mediated but don't involve the IgE pathway. Food protein enterocolitis occurs in less than 1% of infants and tends to be outgrown by age 3. The most common symptoms are vomiting, lethargy, blood in the stool, and diarrhea within two to six hours after food ingestion. The offending foods often are cereals, vegetables, or poultry, typically considered to have low allergenic potential. Dietary protein enteropathy involves similar symptoms following ingestion of cow's milk, soy, chicken, eggs, rice, or fish.[5,65] Because infant rice cereal is one of the most common first foods, it's important for health professionals to be aware that a reaction may occur.

Though general dietary guidelines regarding food allergy prevention don't suggest dietary intervention unless symptoms are present, recent studies have unveiled certain foods and nutrients as well as supplements in infants' diets that may be beneficial in decreasing the risk of allergy. Antioxidants may be protective, along with vitamins D and E, though results are controversial.[64] One birth cohort study revealed that diets consisting largely of homemade foods, fruits, and vegetables correlated with less food allergy by age 2.[66]

Fish, DHA, and ARA also are potentially protective in the development of allergic disease. One-year-old children who ate fish more than twice per month were found to have a lower overall risk of allergy through age 12, and infants supplemented with DHA and ARA formula had less incidence of allergy up to age 3.[67,68] Formulas with added probiotic strains, particularly *L rhamnosus*, are associated with significantly less atopic eczema in high-risk infants.[24,25,27,69] The AAP cautions against using probiotic therapy in seriously ill, debilitated, or immunocompromised infants and children since the effects of introducing bacterial strains in this population isn't known and may increase the risk and burden of disease.[27,70]

Clearly the critical stages of growth and development during the first year of life require careful consideration to each influential element during this time. Proper nutrition in infancy is paramount in guarding against disease and providing the building blocks for a strong foundation of health throughout life.

—Christina E. Schmidt Wood, MS, NE, is a Santa Barbara, California–based nutritionist and certified nutrition educator who has been featured on the TODAY show and has written nutrition articles for The Bump. She also is the author of the Baby Bistro and Toddler Bistro books and boxes.

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Examination

1. What percentage of the US infant population meets the American Academy of Pediatrics guideline for exclusive breast-feeding for the first six months of life?
A. 13
B. 25
C. 47
D. 55
E. More than 75

2. Which component of breast milk is involved in infant immune protection?
A. Whey
B. Cortisol
C. Long-chain fatty acids
D. Insulinlike growth factor-1
E. Selenium

3. Which nutrient in breast milk resists maternal dietary changes?
A. Selenium
B. Iron
C. DHA
D. Vitamin B12
E. Vitamin D

4. Research consistently shows the use of formulas supplemented with DHA and arachidonic acid are associated with which of the following?
A. Increased IQ
B. Improved attention span
C. Lower heart rate
D. Visual acuity
E. Improved motor skills

5. What is the current recommendation regarding vitamin D supplementation for infants?
A. 400 IU/day for all infants shortly after birth
B. 400 IU/day for exclusively breast-fed infants
C. 200 IU/day for all infants
D. 400 IU/day for breast-fed infants during the winter months
E. 200 IU/day for infants living in northern latitudes

6. Which nutrient(s) should be supplemented in breast-fed vegan/vegetarian infants' diets if the mother's diet is insufficient?
A. Vitamin B12
B. Calcium
C. Zinc and iron
D. DHA
E. Vitamin A

7. At what age does an infant's iron stores from birth become depleted?
A. 2 to 3 months
B. 3 to 4 months
C. 4 to 6 months
D. 8 to 12 months
E. After 12 months

8. Which are the most common allergenic foods and when should they be introduced into infants' diets?
A. eggs, nuts, milk, wheat, soy, fish; 1 year of age
B. eggs, fish, shellfish, peanuts, tree nuts, dairy, soy, wheat; 4 to 6 months of age
C. cow milk, fish, soy, eggs, wheat, nuts; 3 years of age
D. eggs, shellfish, peanuts, dairy, soy, wheat; 2 years of age
E. eggs, fish, shellfish, peanuts, tree nuts, dairy, soy, wheat; 1 year of age for eggs, wheat, dairy; 2 years of age for nuts; 3 years of age for fish

9. Which of the following is an acceptable food for infants only after 12 months of age?
A. Infant cereals
B. Puréed fruits and vegetables
C. Soft eggs
D. Puréed meats
E. Cow's milk

10. Which of the following may decrease the risk of food allergies?
A. Delaying the introduction of allergenic foods beyond age 1
B. Offering whole cow's milk at 4 to 6 months of age
C. Delaying the introduction of nuts and fish until age 3
D. Exclusive breast-feeding for at least the first four months and including foods rich in omega-3 fatty acids and antioxidants among first foods
E. Delaying foods containing gluten until 7 months of age