

Dietary Recommendations for Children and Adolescents

A Guide for Practitioners

Consensus Statement From the American Heart Association

Endorsed by the American Academy of Pediatrics

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Abstract—Since the American Heart Association last presented nutrition guidelines for children, significant changes have occurred in the prevalence of cardiovascular risk factors and nutrition behaviors in children. Overweight has increased, whereas saturated fat and cholesterol intake have decreased, at least as percentage of total caloric intake. Better understanding of children's cardiovascular risk status and current diet is available from national survey data. New research on the efficacy of diet intervention in children has been published. Also, increasing attention has been paid to the importance of nutrition early in life, including the fetal milieu. This scientific statement summarizes current available information on cardiovascular nutrition in children and makes recommendations for both primordial and primary prevention of cardiovascular disease beginning at a young age. (*Circulation*. 2005; 112:2061-2075.)

Key Words: AHA Scientific Statements ■ adolescents ■ children ■ diet ■ nutrition

It is estimated that 75% to 90% of the cardiovascular disease epidemic is related to dyslipidemia, hypertension, diabetes mellitus, tobacco use, physical inactivity, and obesity; the principal causes of these risk factors are adverse behaviors, including poor nutrition.¹⁻³ The atherosclerotic process begins in youth, culminating in the risk factor-related development of vascular plaque in the third and fourth decades of life.⁴⁻⁶ Good nutrition, a physically active lifestyle, and absence of tobacco use contribute to lower risk prevalence and either delay or prevent the onset of cardiovascular disease.^{2,3} These observations have established the concept of prevention of the development of cardiovascular risk factors in the first place, now called primordial prevention.⁷ Education, with the support of the healthcare community, combined with health policy and environmental change to support optimal nutrition and physical activity, are central to this health strategy.

This document provides dietary and physical activity recommendations for healthy children; discusses the current content of children's diets; reviews the adverse health

consequences of increased intakes of calories (relative to energy expenditure), saturated and *trans* fat, and cholesterol; and provides age-specific guidelines for implementation of the recommended diet, including the period from before birth to 2 years of age. Medical practitioners are the intended audience, and guidelines to implement recommendations in clinical practice settings are provided. Public health strategies for improving the quality of children's diets are also discussed.

This scientific statement on optimal cardiovascular nutrition for infants, children, and adolescents revises the 1982 document on the same topic and also builds on the recent consensus statement on optimal nutrition for the prevention of many chronic diseases of adulthood.^{8,9} This revision responds to the obesity epidemic that has emerged since the publication of the last statement that addressed children's nutrition from the American Heart Association (AHA) and has new focuses on both total caloric intake and eating behaviors.^{10,11} This revision strongly conveys the message that foods and beverages that fulfill nutritional requirements

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TABLE 1. AHA Pediatric Dietary Strategies for Individuals Aged >2 Years: Recommendations to All Patients and Families

Balance dietary calories with physical activity to maintain normal growth
60 Minutes of moderate to vigorous play or physical activity daily
Eat vegetables and fruits daily, limit juice intake
Use vegetable oils and soft margarines low in saturated fat and <i>trans</i> fatty acids instead of butter or most other animal fats in the diet
Eat whole grain breads and cereals rather than refined grain products
Reduce the intake of sugar-sweetened beverages and foods
Use nonfat (skim) or low-fat milk and dairy products daily
Eat more fish, especially oily fish, broiled or baked
Reduce salt intake, including salt from processed foods

are appropriate for growing and developing infants, children, and adolescents. Calorie-dense foods and beverages with minimal nutritional content must return to their role as occasional discretionary items in an otherwise balanced diet.

A critical component of contemporary guidelines is the strength of the scientific evidence base for recommendations. Whereas the scientific base for understanding the potential harm and benefit of current dietary practices and the relationship to risk factors is strong, the scientific base for recommended interventions is weaker for several reasons: limited number, statistical power, and scope of intervention studies; limited efficacy of attempted interventions; and lack of generalizability of studies of feeding behaviors at younger ages. Historically, most have had small sample size and have not had ethnic diversity among participants. Nonetheless, given the current obesity epidemic, sufficient natural history and prevalence data exist to justify intervention, although continued evaluation is necessary to identify optimal strategies.¹²

Dietary Recommendations

The general dietary recommendations of the AHA for those aged 2 years and older stress a diet that primarily relies on fruits and vegetables, whole grains, low-fat and nonfat dairy products, beans, fish, and lean meat.^{1,13} These general recommendations echo other recent public health dietary guidelines in emphasizing low intakes of saturated and *trans* fat, cholesterol, and added sugar and salt; energy intake and physical activity appropriate for the maintenance of a normal weight for height; and adequate intake of micronutrients.^{14–16} Tables 1 and 2 provide strategies for implementing healthy cardiovascular nutrition. The recently published *Dietary Guidelines for Americans* (for those 2 years of age and older) and American Academy of Pediatrics Nutrition Handbook provide important supporting reference information with regard to overall diet composition, appropriate caloric intakes at different ages, macronutrients, micronutrients, portion size, and food choices.^{14,17,18} Table 3 provides daily estimated calorie and serving recommendations for grains, fruits, vegetables, and milk/dairy products by age and gender. Consistent with the *Dietary Guidelines for Americans, 2005*,^{14,18} nutrient and energy contributions from each food group are calculated according to the nutrient-dense forms of foods in each group (eg, lean meats and fat-free milk), with the

TABLE 2. Tips for Parents to Implement AHA Pediatric Dietary Guidelines

Reduce added sugars, including sugar-sweetened drinks and juices
Use canola, soybean, corn oil, safflower oil, or other unsaturated oils in place of solid fats during food preparation
Use recommended portion sizes on food labels when preparing and serving food
Use fresh, frozen, and canned vegetables and fruits and serve at every meal; be careful with added sauces and sugar
Introduce and regularly serve fish as an entrée
Remove the skin from poultry before eating
Use only lean cuts of meat and reduced-fat meat products
Limit high-calorie sauces such as Alfredo, cream sauces, cheese sauces, and hollandaise
Eat whole grain breads and cereals rather than refined products; read labels and ensure that "whole grain" is the first ingredient on the food label of these products
Eat more legumes (beans) and tofu in place of meat for some entrées
Breads, breakfast cereals, and prepared foods, including soups, may be high in salt and/or sugar; read food labels for content and choose high-fiber, low-salt/low-sugar alternatives

exception of the guidelines for 1-year-old children, which included 2% fat milk. For youth 3 years of age and older, calorie estimates are based on a sedentary lifestyle. More physically active children and adolescents will require additional calories.^{14,17–19} This table is provided as a starting point for dietary counseling; recommendations will need to be individualized in clinical practice. Table 4 provides daily recommended intakes of sodium, potassium, and fiber.¹⁸ More complete guidelines for infants, particularly with regard to the transition from breast/formula-feeding to table foods, will be discussed below.

Emphases different from the past include the allowance of a more liberal intake of unsaturated fat and a focus on ensuring adequate intakes of omega-3 fatty acids. There is an emphasis on foods that are rich in nutrients and that provide increased amounts of dietary fiber. The AHA continues to recommend diets low in saturated and *trans* fats. Healthy foods include fruits, vegetables, whole grains, legumes, low-fat dairy products, fish, poultry, and lean meats. Fruits, vegetables, and fish are often inadequately consumed by children and adolescents. Because the major sources of saturated fat and cholesterol in children's diets are full-fat milk and cheese and fatty meats, use of low-fat dairy products and lean cuts of meat in appropriate portion sizes will be critical in meeting dietary needs and nutrient requirements.²⁰

Fish is an important food with growing evidence of potential benefit. However, consumers may have difficulty in distinguishing among several health messages about fish consumption. Although strong data associate cardiovascular disease prevention with increased fish consumption, there are also concerns about potential polycarbonate phenols (PCBs) and mercury contamination.^{21,22} The Food and Drug Administration (FDA) and AHA stress that seafood is an important part of a healthy diet and advocate consumption of a wide variety of fish and shellfish. Current FDA recommendations with regard to limiting fish intake pertain to women who may

TABLE 3. Daily Estimated Calories and Recommended Servings for Grains, Fruits, Vegetables, and Milk/Dairy by Age and Gender

	1 Year	2–3 Years	4–8 Years	9–13 Years	14–18 Years
Calories†	900 kcal	1000 kcal			
Female			1200 kcal	1600 kcal	1800 kcal
Male			1400 kcal	1800 kcal	2200 kcal
Fat	30%–40% kcal	30%–35% kcal	25%–35% kcal	25%–35% kcal	25%–35% kcal
Milk/dairy‡	2 cups¶	2 cups	2 cups	3 cups	3 cups
Lean meat/beans	1.5 oz	2 oz		5 oz	
Female			3 oz		5 oz
Male			4 oz		6 oz
Fruits§	1 cup	1 cup	1.5 cups	1.5 cups	
Female					1.5 cups
Male					2 cups
Vegetables§	3/4 cup	1 cup			
Female			1 cup	2 cups	2.5 cups
Male			1.5 cup	2.5 cups	3 cups
Grains	2 oz	3 oz			
Female			4 oz	5 oz	6 oz
Male			5oz	6 oz	7 oz

*Calorie estimates are based on a sedentary lifestyle. Increased physical activity will require additional calories: by 0–200 kcal/d if moderately physically active; and by 200–400 kcal/d if very physically active.

†For youth 2 years and older; adopted from Table 2, Table 3, and Appendix A-2 of the *Dietary Guidelines for Americans* (2005)¹⁴; <http://www.healthierus.gov/dietaryguidelines>. Nutrient and energy contributions from each group are calculated according to the nutrient-dense forms of food in each group (eg, lean meats and fat-free milk).

‡Milk listed is fat-free (except for children under the age of 2 years). If 1%, 2%, or whole-fat milk is substituted, this will utilize, for each cup, 19, 39, or 63 kcal of discretionary calories and add 2.6, 5.1, or 9.0 g of total fat, of which 1.3, 2.6, or 4.6 g are saturated fat.

§Serving sizes are 1/4 cup for 1 year of age, 1/3 cup for 2 to 3 years of age, and 1/2 cup for ≥4 years of age. A variety of vegetables should be selected from each subgroup over the week.

||Half of all grains should be whole grains.

¶For 1-year-old children, calculations are based on 2% fat milk. If 2 cups of whole milk are substituted, 48 kcal of discretionary calories will be utilized. The American Academy of Pediatrics recommends that low-fat/reduced fat milk not be started before 2 years of age.

become pregnant or are already pregnant, nursing mothers, and young children. The FDA recommends that people in those categories avoid shark, swordfish, king mackerel, and tilefish because they contain high levels of mercury. Five of the most commonly eaten varieties of fish are low in mercury (shrimp, canned light tuna, salmon, pollack, and catfish). The AHA continues to recommend 2 servings of fish weekly.²³ Recent evidence suggests that commercially fried fish products, likely because they are relatively low in omega-3 fatty acids and high in *trans* fatty acids (if hydrogenated fat is used for preparation), do not provide the same benefits as other sources of fish.²⁴

Discretionary Calories

The obesity epidemic has prioritized consideration of the complex issue of matching appropriate energy intake to energy expenditure.^{10,11} One approach is the concept of discretionary calories illustrated in Figure 1.¹⁴ Total caloric intake is the sum of essential calories, the total energy intake necessary to meet recommended nutrient intakes, and discretionary calories, the additional calories necessary to meet

energy demand and for normal growth.¹⁸ The figure shows essential calories and discretionary calories; these increase with age and increasing levels of physical activity. There is a large difference in the discretionary calorie allowance among sedentary, moderately active, and active children, with more physically active children needing more energy from food to maintain normal growth. For young sedentary children, the amount of total energy intake that can come from foods used purely as a source of energy, ≈100 to 150 calories, is less than that provided by a usual portion size of most low-nutrient-dense snacks and beverages. With increasing activity, this discretionary calorie amount may increase to 200 to 500 calories, depending on the age and gender of the child and the level of physical activity. The message portrayed by Figure 1 is clear: To be sedentary, have a nutritionally adequate diet, and to avoid excessive caloric intake in contemporary society is difficult.²⁵ The challenge to healthcare providers and public health professionals is to translate the complex science-based energy balance message from Figure 1 into effective practice and public health policy.^{25a} Consuming diets that include primarily nutrient-dense forms of the foods listed in Table 3,

TABLE 4. Daily Recommended Intakes of Fiber, Sodium, and Potassium by Age and Gender

Gender/ Age	Fiber, g*	Sodium, mg	Potassium, mg
1–3 y	19	<1500	3000
4–8 y			
Female	25	<1900	3800
Male	25	<1900	3800
9–13 y			
Female	26	<2200	4500
Male	31	<2200	4500
14–18 y			
Female	29	<2300	4700
Male	38	<2300	4700

*Total fiber preferred minimum 14 g/1000 kcal. Read labels to determine amounts on all packaged foods. Adapted from the report of the 2005 Dietary Guideline Advisory Committee on *Dietary Guidelines for Americans*.¹⁸

participating in regular moderate to vigorous physical activity most days of the week for at least 1 hour per day, and limiting video screen time to less than 2 hours per day will help accomplish this goal.

Scientific Support for Current Dietary Recommendations

The importance of dietary saturated and *trans* fat and cholesterol to the development of elevated cholesterol and subsequent cardiovascular disease as well as other cardiovascular risk factors has been extensively studied and reviewed. Pathological evidence demonstrates that as the number of cardiovascular risk factors increases, so does the evidence of atherosclerosis in the aorta and coronary arteries beginning in early childhood.^{4,5,26} Evidence of increased carotid artery intima-media thickness and coronary artery calcium mea-

sured by electron beam computed tomography among 29- to 39-year-old young adults who have been monitored from childhood further documents that the significant precursors of adult atherosclerosis are obesity, elevated blood pressure, and dyslipidemia.^{6,27,28} Epidemiological data from longitudinal studies provide further evidence that overweight, hypercholesterolemia, and hypertension track over time from childhood into adult life and that lifestyle choices, eg, diet, excess caloric intake, physical inactivity, and cigarette smoking, influence these risk factors.^{29–34} Intervention studies aimed at measuring the efficacy and safety of diets reduced in total and saturated fat and cholesterol have also now contributed evidence at both the clinical and school-based levels.^{35–37}

A meta-analysis of adult studies of low-saturated fat, low-cholesterol diets suggested that introduction of the diet lowers LDL cholesterol an average of 12%, with a 1.93-mg/dL decline in LDL cholesterol for every 1% decline in saturated fat.³⁸ Further restricting saturated fat from 10% of total energy to 7% (the Therapeutic Lifestyle Change diet) increased the LDL cholesterol reduction to 16%.^{38,39} Pediatric confirmation of adult studies showing safety and efficacy of a low-cholesterol and low-saturated fat diet has emerged. The Dietary Intervention Study in Children (DISC) was a randomized trial of a low-saturated fat, low-cholesterol diet conducted over 3 years in US children initially prepubertal and aged 8 to 11 years.³⁵ The Special Turku Risk Intervention Program (STRIP) was a randomized dietary intervention trial begun at weaning (age ≈7 months) with parental dietary education continued through the age of 7 years.^{40–42} Both studies achieved diets in intervention groups consistent with current recommendations for therapeutic lifestyle changes to lower elevated cholesterol levels, with total fat <30% of total calories and cholesterol intake <200 mg/d.³⁹ Saturated fat intake, although not <7% of total calories, was significantly less than in children assigned to usual care. Across a wide array of safety measures, including measures of growth,

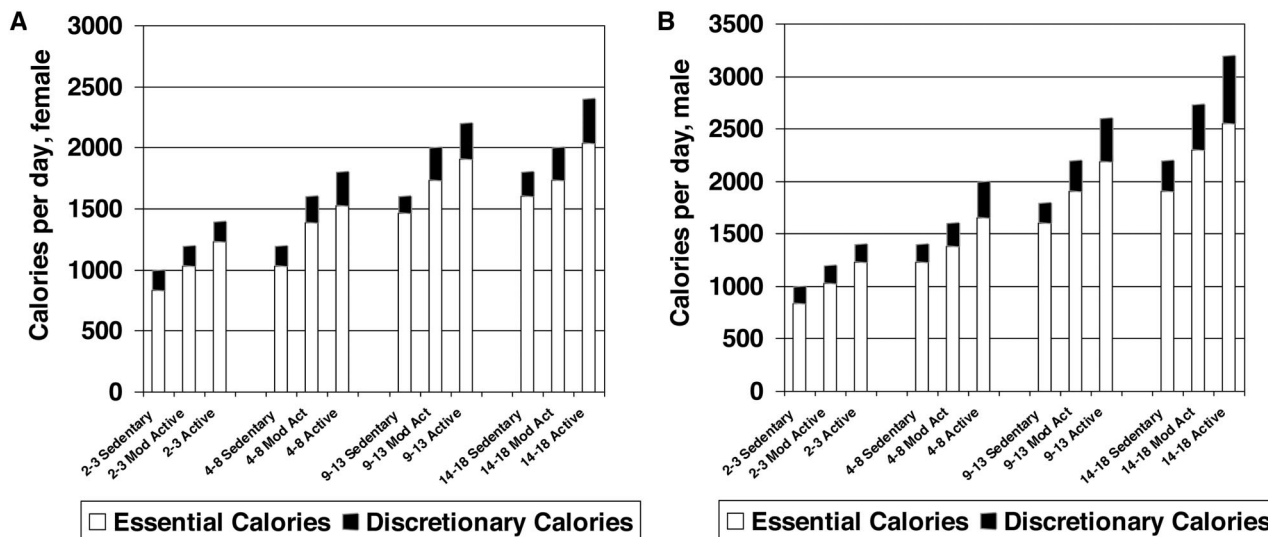


Figure 1. Concept of discretionary calories by gender. As daily physical activity increases, more energy is needed for normal growth. For sedentary children, only small amounts of discretionary calories can be consumed before caloric intake becomes excessive. Discretionary calories for children aged 4 to 8 years are based on 2 servings of dairy per day. Mod Act indicates moderately active. Based on estimated calorie requirements and discretionary calories published in *Dietary Guidelines for Americans* (2005).¹⁴

neurological development, metabolic function, and nutrient adequacy, no adverse effects of the recommended intervention diets were observed.^{40,43–45} LDL cholesterol levels were significantly lower among children receiving dietary intervention in the DISC study and in boys receiving dietary intervention in the STRIP study compared with controls.^{35,42} Most importantly, in both studies children receiving dietary intervention were significantly more likely to make healthy food choices.²⁵ Three-year follow-up of children with severe hyperlipidemia who were following recommended therapeutic lifestyle changes showed no adverse effects on growth and development.⁴⁶

The relationship between obesity and multiple cardiovascular risk factors, including elevated blood pressure, dyslipidemia, low physical fitness, and insulin resistance/diabetes mellitus, is well established.^{10,47–49} Both excess caloric intake and physical inactivity are strongly associated with obesity.⁵⁰ Studies of weight loss in overweight individuals consistently show improvement in obesity-related comorbidities, particularly when interventions include regular exercise in the treatment program.^{51–53} Population-based cross-sectional studies of secular trends in cardiovascular risk have shown strong associations between increasing prevalence of obesity and increasing blood pressure levels but inconsistent trends in dyslipidemia.^{47,54,55} Longitudinal studies of secular trends in children, however, have shown strong relationships between increases in adiposity and adverse trends in blood pressure and lipids.⁵⁶ Maintaining body mass index (BMI) is beneficial, even without weight loss, because this prevents worsening of risk status.⁵⁷ Maintenance of body weight during normal growth will improve BMI and cardiovascular risk status. Although primary prevention trials of reduction of daily caloric intake in at-risk children are under way, the evidence for harm from excess caloric intake is sufficient to support public health efforts for obesity prevention.^{11,58,59}

What Children Currently Eat

It is important to understand the gap between current dietary practices and recommended diets for infants, children, and adolescents. Sufficient population-based data exist to identify the magnitude of the problem confronting those interested in improving cardiovascular health in youth. Areas to consider include appropriateness of total caloric intake, eating patterns, balance of foods/beverages chosen from each food group, and intake of specific nutrients. Published data evaluate each of these areas with age and gender as important associated considerations.

For infants, it is encouraging that $\approx 76\%$ of mothers have initiated breast-feeding.⁶⁰ However, maintenance of breast-feeding for the first 4 to 6 months of life has been less successful. Only 4% of infants participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and 17% of the nonparticipants remain exclusively breast fed at 6 months of age. This suggests a strong socioeconomic status gradient in breast-feeding behavior. By 4 to 6 months, 66% of infants have received grain products, 40% vegetables, 42% fruits, 14% meat, and 0.6% some type of sweetened beverages.⁶¹ By 9 to 11 months, 98% of infants have received grain products, 73% vegetables, 76%

fruits, 79% meat, and 11% some type of sweetened beverages.⁶¹ Sweetened beverages have been consumed by 28% of the 12- to 14-month-old children, 37% of the 15- to 18-month-old children, and 44% of the 19- to 24-month-old children.⁶¹ During the transition from a milk-based diet to adult foods, the types of vegetables consumed change adversely. Deep yellow vegetables are consumed by 39% of children at 7 to 8 months and by 13% at 19 to 24 months, whereas French fries become the most commonly consumed vegetable by this age.⁶¹ Similarly, fruit consumption declines to the point where one third of 19- to 24-month-old children consume no fruit, whereas 60% consume baked desserts, 20% candy, and 44% sweetened beverages on a given day.⁶¹

Significant adverse changes have occurred in older children's food consumption.⁶² These include a reduction in regular breakfast consumption, an increase in consumption of foods prepared away from the home, an increase in the percentage of total calories from snacks, an increase in consumption of fried and nutrient-poor foods, a significant increase in portion size at each meal, and an increase in consumption of sweetened beverages, whereas dairy product consumption has decreased, and a shift away from high-fiber fruits and vegetables as well as a general decline in fruit and vegetable consumption other than potatoes.^{62–67} Fried potatoes make up a substantial portion of the vegetable intake.⁶⁷ Sugar consumption has increased, particularly in preschool children.⁶⁸ With regard to micronutrients, the shift in dietary patterns has resulted in median intakes below recommended values of many important nutrients during adolescence.⁶⁹ Sodium intake is far in excess of recommended levels, whereas calcium and potassium intakes are below recommended levels.^{69–71}

Implementation of Dietary Recommendations Including Considerations for Specific Age Groups

This section reviews age-specific pediatric research on cardiovascular and general nutrition. Although in some areas there is a reasonable body of work about which to make useful judgments, in many areas studies have significant methodological limitations: small sample size, confounding by a variety of factors (including cultural factors), and difficulty of using classic randomized trial designs to answer pertinent research questions. Nevertheless, the current dietary pattern of contemporary children mandates change. The recommendations provided herein are based on expert consensus of emerging evidence. Their purpose is to improve the nutritional quality, amount, and pattern of food consumption by children and their families. Although the narrative emphasizes nutrition to improve cardiovascular risk, it is recognized that optimal nutrition for overall health and normal growth is the preeminent goal.

Recommendations for children's nutrition consider the family and cultural milieu.^{72,73} It has been decades since the majority of meals were consumed within the home.^{60–67} Sources of nourishment include schools, child-care and after-school youth programs, restaurants, vending machines, convenience stores, work sites, and foods prepared by industry designed for minimal preparation time in the household.⁷⁴

TABLE 5. Parent, Guardian, and Caregiver Responsibilities for Children's Nutrition

Choose breast-feeding for first nutrition; try to maintain for 12 months
Control when food is available and when it can be eaten (nutrient quality, portion size, snacking, regular meals)
Provide social context for eating behavior (family meals, role of food in social intercourse)
Teach about food and nutrition at the grocery store, when cooking meals
Counteract inaccurate information from the media and other influences
Teach other care providers (eg, daycare, babysitters) about what you want your children to eat
Serve as role models and lead by example; "do as I do" rather than "do as I say"
Promote and participate in regular daily physical activity

Common situations affecting food preparation include households in which both parents work, single-parent households, and work schedules that demand that parents be away from home at mealtime. Likewise, children have complex schedules that demand frequent meals away from home. Schools provide less education on food preparation (eg, home economics) than in the past.

Culture-specific dietary practices can influence the diet both for better and for worse. A specific problem is the folk belief that a fat baby or chubby toddler is healthy. Popular fad diets often mix helpful and harmful components in their educational messages. Layered on top of this is a largely unregulated media dedicated to selling large quantities of a wide array of foods and food products of poor nutritional value. Despite unparalleled availability of nutrition resources, sifting through the food message bombardment is often the most difficult task facing a parent interested in providing proper nutrition for his or her family. Teaching those involved in supervision of children's diets to consume a healthful diet themselves and thus provide consistent role model behavior improves diet quality.^{73,75} Table 5 provides a summary of areas in which adult influences are most important with regard to childhood nutrition.^{76–81} Parents choose the time for meals and snacks and the types of foods and beverages to be served. Children can then choose how much to consume. Parents, guardians, and caregivers must provide appropriate role modeling through their own behavior, that is, influence children to "do as I do" rather than "do as I say." A similar responsibility falls on those who attempt to provide reliable information to parents and educators in an effort to counterbalance adverse folk/cultural practices, media influences, and other sources of disinformation. Also critical to implementation of nutritional change is the social perception of risk.⁸² Unless people believe that certain dietary practices are harmful or food providers believe that their actions endanger their clients, motivation to change will be limited. Increasing social pressure for eating properly can counteract the ubiquitous presence of food and food marketing of energy-dense, nutrient-poor choices.

Birth to 2 Years

There has been considerable interest in the influence of both the intrauterine environment and infant nutrition on future cardio-

vascular risk.^{83,84} It has been hypothesized that "programming" of future cardiovascular responses is established either in the womb or in response to feeding exposures early in life. Animal models support the programming hypothesis, but there are as yet few human experimental data.^{85–87} Lower birth weight, because of presumed intrauterine malnutrition and association with rapid postnatal rapid weight gain, is associated with central adiposity, the metabolic syndrome, diabetes mellitus, and cardiovascular disease outcomes in adulthood.⁸⁸ Babies large for gestational age, probably through consequences of maternal insulin resistance and glucose intolerance, are also at higher risk of future obesity.^{89,90}

It is important for parents or parents-to-be to obtain a healthy weight because children whose mothers are obese early in pregnancy are more likely to be overweight as young children.⁹¹ A similar effect is seen in children whose parents are or become obese during their childhood.³¹ To ensure optimal growth of the fetus, pregnant women must optimize their nutrition and weight gain during pregnancy, according to the Institute of Medicine guidelines.⁹² Excessive maternal weight gain has been associated with a 2- to 3-fold increased risk that the mother will be overweight after a pregnancy.⁹³ This may increase subsequent offspring risk during adolescence for obesity, impaired glucose tolerance, impaired insulin secretion, and type 2 diabetes. Studies of maternal nutrition, for example, assessments of protein and calcium intake, suggest that maternal diet during pregnancy may influence offspring's blood pressure.^{94,95} However, evidence is insufficient to make specific recommendations about nutrition during pregnancy based on future cardiovascular disease.

Human milk is uniquely superior for infant feeding and is the reference against which other infant feeding strategies must be measured.⁹⁶ Breast milk is rich in both saturated fat and cholesterol but low in sodium. There has been substantial work on the relationship of breast-feeding to both future cardiovascular events and cardiovascular risk factors. Although pooling estimates from these studies is difficult because of differences in exposure and outcome assessment, recent meta-analyses have suggested no meaningful impact of breast-feeding on subsequent cardiovascular or all-cause mortality in adulthood.⁹⁷ Other systematic reviews, however, suggest benefits of breast-feeding, particularly in the prevention of future obesity.^{98,99} Several studies suggest that breast-feeding leads to lower blood pressure later in childhood.^{100,101} Although breast-feeding is associated with higher blood cholesterol levels at 1 year of age, it may also result in lower blood cholesterol levels in adults.¹⁰² Rapid weight gain during the first 4 to 6 months of life is associated with future risk of overweight^{103,106}; studies suggest that partially breast-fed and formula-fed infants consume 20% more total calories per day than do exclusively breast-fed infants.^{104,105} Physicians should identify infants who are gaining weight rapidly and/or whose weight-to-length percentile exceeds the 95th percentile to help correct overfeeding if present.

At least 2 behavioral benefits of breast-feeding may lead to reduced cardiovascular risk, but the impact of these has not been studied in large trials.^{107–110} The first potential benefit may be better self-regulation of intake. Compared with

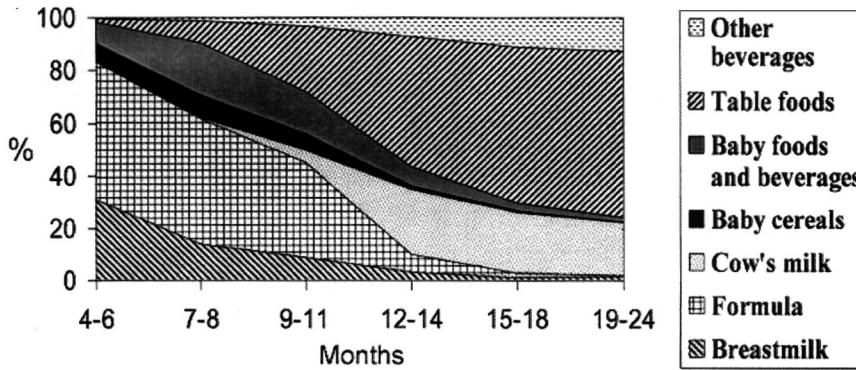


Figure 2. Dramatic change in food sources during the first 2 years of life. Diet is initially based on breast milk at birth and transitions to conventional foods by 2 years, although dairy products remain a major source of energy and nutrition. Reprinted from Lederman et al^{126a} with permission of *Pediatrics*. Adapted from Devaney et al¹²⁹ and Skinner et al.¹³⁰

parents who bottle-feed, mothers who breast-feed appear to allow the infant to take an active role in controlling intake, possibly promoting maternal feeding practices that can foster better self-regulation of energy intake as the child grows up.¹⁰⁸ Children with improved self-regulation may better withstand the current food surplus environment.¹¹¹ The second potential benefit relates to taste preference.¹¹²⁻¹¹⁶ Both amniotic fluid and breast milk provide flavor exposure to the fetus and infant. These exposures influence taste preference and food choices after weaning. Thus, exposure to healthier foods through maternal food consumption during pregnancy and lactation may improve acceptance of healthy foods after weaning. Because infant responses to taste are different than mature taste, these early exposures may be critical in determining food preference later in life.

A critical social problem for mothers interested in breast-feeding in the United States is the lack of a tolerant social structure.¹¹⁷ Breast-feeding rates decline rapidly between 2 and 3 months, which is when many mothers return to work or school.^{118,119} Full-time employment is consistently associated with shorter periods of breast-feeding.¹²⁰⁻¹²³ In Scandinavian countries, where women routinely receive paid maternity benefits (eg, 42 weeks with full pay or 52 weeks at 80% of salary in Norway), women far surpass the US Healthy People 2010 goals for breast-feeding. In Norway, 97% of women are breast-feeding when they leave the hospital, 80% are breast-feeding at 3 months, and 36% are breast-feeding at 12 months.¹²⁴ Most African and Asian countries are highly supportive of breast-feeding. Policies enacted within the workplace and public places can also help to overcome barriers to breast-feeding.^{117,125}

The period from weaning to consumption of a mature diet, from 4 to 6 months to ≈2 years of age, represents a radical shift in pattern of food consumption (Figure 2),^{17,126,126a,129,130} but there has been very little research on the best methods to achieve optimal nutritional intakes during this transition. Infants mature from receiving all nutrition from a milk-based diet to a diet chosen from the range of adult foods, in part self-selected and in part provided by caregivers. Transition to other sources of nutrients should begin at 4 to 6 months of age to ensure sufficient micronutrients in the diet, but the best methods for accomplishing this task are essentially unknown.^{15,126} Current feeding practices and guidelines are influenced by small-scale studies of infant feeding behavior, idiosyncratic parental behavior, and popular opinion.^{17,60,127,128}

Food consumption data suggest that infants are currently exposed to a wide variety of “kid” foods that tend to be high in fat and sugar, including excess juice, juice-based sweetened beverages, French fries, and nutrient-poor snacks.⁶¹ Usual food intakes of infants and young children may exceed estimated energy requirements. For infants aged 0 to 6 months, reported intakes exceed requirements by 10% to 20%; for children aged 1 to 4 years, intakes exceed requirements by 20% to 35%. Although some of these reports may reflect overreporting of food intake, these data might also explain the rise in the prevalence of overweight at very young ages.^{129,130}

For those participating in public nutrition assistance programs (US Department of Agriculture [USDA] 2002), the foods supplied for infants and children are limited in variety, reflecting more closely the nutritional concerns of the 1970s, when the program was designed (inadequate calories, protein, vitamin A, vitamin C, and iron), than nutritional concerns today (excess calories, fat, and sugar and inadequate fruits, vegetables, and whole grains).¹³¹ Moreover, beverages provided to most children are not optimal. Children aged 1 to 5 years enrolled in WIC receive twice the amount of fruit juice (9.5 fl oz/d) currently recommended, and most participants also receive or choose whole milk.^{14,17,131,132} For formula-fed infants, there may also be a role for clearer prescriptive feeding advice for parents to understand their infant’s satiety cues and appropriate energy intake than is currently the norm. Table 6 provides a number of strategies to improve general and cardiovascular nutrition during this transitional stage. When normal growth is present, overfeeding may result from arbitrarily increasing amounts fed to achieve specific portion sizes per meal rather than allowing infants and toddlers to self-regulate. New healthy foods may need to be introduced

TABLE 6. Improving Nutritional Quality After Weaning

Maintain breast-feeding as the exclusive source of nutrition for the first 4–6 months of life
Delay the introduction of 100% juice until at least 6 months of age and limit to no more than 4–6 oz/d; juice should only be fed from a cup
Respond to satiety clues and do not overfeed; infants and young children can usually self-regulate total caloric intake; do not force children to finish meals if not hungry as they often vary caloric intake from meal to meal
Introduce healthy foods and continue offering if initially refused; do not introduce foods without overall nutritional value simply to provide calories

TABLE 7. Improving Nutrition in Young Children

Parents choose meal times, not children
Provide a wide variety of nutrient-dense foods such as fruits and vegetables instead of high-energy-density/nutrient-poor foods such as salty snacks, ice cream, fried foods, cookies, and sweetened beverages
Pay attention to portion size; serve portions appropriate for the child's size and age
Use nonfat or low-fat dairy products as sources of calcium and protein
Limit snacking during sedentary behavior or in response to boredom and particularly restrict use of sweet/sweetened beverages as snacks (eg, juice, soda, sports drinks)
Limit sedentary behaviors, with no more than 1 to 2 hours per day of video screen/television and no television sets in children's bedrooms
Allow self-regulation of total caloric intake in the presence of normal BMI or weight for height
Have regular family meals to promote social interaction and role model food-related behavior

repeatedly, as many as 10 times to establish taste preferences.¹³³

Age 2 to 6 Years

At this age, recommendations for diet content are similar to those for older individuals. Challenges here relate to providing quality nutrient intake and avoiding excess caloric intake. Dairy products are a major source of saturated fat and cholesterol in this age group, and therefore a transition to low-fat milk and other dairy products is important.^{34,134} Sweetened beverages and other sugar-containing snacks are a major source of caloric intake.^{135,136} Table 7 provides a list of strategies for managing nutrition in young children.^{77,78,137–141} Parents should remember that they are responsible for choosing foods that are eaten and when and where they are eaten. The child is responsible for whether or not he or she wants to eat and how much. Two natural parental impulses, pressuring children to eat and restricting access to specific foods, are not recommended because they often lead to overeating, dislikes, and paradoxical interest in forbidden items.^{142,143}

Healthcare providers must provide useful advice to parents, but they are constrained by time pressures in the typical health maintenance office visit. In addition to the information in Table 7, advice on caloric/energy values of food, particularly nutrient-poor foods, can be provided in a relatively short period of time. At office visits, BMI percentile can be plotted, the appropriateness of weight gain in the last year can be assessed from standard growth curves, and recommendations for optimal weight gain in the next year can be given. Blood pressure screening and cholesterol measurement, if indicated, are begun in this age range.⁷

Ages 6 Years and Above

As children grow up, sources of food and influences on eating behavior increase. Social constraints on families may necessitate the presence of multiple caregivers, eating out, and frequent fast food consumption. Many children, because of parental work schedules, are home alone and prepare their own snacks and meals. By early adolescence, peer pressure begins to usurp parental authority, and fad diets may be

initiated. Many meals and snacks are routinely obtained outside the home, often without supervision. Sites include schools, friends' homes, child-care centers, and social events. Older children have discretionary funds to use for self-selected foods. Current eating patterns do not at all resemble the "norm" of providing at least breakfast, dinner, and a single snack at home with lunch carried to school or purchased from a health-conscious cafeteria. For example, current diet studies suggest that many children do not eat breakfast and get at least one third of calories from snacks. Sweetened beverage intakes contribute significantly to total caloric intake.¹⁴⁴ Sweetened beverages and naturally sweet beverages, such as fruit juice, should be limited to 4 to 6 oz per day for children 1 to 6 years old, and to 8 to 12 oz per day for children 7 to 18 years old.^{144,145} These snacks often contribute to excess consumption of discretionary calories and/or supplant the intake of foods containing essential nutrients.^{25,146}

Adolescence is a nutritionally vulnerable developmental stage because growth rate accelerates. Amplified caloric and global nutrition needs due to pubertal growth stimulate appetite. The combination of centrally driven appetite stimulation and an increasingly sedentary lifestyle due to a decline in recreational sports participation augments obesity.⁵⁰ Parallel to the psychosocial transition from dependence on parental authority to independent thought processes, food choices and purchases are increasingly made by the adolescent. Peer pressure for conformity, in part driven by media promotion of fast food directly to teens, makes overeating natural. Currently, adolescents have an increased intake of sweetened beverages, French fries, pizza, and fast food entrées, including hamburgers, and a consequent lack of recommended fruits, vegetables, dairy foods, whole grains, lean meats, and fish. This change in eating pattern results in consumption of excess fat, saturated fat, *trans* fats, and added sugars along with insufficient consumption of micronutrients such as calcium, iron, zinc, and potassium, as well as vitamins A, D, and C and folic acid.^{146,147}

Counseling of older children and adolescents must be individualized to accommodate the range of contemporary lifestyles; less success is achieved at older ages. Current dietary practices and readiness to change must be understood before family-based intervention is attempted.¹⁴⁸ Parental role modeling is important in establishing children's food choices.^{53,78,132} Depending on their own food choices, parents can be either positive or negative role models.⁸¹

Public Health Issues

Modern life extends the umbrella of social responsibility for provision of appropriate nutrition and nutrition knowledge beyond the home to government, the health professions, schools, the food industry, and the media. It is beyond the scope of this document to evaluate the large public health effort related to overweight and nutrition now being undertaken. Some important areas are highlighted below. Because there is little scientific information to guide current policy directed at changing eating behaviors, it is strongly recommended that evaluation, safety, and efficacy tools be incorporated into policy implementation.

TABLE 8. Strategies for Schools

Identify a “champion” within the school to coordinate healthy nutrition programs
Establish a multidisciplinary team including student representation to assess all aspects of the school environment using the School Health Index (Centers for Disease Control and Prevention) or similar assessment
Identify local, regional, and national nutrition programs; select those proven effective (http://www.ActionForHealthyKids.org)
Develop policies that promote student health and identify nutrition issues within the school (http://www.nasbe.org/HealthySchools/healthy_eating.html)
Work to make predominantly healthful foods available at school and school functions by influencing food and beverage contracts, adapt marketing techniques to influence students to make healthy choices, and restrict in-school availability of and marketing of poor food choices
Maximize opportunities for all physical activity and fitness programs (competitive and intramural sports); utilize coaches/teachers as role models
Lobby for regulatory changes that improve a school’s ability to serve nutritious food
Ban food advertising on school campuses

Schools have become a battleground for fighting the obesity epidemic.^{149,150} Cafeterias are under attack for serving unhealthy food, yet the food provided is constrained by budgetary and regulatory issues largely external to public health concerns. USDA guidelines require school food programs to provide minimum quantities of specific nutrients over a 3- to 7-day span but do not address maximum food amounts. Vending machines and competing nutrient-poor foods provide excess calories but also provide revenue to support school programs. Table 8 summarizes some strategies currently being implemented in many locales.

Nutrition education in schools is considered useful in improving knowledge about nutrition, but few studies suggest that it is effective in altering eating behaviors in the absence of environmental change.¹⁵⁰ The largest study, the Child and Adolescent Trial for Cardiovascular Health (CATCH), was a multicenter intervention that included nutrition education, a cafeteria intervention, changes in physical education programs, and parental education. The fat content of school lunch but not school breakfast was modified, and blood cholesterol levels and children’s weight status were unchanged.^{36,151,152} Other school studies have shown improvements in fruit (but not vegetable) intake.^{153–155} High-quality foods sold in vending machines will be selected if they are competitively priced.⁶² An intervention that included nutrition education, a cafeteria intervention, changes in physical activity, and a parent component for younger children attending Head Start programs was successful in decreasing children’s blood cholesterol levels but did not affect the prevalence of childhood overweight.¹⁵⁶

Physical education programs are often subject to budget constraints. The percentage of pupils attending physical education classes has decreased. For example, in a study of a representative sample of US high schools, participation rates fell from 79% in ninth grade to 36% in 12th grade.¹⁵⁷ In addition, participation in school-sponsored after-school teams is frequently limited to elite athletes, limiting the opportunity

TABLE 9. Types of Legislation Under Consideration to Improve Children’s Nutrition

Measurement of BMI by school staff for health surveillance and/or to report information to parents
Restriction of certain types of food and beverages available on school grounds
Taxation of specific foods or sedentary forms of entertainment
Establishment of local school wellness policies using a multidisciplinary team of school staff and community volunteers (mandated for schools participating in federal reimbursable school lunch, breakfast, or milk programs)
Food labeling regulations, including appropriate descriptions of portion sizes (eg, a medium-sized sugar-containing drink should be 6–8 oz)
Regulation of food advertising directed at children

for high school–aged students to engage in regular physical activity.

Media has a pervasive influence on children’s food choices. Children, including the very young, are heavily marketed by the food industry. Time spent watching television is directly related to children’s food requests. The most frequently advertised foods are high-sugar breakfast cereals, fast food restaurant products, sweetened beverages, frozen dinners, cookies, and candy. Fruits and vegetables are almost never advertised. Watching television during meals is associated with increased frequency of poor food choices and decreased frequency of good choices.^{77,158–160} Several European countries now have restrictions on advertising to children as well as school-based marketing.

State and local governments are now becoming active in the effort to control obesity on a wide variety of fronts. For example, several states have adopted legislation mandating school staff report to parents the BMI status of their children. Changes in food labeling, taxes on certain types of foods, restrictions on foods provided to children in government-sponsored programs, and requiring restaurants to provide nutrition information are examples of regulations under consideration.^{11,161} Strategy types are summarized in Table 9. Given the widening discrepancy between recommended dietary guidelines and current dietary intake, a reevaluation of federal agricultural policies may be warranted. Strategies for food subsidies and taxation should reflect health goals. Foods made available and served through public nutrition programs must be consistent with current recommendations.

Therapeutic Lifestyle Changes for Treatment of Hypertension and Hypercholesterolemia

There are currently established consensus guidelines for the role of diet in the management of children with established cardiovascular risk factors. Cut points for diagnosing dyslipidemia and hypertension are provided in Table 10.^{7,39,162,163} The Fourth Pediatric Report of the National High Blood Pressure Education Program recommends a diet consistent with the current recommendations for children with hypertension.¹⁶² For overweight children, weight loss is the initial therapeutic strategy. The Dietary Approaches to Stop Hypertension (DASH) study has recently shown that implementation of a diet rich in fruits, vegetables, nonfat dairy products,

TABLE 10. Consensus Guidelines for Diagnosis of Hypertension and Dyslipidemia in Children

Hypertension	Guideline
Prehypertension	Systolic or diastolic blood pressure >90th percentile for age and gender or 120/80 mm Hg, whichever is less
Stage 1 hypertension	Systolic or diastolic blood pressure >95th percentile for age and gender on 3 consecutive visits or 140/90 mm Hg, whichever is less
Stage 2 hypertension	Systolic or diastolic blood pressure >99th percentile + 5 mm Hg for age and gender or 160/110 mm Hg, whichever is less
Total cholesterol	
Borderline	≥170 mg/dL
Abnormal	≥200 mg/dL
LDL cholesterol	
Borderline	≥100 mg/dL
Abnormal	≥130 mg/dL
HDL cholesterol	
Abnormal	<40 mg/dL
Triglycerides	
Abnormal	≥200 mg/dL

and whole grains can effectively lower blood pressure in adults with hypertension.¹⁶⁴ Although there are no comparable clinical trial data in children, there is no reason to suspect that the DASH diet would not be safe to implement in older children and adolescents as long as protein and calorie needs are met.^{165,166}

There has not been an update of the Report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents published since its publication in 1992, but the National Cholesterol Education Program (NCEP) generally recommends restriction of saturated fat intake to <7% of total calories and restriction of cholesterol intake to <200 mg/d for treatment of elevated LDL cholesterol levels.^{39,163} There are now data from randomized trials demonstrating that such diets are safe in children as young as 7 months of age.^{40,42,44,45}

Efficacy is variable, however, and unless the diet is extremely high in saturated fat before changes are made, it is unlikely that diet alone will be sufficient to achieve target levels for LDL cholesterol in those with genetic dyslipidemias and LDL cholesterol ≥190 mg/dL. Increased intake of soluble fiber is recommended as an adjunct to the reduced intakes of saturated fatty acids and cholesterol.^{14,167} Recently plant sterols and stanols have been used, often in margarines, to lower LDL cholesterol through inhibition of cholesterol absorption. Adult studies have shown reductions of 4% to 11% without adverse events.¹⁶⁸ One randomized controlled trial in children showed that 20 g/d of plant sterol-containing margarine lowered LDL cholesterol 8%.¹⁶⁹ These products may be used, although caution is recommended with regard to the potential for decreased absorption of fat-soluble vitamins and beta-carotene. Formal recommendation of their use for children awaits clinical trial data.^{42,170–177}

Summary

This scientific statement updates nutrition recommendations for the promotion of cardiovascular health among children. Recommendations have been made with regard to diet composition, total caloric intake, and physical activity. Implementation requires that children and all other members of their households actively make the recommended changes. Adverse recent trends in children's diets have been noted. Cardiovascular nutrition issues surrounding the first 2 years of life have been addressed. Strategies to improve implementation of the recommended diet have been presented. A brief overview of public health issues related to nutrition is included.

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