

In Brief

Vegan Diets in Infants, Children, and Adolescents

Adolescent Vegetarians: How Well Do Their Dietary Patterns Meet the Healthy People 2010 Objectives?

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For most children, a pediatrician's inquiries into the diet history lead to routine discussions of when whole milk should be weaned to skim or how to ensure that teens get enough calcium. However, for families and children who have chosen a vegan or vegetarian diet, the pediatrician may need to delve deeper into the diet history and perhaps deeper into the nutritional literature to assure that nutritional needs are met.

Vegan diets include only foods of plant origin. Strict vegans eat only grains, vegetables, fruits, legumes, nuts, seeds, and vegetable fats. Many families, however, practice variations on veganism and vegetarianism, and each patient's specific diet restrictions must be obtained by history.

Some people believe that patients following vegan or vegetarian diets suffer from nutritional deficiencies. Although there have been case reports of children failing to thrive or developing cobalamin deficiency on vegan diets, these are rare exceptions. Multiple experts have concluded independently that vegan diets can be followed safely

by infants and children without compromise of nutrition or growth and with some notable health benefits. Pediatricians working with vegan families must ensure that the parents understand the special nutritional needs of children at different developmental stages and assist them in meeting those needs within the framework of their beliefs.

During pregnancy and for breastfed infants after birth, the maternal diet is the indirect source of nutrition. It is not clear if there are differences in pregnancy duration or birthweight among pregnant women who are vegetarians. Regardless, pregnant vegan women should be encouraged to maximize their energy intake and take standard prenatal vitamins during their pregnancies.

After birth, infants preferentially should be fed human milk, and its composition is affected by maternal diet. The nutrients in human milk that are most sensitive to maternal diet are vitamins A, C, D, and the B group. Analysis of the milk of vegan mothers compared with population norms has not shown significant differences in levels of most of these vitamins or in magnesium, calcium, taurine, or isoflavones (soy-derived estrogen analogs). Vegans generally are aware of the need to take supplemental vitamin B12 because their diets provide very little. However, vegan mothers can have borderline low B12 levels, which will result in milk that has a low B12 content. There have been case reports of B12 deficiency in exclusively breastfed infants of vegan mothers, and for this reason, supplementation of all breastfed infants of vegan mothers is recommended unless the mother is taking approved B12 supplements or regularly

includes B12-fortified foods in her diet. The recommended supplementation of B12 for breastfed vegan infants is 0.4 mcg/d during the first 6 months after birth and 0.5 mcg/d beginning at 6 months of age.

The long-chain fatty acid docosahexanoic acid (DHA) recently has been added to some infant formulas in the United States. This fatty acid is found in high concentrations in the brain and retina, and there is evidence that early dietary intake of DHA is associated with superior developmental scores at some milestones. DHA is derived primarily from fish and eggs, and vegan adults who do not get it from dietary sources must synthesize it from linolenic acid. DHA levels in the milk of vegan mothers are lower than those seen in other populations, although higher than that seen in nonsupplemented infant formulas. Breastfed vegan infants have lower erythrocyte DHA levels than do breastfed infants of omnivore mothers. Studies are underway to determine the best way to increase DHA in the milk of vegan mothers. Options currently under investigation include increasing endogenous synthesis by increasing dietary intake of sources of linolenic acid (ground flaxseed, flaxseed oil, canola oil, soybean oil) or via a DHA-triacylglycerol supplement produced by algae.

For vegan infants who are not breastfed, soy-based infant formula is the only option during the first year of life. Unfortunately, there are no available and nutritionally sufficient formulas free of animal products for preterm infants and for those who cannot tolerate soy-based formula. Failure to thrive in vegan infants usually is due to use of a homemade formula in the first

year after birth. Parents should be cautioned that soy milk, rice milk, nut or seed milk, nondairy creamer, water-based cereals, or mixtures of fruit and vegetable juices do not contain sufficient vitamins, minerals, or nutrients for their baby. For the same reasons that nonvegan infants are not transitioned to whole cow milk before 1 year of age (low iron bioavailability, inappropriately high sodium, potassium, and chloride), vegan infants should not be started on commercial soy milk before 12 months of age.

By 7 to 8 months of age, solid food intake of vegan infants should include sources of additional protein and foods that are nutrient-dense. Good sources of protein can include mashed or pureed beans, mashed tofu, or soy yogurt. The need to concentrate on nutrient-dense foods stems from the problem that many vegan foods have high fiber content and bulk. Infants who eat only small quantities may not take in enough volume to meet their energy and nutrient requirements. Sources of concentrated calories and nutrients include mashed firm tofu, bean spreads, mashed avocado, and cooked dried fruits.

Infants can be started on fortified full-fat soy milk at 1 year of age. This should be supplemented with human milk or soy-based formula until the infant is 2 years old or reliably able to drink 24 oz of soy milk daily. The total fat content of full-fat soy milk is comparable to that of 2% fat cow milk, so as noted previously, the infant's diet should include other sources of concentrated calories. There are commercially available baby foods for vegan infants, but because the selection may be limited, many vegan parents choose to prepare their own baby foods. Parents preparing homemade baby foods should be cautioned to follow preparation guidelines to ensure appropriate consistency and freshness.

Zinc supplementation may be re-

quired in vegan infants as they transition to solid foods. Zinc levels in human milk decline throughout lactation, but as nonvegan infants make the transition to solid foods, they usually obtain sufficient zinc from these sources. Vegan infants, however, usually have an increased intake of phytate, found in whole grains and legumes, which reduces the bioavailability of dietary zinc. Zinc bioavailability can be improved by choosing fermented soy products such as tempeh and miso or yeast-leavened whole grain breads. Formal recommendations for zinc supplementation are not available, and if there is concern for zinc deficiency in a vegan infant, consultation with a nutritionist may be indicated.

For toddlers and older children, the challenges are to ensure sufficient intake of energy, protein, vitamins, and minerals. Energy intake can be assessed either by measuring dietary intake with comparison to recommendations or population norms or by evaluating growth parameters. Studies that compare energy intake between vegan and nonvegan children find that intakes of energy and protein are similar, although as compared with age-matched nonvegan children, the vegan population derives a lower percentage of energy intake as fat and a correspondingly higher percentage as carbohydrate.

Energy intake in vegan children may be compromised by the composition of their diets. Children whose diets are based predominantly on fruits, vegetables, and cereals can develop energy deficits because this diet has low energy density and high bulk. The upper limit of fiber recommended in children's diets by the American Academy of Pediatrics is 0.5 g/kg per day. The American Health Foundation recommends the following formula for maximum fiber intake in g/d: patient's age in years + 10. Soy products, legumes, nuts, and nut butters combined with grains should be recommended to in-

crease energy density. Choosing refined instead of whole grains and peeling fruits and vegetables can reduce fiber content.

There are a few studies of the growth of vegan children. A study of 404 vegan children in Tennessee ages 4 months to 10 years compared height, weight, and weight for height with National Center for Health Statistics norms. This comparison showed small though significant differences in height for age for children younger than 5 years and significant differences in weight for age in the 9- and 10-year-old range, with the vegan children weighing 1.11 kg less than the reference population. A British study of vegan children through age 18 years showed the vegan population to be within the normal range for height, weight, head, and chest circumference compared with population standards. In this study, vegan boys tended to be slightly lighter and shorter (below the 50th percentile for nonvegan boys), and girls tended to be slightly lighter. Despite these growth differences, no evidence of growth failure in the vegan population (weight for age below the 3rd or 5th percentile) was seen in either of these studies. Indeed, smaller size may be associated with better long-term health, as has been demonstrated in animal studies.

Most vegan diets that provide sufficient energy also provide appropriate amounts of protein. Because protein derived from plant sources is only about 85% digestible and the amino acid composition of a vegan diet is less varied, daily protein intake in vegan children should be increased by 30% to 35% in children younger than 2 years, 20% to 30% in children 2 to 6 years, and 15% to 20% in children older than 6 years. This translates into an additional 2 to 14 g of protein per day, easily met by an energy-sufficient diet.

Attention to calcium in the diets of vegan children is important because

studies have shown that calcium intake frequently is low. Calcium-fortified rice and soy milk and orange juice provide the same amount of calcium as cow milk (about 300 mg per 8-oz cup). In addition, high-calcium, low-oxalate vegetables such as broccoli, kale, and collard greens should be encouraged. If vegan children do not drink fortified milk or orange juice, their parents should be provided with information about alternate sources of calcium in vegan foods, and the children should receive calcium supplements if their dietary intake is suboptimal.

Vitamin D-dependent rickets has recurred in industrialized countries recently. Recommendations for vitamin D intake are the same for vegan and nonvegan children. The primary dietary source for nonvegan children is vitamin D-fortified cow milk. For vegan families, fortified soy milk and cereals should be recommended in dark-skinned children or for those unlikely to get at least 30 minutes of sun exposure to the face and hands three times a week.

The concentration of riboflavin is low in whole grains, so vegan children can benefit from substituting small amounts of enriched grains to increase riboflavin intake. Other good sources of this nutrient include nutritional yeast, wheat germ, soybeans, mushrooms,

leafy green vegetables, avocados, almonds, sea vegetables, and fortified cereals.

Iron deficiency anemia is a common nutrition problem among all population groups. Although vegan and vegetarian adults have been shown to have lower iron stores, they experience no higher rates of anemia than is seen in the general population. Several studies of iron intake in vegan preschoolers and children have shown them to be above the recommended daily allowance, but nonheme iron is absorbed less well than iron from meat sources. Vegan children's high vitamin C intake, which improves absorption of nonheme iron, likely compensates for this lower bioavailability. As with all children, parents should be aware of the need to include iron-fortified foods. Screening tests for iron deficiency anemia should be performed according to the American Academy of Pediatrics schedule.

A growing population of vegan adolescents lives in nonvegan households. Because neither the adolescent nor the parents are likely to be very familiar with the nutritional concerns or available food options, these families may need detailed information and support. Many parents and clinicians are concerned that teenage girls may use vegetarianism or veganism to mask an

eating disorder. A study of adolescent eating patterns in Minnesota found that a significant proportion of the adolescents who identified themselves as vegetarian had adopted this diet as a method of weight control. Parents and physicians must be alert to adolescent vegetarians who have extremely restrictive eating patterns. However, teenagers should not be discouraged from choosing a vegetarian diet based on the Minnesota study because the study's overall nutritional assessment found that a significantly higher percentage of the vegetarian or vegan population had a diet that was in compliance with the Healthy People 2010 objectives for percent calories from fat and for fruit and vegetable intake.

Vegan families and adolescents who choose veganism can avoid nutritional deficiencies and may gain health benefits from their dietary choices. They simply must be well educated regarding nutritional needs and the food choices that will meet them. Physicians and nutritionists can provide invaluable information and support to these patients.

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