AHA Scientific Statement

Dietary Recommendations for Children and Adolescents

A Guide for Practitioners

Consensus Statement From the American Heart Association

Endorsed by the American Academy of Pediatrics

Samuel S. Gidding, MD, *Chair*; Barbara A. Dennison, MD, *Cochair*; Leann L. Birch, PhD; Stephen R. Daniels, MD, PhD; Matthew W. Gilman, MD; Alice H. Lichtenstein, DSc; Karyl Thomas Rattay, MD; Julia Steinberger, MD; Nicolas Stettler, MD; Linda Van Horn, PhD, RD

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

The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

This statement was approved by the American Heart Association Science Advisory and Coordinating Committee on July 22, 2005. A single reprint is available by calling 800-242-8721 (US only) or writing the American Heart Association, Public Information, 7272 Greenville Ave, Dallas, TX 75231-4596. Ask for reprint No. 71-0341. To purchase additional reprints: up to 999 copies, call 800-611-6083 (US only) or fax 413-665-2671; 1000 or more copies, call 410-528-4121, fax 410-528-4264, or E-mail kgray@lww.com. To make photocopies for personal or educational use, call the Copyright Clearance Center, 978-750-8400.

Expert peer review of AHA Scientific Statements is conducted at the AHA National Center. For more on AHA statements and guidelines development, visit http://www.americanheart.org/presenter.jhtml?identifier=3023366.

Circulation **is available at http://www.circulationaha.org** **DOI: 10.1161/CIRCULATIONAHA.105.169251**

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 *trans* 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

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

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 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 measured 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,

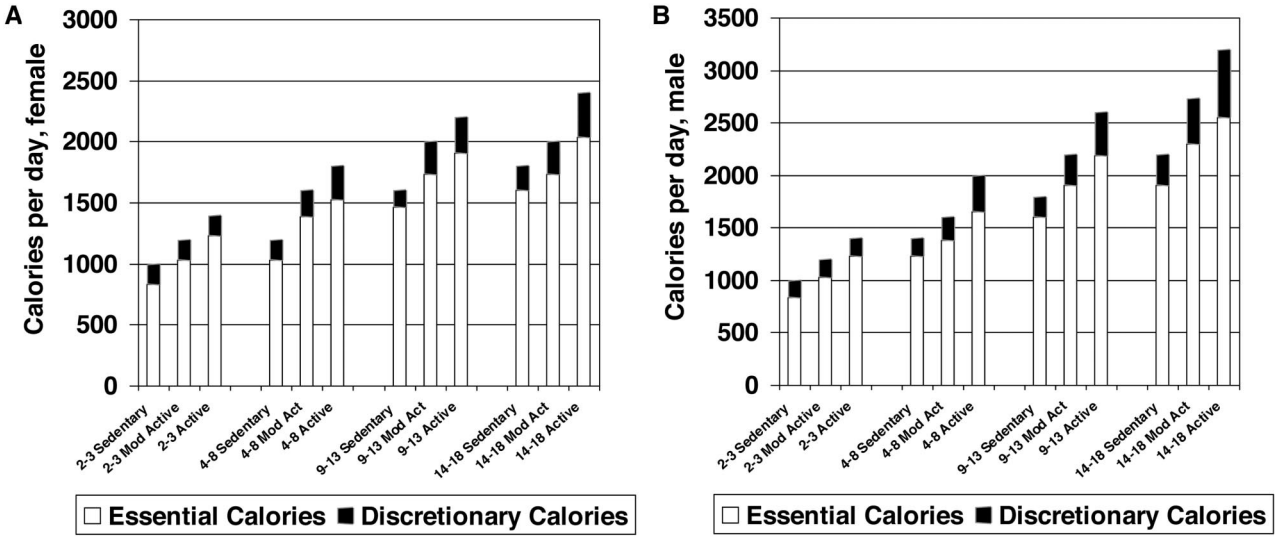

Figure 1. Concept of discretionary calories by gender. As daily physical activity increases, more energy is needed for normal growth. For sedentary children, only small amounts of discretionary calories can be consumed before caloric intake becomes excessive. Discretionary calories for children aged 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 ≈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 cardiovascular 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

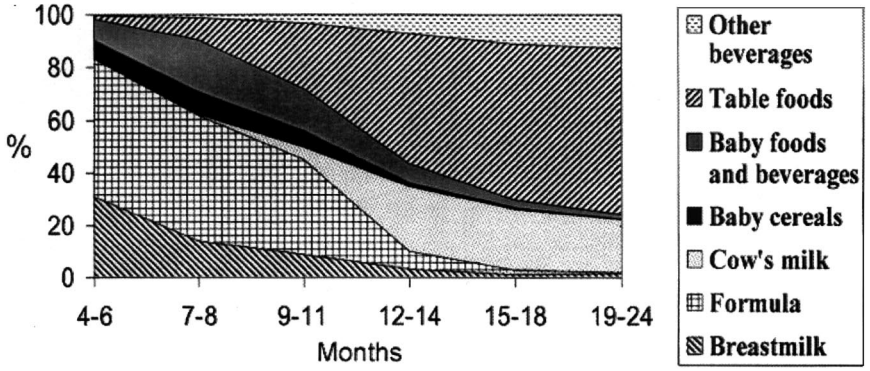

Figure 2. Dramatic change in food sources during the first 2 years of life. Diet is initially based on breast milk at birth and transitions to conventional foods by 2 years, although dairy products remain a major source of energy and nutrition. Reprinted from Lederman et al[126a] with permission of *Pediatrics*. Adapted from Devaney et al[129] 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 for high school–aged students to engage in regular physical activity.

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

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.

Acknowledgments

The authors acknowledge the contributions of many additional experts who reviewed portions of the material presented or supplied additional expertise. These include Julie Mennella, PhD, Gary A. Emmett, MD, and Penny Kris-Etherton, PhD. Carol Muscar provided invaluable support in the preparation of the manuscript and its editing. The AHA thanks the Nemours Health and Prevention Services group for providing meeting space and organizational support to the investigators and AHA staff, facilitating the rapid completion of this report.

Writing Group Disclosures

Writing Group Member	Employment	Research Grant	Other Research Support	Speakers Bureau/Honoraria	Ownership Interest	Consultant/Advisory Board	Other
Samuel Gidding	Nemours Foundation	None	None	None	None	None	None
Barbara Dennison	New York State Department of Health	National Institute of Diabetes and Digestive and Kidney Diseases—grantee USDA–Improving Human Nutrition—grantee	None	None	None	Bassett Healthcare–Research Scientist; Mead Johnson Nutritionals–Consultant Toddler/Children Panel; American Dairy Association–Consultant; University of North Carolina–Consultant	None
Stephen Daniels	Children's Hospital Cincinnati	None	None	None	None	None	None
Linda Van Horn	Northwestern University–Feinberg School of Medicine	None	None	None	None	*Journal of the American Dietetic Association*–Editor in Chief	None
Julia Steinberger	University of Minnesota	None	None	None	None	American Phytotherapy Research Lab–Consultant	None
Alice Lichtenstein	Tufts University	None	None	None	None	None	None
Leann Birch	Pennsylvania State University	National Institute of Child Health & Human Development–Grantee; Dairy Management Inc–Grantee; USDA-CSREES–Grantee (coinvestigator)	None	None	None	Institute of Medicine Committee on Prevention of Childhood Obesity in Children and Youth–Chair	None
Nicolas Stettler	University of Pennsylvania School of Medicine	None	None	None	None	European Society for Pediatric Research–Member; International Epidemiological Association–Member; World Heart Federation–Member; Swiss Pediatric Society–Member; Swiss Medical Society–Member; American Society for Nutritional Sciences–Member; American Society for Clinical Nutrition–Member; North American Association for the Study of Obesity–Member; Children Are Our Messengers: Changing the Health Message, International Society on Hypertension in Blacks–Advisory Committee Member; Community Health Centers, Child Health Project, US Department of Health and Human Services–Consultant; Early Origins of Adult Health Working Group, National Children's Study–Core Member; Society for Pediatric Research–Member; Comprehensive School Nutrition Policy Task Force, US Department of Agriculture/Food–Consultant; National High Blood Pressure Education Program on Blood Pressure in Children and Adolescents; Institute of Medicine Committee on Nutrient Relationships in Seafood	None
Matthew Gillman	Harvard University	None	None	None	None	None	None
Karyl Rattay	Nemours Health and Prevention Services	None	None	None	None	None	None

CSREES indicates Cooperative State Research, Education, and Extension Service. This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire that all members of the writing group are required to complete and submit. A relationship is considered "significant" if (1) the person receives ≥$10 000 during any 12-month period or ≥5% of the person's gross income or (2) the person owns ≥5% of the voting stock or share of the entity or owns ≥$10 000 of the fair market value of the entity. A relationship is considered "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.

Reviewer Disclosures

Reviewer	Employment	Research Grant	Other Research Support	Speakers Bureau/Honoraria	Ownership Interest	Consultant/Advisory Board	Other
Frank Greer	University of Wisconsin–Madison	None	None	None	None	None	None
Nancy F. Krebs	The Children's Hospital	None	None	None	None	None	None
Kristie Lancaster	New York University	None	None	None	None	None	None
William Neal	West Virginia University	None	None	None	None	None	None
Theresa A. Nicklas	Baylor College of Medicine	USDA; National Institutes of Health	Dairy Management Inc; National Cattlemen's Beef Association; Mars, Inc	National Dairy Council Speakers Bureau; National Cattlemen's Beef Association Speakers Bureau	None	Brands Global Advisory Council on Health, Nutrition and Fitness; US Potato Board's Scientific Advisory Panel; Cadbury Scientific Advisory Committee; Grain Foods Foundation Scientific Advisory Board	International Food Information Council Expert Resource to Media; 2005 Dietary Guidelines Advisory Committee

This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire that all reviewers are required to complete and submit.

References

1. Kavey RE, Daniels SR, Lauer RM, Atkins DL, Hayman LL, Taubert K; American Heart Association. American Heart Association guidelines for primary prevention of atherosclerotic cardiovascular disease beginning in childhood. *Circulation*. 2003;107:1562–1566.
2. Stamler J, Stamler R, Neaton JD, Wentworth D, Daviglus ML, Garside D, Dyer AR, Liu K, Greenland P. Low risk-factor profile and long-term cardiovascular and noncardiovascular mortality and life expectancy: findings for 5 large cohorts of young adult and middle-aged men and women. *JAMA*. 1999;282:2012–2018.
3. Daviglus ML, Stamler J, Pirzada A, Yan LL, Garside DB, Liu K, Wang R, Dyer AR, Lloyd-Jones DM, Greenland P. Favorable cardiovascular risk profile in young women and long-term risk of cardiovascular and all-cause mortality. *JAMA*. 2004;292:1588–1592.
4. Relationship of atherosclerosis in young men to serum lipoprotein cholesterol concentrations and smoking. A preliminary report from the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) Research Group. *JAMA*. 1990;264:3018–3024.
5. Berenson GS, Srinivasan SR, Bao W, Newman WP 3rd, Tracy RE, Wattigney WA. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. The Bogalusa Heart Study. *N Engl J Med*. 1998;338:1650–1656.
6. Mahoney LT, Burns TL, Stanford W, Thompson BH, Witt JD, Rost CA, Lauer RM. Coronary risk factors measured in childhood and young adult life are associated with coronary artery calcification in young adults: the Muscatine Study. *J Am Coll Cardiol*. 1996;27:277–284.
7. Williams CL, Hayman LL, Daniels SR, Robinson TN, Steinberger J, Paridon S, Bazzarre T. Cardiovascular health in childhood: A statement for health professionals from the Committee on Atherosclerosis, Hypertension, and Obesity in the Young (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation*. 2002;106:143–160.
8. Krauss RM, Eckel RH, Howard B, Appel LJ, Daniels SR, Deckelbaum RJ, Erdman JW Jr, Kris-Etherton P, Goldberg IJ, Kotchen TA, Lichtenstein AH, Mitch WE, Mullis R, Robinson K, Wylie-Rosett J, St Jeor S, Suttie J, Tribble DL, Bazzarre TL. AHA Dietary Guidelines: revision 2000: A statement for healthcare professionals from the Nutrition Committee of the American Heart Association. *Circulation*. 2000;102:2284–2299.
9. Grundy SM, Bilheimer D, Blackburn H, Brown WV, Kwiterovich PO Jr, Mattson F, Schonfeld G, Weidman WH. Rationale of the diet-heart statement of the American Heart Association. Report of Nutrition Committee. *Circulation*. 1982;65:839A–854A.
10. Gidding SS, Leibel RL, Daniels S, Rosenbaum M, Van Horn L, Marx GR. Understanding obesity in youth: A statement for healthcare professionals from the Committee on Atherosclerosis and Hypertension in the Young of the Council on Cardiovascular Disease in the Young and the Nutrition Committee, American Heart Association. Writing Group. *Circulation*. 1996;94:3383–3387.
11. Institute of Medicine, ed. *Preventing Childhood Obesity: Health in the Balance*. Washington, DC: National Academy Press; 2005.
12. Olshansky SJ, Passaro DJ, Hershow RC, Layden J, Carnes BA, Brody J, Hayflick L, Butler RN, Allison DB, Ludwig DS. A potential decline in life expectancy in the United States in the 21st century. *N Engl J Med*. 2005;352:1138–1145.
13. Fisher EA, Van Horn L, McGill HC Jr. Nutrition and children: A statement for healthcare professionals from the Nutrition Committee, American Heart Association. *Circulation*. 1997;95:2332–2333.
14. US Department of Health and Human Services, US Department of Agriculture. *Dietary Guidelines for Americans*. 6th ed. Washington, DC: US Government Printing Office; 2005.
15. US Department of Agriculture. MyPyramid. 2005. Available at: www.mypyramid.gov. Accessed June 22, 2005.
16. Nicklas T, Johnson R. Position of the American Dietetic Association: Dietary guidance for healthy children ages 2 to 11 years. *J Am Diet Assoc*. 2004;104:660–677. Erratum in: *J Am Diet Assoc*. 2004;104:1075.
17. Kleinman R, ed. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove, Ill: American Academy of Pediatrics; 2004.
18. 2005 Dietary Guideline Advisory Committee. Nutrition and your health: dietary guidelines for Americans. Available at: http://www.health.gov/dietaryguidelines/dga2005/report/HTML/E_translation.htm. Accessed January 17, 2005.
19. Institute of Medicine. *Dietary Reference Intakes for Energy, Carbohydrates, Fiber, Fat, Protein, and Amino Acids (Macronutrients)*. Washington, DC: The National Academies Press; 2002. Available at: http://www.nap.edu/books/0309085373/html/. Accessed January 31, 2005.
20. Peterson S, Sigman-Grant M. Impact of adopting lower-fat food choices on nutrient intake of American children. *Pediatrics*. 1997;100:E4.
21. He K, Song Y, Daviglus ML, Liu K, Van Horn L, Dyer AR, Greenland P. Accumulated evidence on fish consumption and coronary heart disease mortality: a meta-analysis of cohort studies. *Circulation*. 2004;109:2705–2711.
22. US Food and Drug Administration, US Environmental Protection Agency. What you need to know about mercury in fish and shellfish. In: 2004.
23. Kris-Etherton PM, Harris WS, Appel LJ; American Heart Association Nutrition Committee. Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. *Circulation*. 2002;106:2747–2757.
24. Mozaffarian D, Lemaitre RN, Kuller LH, Burke GL, Tracy RP, Siscovick DS; Cardiovascular Health Study. Cardiac benefits of fish consumption may depend on the type of fish meal consumed: the Cardiovascular Health Study. *Circulation*. 2003;107:1372–1377.
25. Van Horn L, Obarzanek E, Friedman LA, Gernhofer N, Barton B. Children's adaptations to a fat-reduced diet: The Dietary Intervention Study in Children (DISC). *Pediatrics*. 2005;115:1723–1733.

25a. Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, Hergenroeder AC, Must A, Nixon PA, Pivarnik JM, Rowland T, Trost S, Trudeau F. Evidence based physical activity for school-age youth. *J Pediatr*. 2005;146:732–737.

26. McGill HC Jr, McMahan CA, Zieske AW, Malcom GT, Tracy RE, Strong JP. Effects of nonlipid risk factors on atherosclerosis in youth with a favorable lipoprotein profile. *Circulation*. 2001;103:1546–1550.
27. Raitakari OT, Juonala M, Kahonen M, Taittonen L, Laitinen T, Maki-Torkko N, Jarvisalo MJ, Uhari M, Jokinen E, Ronnemaa T, Akerblom HK, Viikari JS. Cardiovascular risk factors in childhood and carotid artery intima-media thickness in adulthood: the Cardiovascular Risk in Young Finns Study. *JAMA*. 2003;290:2277–2283.
28. Li S, Chen W, Srinivasan SR, Bond MG, Tang R, Urbina EM, Berenson GS. Childhood cardiovascular risk factors and carotid vascular changes in adulthood: the Bogalusa Heart Study. *JAMA*. 2003;290:2271–2276.
29. Lauer RM, Lee J, Clarke WR. Factors affecting the relationship between childhood and adult cholesterol levels: the Muscatine Study. *Pediatrics*. 1988;82:309–318.
30. Lauer RM, Clarke WR. Childhood risk factors for high adult blood pressure: the Muscatine Study. *Pediatrics*. 1989;84:633–641.
31. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997;337:869–873.
32. Janz KF, Dawson JD, Mahoney LT. Tracking physical fitness and physical activity from childhood to adolescence: the Muscatine study. *Med Sci Sports Exerc*. 2000;32:1250–1257.
33. Feunekes GI, de Graaf C, Meyboom S, van Staveren WA. Food choice and fat intake of adolescents and adults: associations of intakes within social networks. *Prev Med*. 1998;27:645–656.
34. Rojas NL, Killen JD, Haydel KF, Robinson TN. Nicotine dependence among adolescent smokers. *Arch Pediatr Adolesc Med*. 1998;152:151–156.
35. Obarzanek E, Kimm SY, Barton BA, Van Horn LL, Kwiterovich PO Jr, Simons-Morton DG, Hunsberger SA, Lasser NL, Robson AM, Franklin FA Jr, Lauer RM, Stevens VJ, Friedman LA, Dorgan JF, Greenlick MR; DISC Collaborative Research Group. Long-term safety and efficacy of a cholesterol-lowering diet in children with elevated low-density lipoprotein cholesterol: seven-year results of the Dietary Intervention Study in Children (DISC). *Pediatrics*. 2001;107:256–264.
36. Luepker RV, Perry CL, McKinlay SM, Nader PR, Parcel GS, Stone EJ, Webber LS, Elder JP, Feldman HA, Johnson CC, et al. Outcomes of a field trial to improve children's dietary patterns and physical activity. The Child and Adolescent Trial for Cardiovascular Health. CATCH collaborative group. *JAMA*. 1996;275:768–776.
37. Kaitosaari T, Ronnemaa T, Raitakari O, Talvia S, Kallio K, Volanen I, Leino A, Jokinen E, Valimaki I, Viikari J, Simell O. Effect of 7-year infancy-onset dietary intervention on serum lipoproteins and lipoprotein subclasses in healthy children in the prospective, randomized Special Turku Coronary Risk Factor Intervention Project for Children (STRIP) study. *Circulation*. 2003;108:672–677.
38. Yu-Poth S, Zhao G, Etherton T, Naglak M, Jonnalagadda S, Kris-Etherton PM. Effects of the National Cholesterol Education Program's Step I and Step II dietary intervention programs on cardiovascular disease risk factors: a meta-analysis. *Am J Clin Nutr*. 1999;69:632–646.
39. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) Final Report. *Circulation*. 2002;106:3143–3421.

40. Lagstrom H, Jokinen E, Seppanen R, Ronnemaa T, Viikari J, Valimaki I, Venetoklis J, Myyrinmaa A, Niinikoski H, Lapinleimu H, Simell O. Nutrient intakes by young children in a prospective randomized trial of a low-saturated fat, low-cholesterol diet. The STRIP Baby Project. Special Turku Coronary Risk Factor Intervention Project for Babies. *Arch Pediatr Adolesc Med*. 1997;151:181–188.
41. Viikari JS, Niinikoski H, Juonala M, Raitakari OT, Lagstrom H, Kaitosaari T, Ronnemaa T, Simell O. Risk factors for coronary heart disease in children and young adults. *Acta Paediatr Suppl*. 2004;93:34–42.
42. Talvia S, Lagstrom H, Rasanen M, Salminen M, Rasanen L, Salo P, Viikari J, Ronnemaa T, Jokinen E, Vahlberg T, Simell O. A randomized intervention since infancy to reduce intake of saturated fat: calorie (energy) and nutrient intakes up to the age of 10 years in the Special Turku Coronary Risk Factor Intervention Project. *Arch Pediatr Adolesc Med*. 2004;158:41–47.
43. Obarzanek E, Hunsberger SA, Van Horn L, Hartmuller VV, Barton BA, Stevens VJ, Kwiterovich PO, Franklin FA, Kimm SY, Lasser NL, Simons-Morton DG, Lauer RM. Safety of a fat-reduced diet: the Dietary Intervention Study in Children (DISC). *Pediatrics*. 1997;100:51–59.
44. Lauer RM, Obarzanek E, Hunsberger SA, Van Horn L, Hartmuller VW, Barton BA, Stevens VJ, Kwiterovich PO Jr, Franklin FA Jr, Kimm SY, Lasser NL, Simons-Morton DG. Efficacy and safety of lowering dietary intake of total fat, saturated fat, and cholesterol in children with elevated LDL cholesterol: the Dietary Intervention Study in Children. *Am J Clin Nutr*. 2000;72:1332S–1342S.
45. Rask-Nissila L, Jokinen E, Terho P, Tammi A, Hakanen M, Ronnemaa T, Viikari J, Seppanen R, Valimaki I, Helenius H, Simell O. Effects of diet on the neurologic development of children at 5 years of age: the STRIP project. *J Pediatr*. 2002;140:328–333.
46. Jacobson MS, Tomopoulos S, Williams CL, Arden MR, Deckelbaum RJ, Starc TJ. Normal growth in high-risk hyperlipidemic children and adolescents with dietary intervention. *Prev Med*. 1998;27:775–780.
47. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents: findings from the third National Health and Nutrition Examination Survey, 1988–1994. *Arch Pediatr Adolesc Med*. 2003;157:821–827.
48. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics*. 1999;103:1175–1182.
49. Morrison JA, Sprecher DL, Barton BA, Waclawiw MA, Daniels SR. Overweight, fat patterning, and cardiovascular disease risk factors in black and white girls: The National Heart, Lung, and Blood Institute Growth and Health Study. *J Pediatr*. 1999;135:458–464.
50. Kimm SY, Glynn NW, Kriska AM, Barton BA, Kronsberg SS, Daniels SR, Crawford PB, Sabry ZI, Liu K. Decline in physical activity in black girls and white girls during adolescence. *N Engl J Med*. 2002;347:709–715.
51. Becque MD, Katch VL, Rocchini AP, Marks CR, Moorehead C. Coronary risk incidence of obese adolescents: reduction by exercise plus diet intervention. *Pediatrics*. 1988;81:605–612.
52. Rocchini AP, Katch V, Schork A, Kelch RP. Insulin and blood pressure during weight loss in obese adolescents. *Hypertension*. 1987;10:267–273.
53. Young EM, Fors SW, Hayes DM. Associations between perceived parent behaviors and middle school student fruit and vegetable consumption. *J Nutr Educ Behav*. 2004;36:2–8.
54. Muntner P, He J, Cutler JA, Wildman RP, Whelton PK. Trends in blood pressure among children and adolescents. *JAMA*. 2004;291:2107–2113.
55. Ford ES, Mokdad AH, Ajani UA. Trends in risk factors for cardiovascular disease among children and adolescents in the United States. *Pediatrics*. 2004;114:1534–1544.
56. Gidding SS, Bao W, Srinivasan SR, Berenson GS. Effects of secular trends in obesity on coronary risk factors in children: The Bogalusa Heart Study. *J Pediatr*. 1995;127:868–874.
57. Sinaiko AR, Donahue RP, Jacobs DR Jr, Prineas RJ. Relation of weight and rate of increase in weight during childhood and adolescence to body size, blood pressure, fasting insulin, and lipids in young adults. The Minneapolis Children's Blood Pressure Study. *Circulation*. 1999;99:1471–1476.
58. Kumanyika SK, Obarzanek E, Robinson TN, Beech BM. Phase 1 of the Girls health Enrichment Multi-site Studies (GEMS): conclusion. *Ethn Dis*. 2003;13(suppl 1):S88–S91.
59. Caballero B, Clay T, Davis SM, Ethelbah B, Rock BH, Lohman T, Norman J, Story M, Stone EJ, Stephenson L, Stevens J; Pathways Study Research Group. Pathways: a school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. *Am J Clin Nutr*. 2003;78:1030–1038.
60. Briefel RR, Reidy K, Karwe V, Devaney B. Feeding infants and toddlers study: Improvements needed in meeting infant feeding recommendations. *J Am Diet Assoc*. 2004;104:s31–s37.
61. Fox MK, Pac S, Devaney B, Jankowski L. Feeding infants and toddlers study: What foods are infants and toddlers eating? *J Am Diet Assoc*. 2004;104(suppl 1):s22–s30.
62. French SA, Story M, Jeffery RW. Environmental influences on eating and physical activity. *Annu Rev Public Health*. 2001;22:309–335.
63. Siega-Riz AM, Popkin BM, Carson T. Trends in breakfast consumption for children in the United States from 1965–1991. *Am J Clin Nutr*. 1998;67:748S–756S.
64. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. *Obes Res*. 2002;10:370–378.
65. Nielsen SJ, Popkin BM. Patterns and trends in food portion sizes, 1977–1998. *JAMA*. 2003;289:450–453.
66. Nielsen SJ, Popkin BM. Changes in beverage intake between 1977 and 2001. *Am J Prev Med*. 2004;27:205–210. Erratum in: *Am J Prev Med*. 2005;28:413.
67. Cavadini C, Siega-Riz AM, Popkin BM. US adolescent food intake trends from 1965 to 1996. *Arch Dis Child*. 2000;83:18–24. Erratum in: *Arch Dis Child*. 2002;87:85.
68. Kranz S, Smiciklas-Wright H, Siega-Riz AM, Mitchell D. Adverse effect of high added sugar consumption on dietary intake in American preschoolers. *J Pediatr*. 2005;146:105–111.
69. Wright JD, Wang CY, Kennedy-Stephenson J, Ervin RB. Dietary intake of ten key nutrients for public health, United States: 1999–2000. *Adv Data*. April 2003:1–4.
70. Institute of Medicine Panel on Dietary Reference Intakes for Electrolytes and Water. *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*. Washington, DC: National Academies Press; 2004.
71. Ervin RB, Wang CY, Wright JD, Kennedy-Stephenson J. Dietary intake of selected minerals for the United States population: 1999–2000. *Adv Data*. April 2004:1–5.
72. Rozin P. Family resemblance in food and other domains: the family paradox and the role of parental congruence. *Appetite*. 1991;16:93–102.
73. Rozin P, Millman L. Family environment, not heredity, accounts for family resemblances in food preferences and attitudes: a twin study. *Appetite*. 1987;8:125–134.
74. Cutler D, Glasser E, Shapiro J. *Why Have Americans Become More Obese? The Economics of Obesity Workshop (April 22, 2003)*. Washington, DC: Economic Research Service, US Department of Agriculture; May 2004 (E-FAN-04-004).
75. Brown R, Ogden J. Children's eating attitudes and behaviour: a study of the modelling and control theories of parental influence. *Health Educ Res*. 2004;19:261–271.
76. Videon TM, Manning CK. Influences on adolescent eating patterns: the importance of family meals. *J Adolesc Health*. 2003;32:365–373.
77. Gillman MW, Rifas-Shiman SL, Frazier AL, Rockett HR, Camargo CA Jr, Field AE, Berkey CS, Colditz GA. Family dinner and diet quality among older children and adolescents. *Arch Fam Med*. 2000;9:235–240.
78. Neumark-Sztainer D, Hannan PJ, Story M, Croll J, Perry C. Family meal patterns: associations with sociodemographic characteristics and improved dietary intake among adolescents. *J Am Diet Assoc*. 2003;103:317–322.
79. Kratt P, Reynolds K, Shewchuk R. The role of availability as a moderator of family fruit and vegetable consumption. *Health Educ Behav*. 2000;27:471–482.
80. Fisher JO, Mitchell DC, Smiciklas-Wright H, Birch LL. Parental influences on young girls' fruit and vegetable, micronutrient, and fat intakes. *J Am Diet Assoc*. 2002;102:58–64.
81. Fisher J, Mitchell D, Smiciklas-Wright H, Birch L. Maternal milk consumption predicts the tradeoff between milk and soft drinks in young girls' diets. *J Nutr*. 2001;131:246–250.
82. World Health Organization. *World Health Report 2002: Reducing Risks, Promoting Healthy Life*. Geneva, Switzerland: World Health Organization; 2002. Available at: http://www.who.int/whr/2002/en/whr02_en.pdf. Accessed April 12, 2005.
83. Rich-Edwards JW, Stampfer MJ, Manson JE, Rosner B, Hankinson SE, Colditz GA, Willett WC, Hennekens CH. Birth weight and risk of cardiovascular disease in a cohort of women followed up since 1976. *BMJ*. 1997;315:396–400.
84. Curhan GC, Chertow GM, Willett WC, Spiegelman D, Colditz GA, Manson JE, Speizer FE, Stampfer MJ. Birth weight and adult hypertension and obesity in women. *Circulation*. 1996;94:1310–1315.

85. Langley-Evans SC. Fetal programming of cardiovascular function through exposure to maternal undernutrition. *Proc Nutr Soc*. 2001;60:505–513.
86. Seckl JR. Prenatal glucocorticoids and long-term programming. *Eur J Endocrinol*. 2004;151(suppl 3):U49–U62.
87. Edwards LJ, Coulter CL, Symonds ME, McMillen IC. Prenatal undernutrition, glucocorticoids and the programming of adult hypertension. *Clin Exp Pharmacol Physiol*. 2001;28:938–941.
88. Eriksson J, Forsen T, Tuomilehto J, Osmond C, Barker D. Size at birth, childhood growth and obesity in adult life. *Int J Obes Relat Metab Disord*. 2001;25:735–740.
89. Hediger ML, Overpeck MD, McGlynn A, Kuczmarski RJ, Maurer KR, Davis WW. Growth and fatness at three to six years of age of children born small- or large-for-gestational age. *Pediatrics*. 1999;104:e33.
90. Frisancho AR. Prenatal compared with parental origins of adolescent fatness. *Am J Clin Nutr*. 2000;72:1186–1190.
91. Whitaker RC. Predicting preschooler obesity at birth: the role of maternal obesity in early pregnancy. *Pediatrics*. 2004;114:e29–e36.
92. Institute of Medicine. *Nutrition During Pregnancy, Weight Gain and Nutrient Supplements: Report of the Subcommittee on Nutritional Status and Weight Gain During Pregnancy*. Washington, DC: National Academy Press; 1990.
93. Gunderson EP, Abrams B, Selvin S. The relative importance of gestational gain and maternal characteristics associated with the risk of becoming overweight after pregnancy. *Int J Obes Relat Metab Disord*. 2000;24:1660–1668.
94. Huh SY, Rifas-Shiman SL, Kleinman KP, Rich-Edwards JW, Lipshultz SE, Gillman MW. Maternal protein intake is not associated with infant blood pressure. *Int J Epidemiol*. 2005;34:378–384.
95. Gillman MW, Rifas-Shiman SL, Kleinman KP, Rich-Edwards JW, Lipshultz SE. Maternal calcium intake and offspring blood pressure. *Circulation*. 2004;110:1990–1995.
96. Gartner LM, Morton J, Lawrence RA, Naylor AJ, O'Hare D, Schanler RJ, Eidelman AI; American Academy of Pediatrics Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics*. 2005;115:496–506.
97. Martin RM, Davey Smith G, Mangtani P, Tilling K, Frankel S, Gunnell D. Breastfeeding and cardiovascular mortality: the Boyd Orr cohort and a systematic review with meta-analysis. *Eur Heart J*. 2004;25:778–786.
98. Arenz S, Ruckerl R, Koletzko B, von Kries R. Breast-feeding and childhood obesity–a systematic review. *Int J Obes Relat Metab Disord*. 2004;28:1247–1256.
99. Owen CG, Martin RM, Whincup PH, Smith GD, Cook DG. Effect of infant feeding on the risk of obesity across the life course: a quantitative review of published evidence. *Pediatrics*. 2005;115:1367–1377.
100. Martin RM, Gunnell D, Smith GD. Breastfeeding in infancy and blood pressure in later life: systematic review and meta-analysis. *Am J Epidemiol*. 2005;161:15–26.
101. Owen CG, Whincup PH, Gilg JA, Cook DG. Effect of breast feeding in infancy on blood pressure in later life: systematic review and meta-analysis. *BMJ*. 2003;327:1189–1195.
102. Owen CG, Whincup PH, Odoki K, Gilg JA, Cook DG. Infant feeding and blood cholesterol: a study in adolescents and a systematic review. *Pediatrics*. 2002;110:597–608.
103. Stettler N, Zemel BS, Kumanyika S, Stallings VA. Infant weight gain and childhood overweight status in a multicenter, cohort study. *Pediatrics*. 2002;109:194–199.
104. Dewey KG. Nutrition, growth, and complementary feeding of the breastfed infant. *Pediatr Clin North Am*. 2001;48:87–104.
105. Haisma H, Coward WA, Albernaz E, Visser GH, Wells JC, Wright A, Victora CG. Breast milk and energy intake in exclusively, predominantly, and partially breast-fed infants. *Eur J Clin Nutr*. 2003;57:1633–1642.
106. Dennison BA, Edmunds LE, Stratton H, Pruzek R. Rapid infant weight gain associated with childhood overweight at age 4 years. *Obes Res*. In press.
107. Wright P. Hunger, satiety and feeding behavior in early infancy. In: Boakes RA, Popplewell DA, Burton MJ, eds. *Eating Habits: Food, Physiology and Learned Behavior*. Chichester, UK: Wiley; 1987.
108. Fisher JO, Birch LL, Smiciklas-Wright H, Picciano MF. Breast-feeding through the first year predicts maternal control in feeding and subsequent toddler energy intakes. *J Am Diet Assoc*. 2000;100:641–646.
109. Taveras EM, Scanlon KS, Birch L, Rifas-Shiman SL, Rich-Edwards JW, Gillman MW. Association of breastfeeding with maternal control of infant feeding at age 1 year. *Pediatrics*. 2004;114:e577–e583.
110. Wright P. Patterns of milk intake in breast- and bottle-fed infants. In: Stratton P, ed. *The Psychobiology of the Human Newborn*. New York, NY: Wiley; 1982.
111. Klesges RC, Coates TJ, Brown G, Sturgeon-Tillisch J, Moldenhauer-Klesges LM, Holzer B, Woolfrey J, Vollmer J. Parental influences on children's eating behavior and relative weight. *J Appl Behav Anal*. 1983;16:371–378.
112. Mennella JA, Griffin CE, Beauchamp GK. Flavor programming during infancy. *Pediatrics*. 2004;113:840–845.
113. Mennella JA, Jagnow CP, Beauchamp GK. Prenatal and postnatal flavor learning by human infants. *Pediatrics*. 2001;107:E88.
114. Mennella JA, Pepino MY, Reed DR. Genetic and environmental determinants of bitter perception and sweet preferences. *Pediatrics*. 2005;115:e216–e222.
115. Gerrish CJ, Mennella JA. Flavor variety enhances food acceptance in formula-fed infants. *Am J Clin Nutr*. 2001;73:1080–1085.
116. Liem DG, Mennella JA. Heightened sour preferences during childhood. *Chem Senses*. 2003;28:173–180.
117. Li R, Hsia J, Fridinger F, Hussain A, Benton-Davis S, Grummer-Strawn L. Public beliefs about breastfeeding policies in various settings. *J Am Diet Assoc*. 2004;104:1162–1168.
118. Visness CM, Kennedy KI. Maternal employment and breast-feeding: findings from the 1988 National Maternal and Infant Health Survey. *Am J Public Health*. 1997;87:945–950.
119. Li R, Zhao Z, Mokdad A, Barker L, Grummer-Strawn L. Prevalence of breastfeeding in the United States: the 2001 National Immunization Survey. *Pediatrics*. 2003;111:1198–1201.
120. Kurinij N, Shiono PH, Ezrine SF, Rhoads GG. Does maternal employment affect breast-feeding? *Am J Public Health*. 1989;79:1247–1250.
121. Gielen AC, Faden RR, O'Campo P, Brown CH, Paige DM. Maternal employment during the early postpartum period: effects on initiation and continuation of breast-feeding. *Pediatrics*. 1991;87:298–305.
122. Auerbach KG, Guss E. Maternal employment and breastfeeding. A study of 567 women's experiences. *Am J Dis Child*. 1984;138:958–960.
123. Hills-Bonczyk SG, Avery MD, Savik K, Potter S, Duckett LJ. Women's experiences with combining breast-feeding and employment. *J Nurse Midwifery*. 1993;38:257–266.
124. Lande B, Andersen LF, Veierod MB, Baerug A, Johansson L, Trygg KU, Bjorneboe GE. Breast-feeding at 12 months of age and dietary habits among breast-fed and non-breast-fed infants. *Public Health Nutr*. 2004;7:495–503.
125. Ortiz J, McGilligan K, Kelly P. Duration of breast milk expression among working mothers enrolled in an employer-sponsored lactation program. *Pediatr Nurs*. 2004;30:111–119.
126. Kramer MS, Kakuma R. The optimal duration of exclusive breastfeeding: a systematic review. *Adv Exp Med Biol*. 2004;554:63–77.
126a. Lederman SA, Akabas SR, Moore BJ, Bentley ME, Devaney B, Gillman MW, Kramer MS, Mennella JA, Ness A, Wardle J. Summary of the Presentations at the Conference on Preventing Childhood Obesity, December 8, 2003. *Pediatrics*. 2004;114:1146–1173.
127. Carruth BR, Skinner JD, Houck KS, Moran JD 3rd. Addition of supplementary foods and infant growth (2 to 24 months). *J Am Coll Nutr*. 2000;19:405–412.
128. Mehta KC, Specker BL, Bartholmey S, Giddens J, Ho ML. Trial on timing of introduction to solids and food type on infant growth. *Pediatrics*. 1998;102:569–573.
129. Devaney B, Ziegler P, Pac S, Karwe V, Barr SI. Nutrient intakes of infants and toddlers. *J Am Diet Assoc*. 2004;104(suppl 1):s14–s21.
130. Skinner JD, Ziegler P, Ponza M. Transitions in infants' and toddlers' beverage patterns. *J Am Diet Assoc*. 2004;104(suppl 1):s45–s50.
131. US Department of Agriculture, Food and Nutrition Services. 2002 CFR title 7 volume 4 chapter II (1-1-02 edition). 246-Special Supplemental Nutrition Program for Women, Infants and Children (WIC). Subpart D-Participant benefits. 246.10 Supplemental foods. Available at: http://www.fns.usda.gov/WIC/PDFfiles/WICregulations. Accessed January 31, 2005.
132. Dennison BA, Erb TA, Jenkins PL. Predictors of dietary milk fat intake by preschool children. *Prev Med*. 2001;33:536–542.
133. Sullivan SA, Birch LL. Infant dietary experience and acceptance of solid foods. *Pediatrics*. 1994;93:271–277.
134. Thompson FE, Dennison BA. Dietary sources of fats and cholesterol in US children aged 2 through 5 years. *Am J Public Health*. 1994;84:799–806.
135. Dennison BA, Rockwell HL, Baker SL. Excess fruit juice consumption by preschool-aged children is associated with short stature and obesity. *Pediatrics*. 1997;99:15–22.
136. Welsh JA, Cogswell ME, Rogers S, Rockett H, Mei Z, Grummer-Strawn LM. Overweight among low-income preschool children associated with the consumption of sweet drinks: Missouri, 1999–2002. *Pediatrics*. 2005;115:e223–e229.
137. Drewnowski A. The role of energy density. *Lipids*. 2003;38:109–115.

138. Birch LL, Deysher M. Caloric compensation and sensory specific satiety: evidence for self regulation of food intake by young children. *Appetite*. 1986;7:323–331.
139. Araya H, Vera G, Alvina M. Effect of the energy density and volume of high carbohydrate meals on short term satiety in preschool children. *Eur J Clin Nutr*. 1999;53:273–276.
140. Bandini LG, Vu D, Must A, Cyr H, Goldberg A, Dietz WH. Comparison of high-calorie, low-nutrient-dense food consumption among obese and non-obese adolescents. *Obes Res*. 1999;7:438–443.
141. Phillips SM, Bandini LG, Naumova EN, Cyr H, Colclough S, Dietz WH, Must A. Energy-dense snack food intake in adolescence: longitudinal relationship to weight and fatness. *Obes Res*. 2004;12:461–472.
142. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. *Pediatrics*. 1998;101(pt 2):539–549.
143. Fisher JO, Birch LL. Restricting access to palatable foods affects children's behavioral response, food selection, and intake. *Am J Clin Nutr*. 1999;69:1264–1272.
144. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet*. 2001;357:505–508.
145. Committee on Nutrition. American Academy of Pediatrics: the use and misuse of fruit juice in pediatrics. *Pediatrics*. 2001;107:1210–1213.
146. Bowman SA, Gortmaker SL, Ebbeling CB, Pereira MA, Ludwig DS. Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. *Pediatrics*. 2004;113(pt 1):112–118.
147. Putnam J, Allshouse J, Kantor L. *U.S. Per Capita Food Supply Trends: More Calories, Refined Carbohydrates and Fats*. Washington, DC: Economic Research Service, US Department of Agriculture; 2002.
148. Epstein LH, Valoski A, Wing RR, McCurley J. Ten-year follow-up of behavioral, family-based treatment for obese children. *JAMA*. 1990;264:2519–2523.
149. Hayman LL, Williams CL, Daniels SR, Steinberger J, Paridon S, Dennison BA, McCrindle BW; Committee on Atherosclerosis, Hypertension, and Obesity in Youth (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. Cardiovascular health promotion in the schools: a statement for health and education professionals and child health advocates from the Committee on Atherosclerosis, Hypertension, and Obesity in Youth (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation*. 2004;110:2266–2275.
150. Position of ADA, SNE, and ASFSA: school-based nutrition programs and services. *J Am Diet Assoc*. 1995;95:367–369.
151. Osganian SK, Ebzery MK, Montgomery DH, Nicklas TA, Evans MA, Mitchell PD, Lytle LA, Snyder MP, Stone EJ, Zive MM, Bachman KJ, Rice R, Parcel GS. Changes in the nutrient content of school lunches: results from the CATCH Eat Smart Food service Intervention. *Prev Med*. 1996;25:400–412.
152. Dwyer JT, Hewes LV, Mitchell PD, Nicklas TA, Montgomery DH, Lytle LA, Snyder MP, Zive MM, Bachman KJ, Rice R, Parcel GS. Improving school breakfasts: effects of the CATCH Eat Smart Program on the nutrient content of school breakfasts. *Prev Med*. 1996;25:413–422.
153. Perry CL, Bishop DB, Taylor GL, Davis M, Story M, Gray C, Bishop SC, Mays RA, Lytle LA, Harnack L. A randomized school trial of environmental strategies to encourage fruit and vegetable consumption among children. *Health Educ Behav*. 2004;31:65–76.
154. Cullen KW, Ash DM, Warneke C, de Moor C. Intake of soft drinks, fruit-flavored beverages, and fruits and vegetables by children in grades 4 through 6. *Am J Public Health*. 2002;92:1475–1478.
155. Birnbaum AS, Lytle LA, Story M, Perry CL, Murray DM. Are differences in exposure to a multicomponent school-based intervention associated with varying dietary outcomes in adolescents? *Health Educ Behav*. 2002;29:427–443.
156. Williams CL, Strobino BA, Bollella M, Brotanek J. Cardiovascular risk reduction in preschool children: the "Healthy Start" project. *J Am Coll Nutr*. 2004;23:117–123.
157. Levin S, Lowry R, Brown DR, Dietz WH. Physical activity and body mass index among US adolescents: youth risk behavior survey, 1999. *Arch Pediatr Adolesc Med*. 2003;157:816–820.
158. Boynton-Jarrett R, Thomas TN, Peterson KE, Wiecha J, Sobol AM, Gortmaker SL. Impact of television viewing patterns on fruit and vegetable consumption among adolescents. *Pediatrics*. 2003;112(pt 1):1321–1326.
159. Dennison BA, Erb TA, Jenkins PL. Television viewing and television in bedroom associated with overweight risk among low-income preschool children. *Pediatrics*. 2002;109:1028–1035.
160. Coon KA, Goldberg J, Rogers BL, Tucker KL. Relationships between use of television during meals and children's food consumption patterns. *Pediatrics*. 2001;107:E7.
161. Institute of Medicine. *WIC Food Packages: Time for Change: Executive Summary*. Washington, DC: National Academy of Sciences; 2004. Available at: http://www.nap.edu/catalog/11280.html. Accessed April 30, 2005.
162. National High Blood Pressure Education Program NIH. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics*. 2004;114:555–576.
163. National Cholesterol Education Program (NCEP): highlights of the report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents. *Pediatrics*. 1992;89:495–501.
164. Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, Sacks FM, Bray GA, Vogt TM, Cutler JA, Windhauser MM, Lin P-H, Karanja N. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. *N Engl J Med*. 1997;336:1117–1124.
165. Simons-Morton DG, Obarzanek E. Diet and blood pressure in children and adolescents. *Pediatr Nephrol*. 1997;11:244–249.
166. Simons-Morton DG, Hunsberger SA, Van Horn L, Barton BA, Robson AM, McMahon RP, Muhonen LE, Kwiterovich PO, Lasser NL, Kimm SY, Greenlick MR. Nutrient intake and blood pressure in the Dietary Intervention Study in Children. *Hypertension*. 1997;29:930–936.
167. Van Horn L. Fiber, lipids, and coronary heart disease: a statement for healthcare professionals from the Nutrition Committee, American Heart Association. *Circulation*. 1997;95:2701–2704.
168. Lichtenstein AH, Deckelbaum RJ. AHA Science Advisory. Stanol/sterol ester-containing foods and blood cholesterol levels. A statement for healthcare professionals from the Nutrition Committee of the Council on Nutrition, Physical Activity, and Metabolism of the American Heart Association. *Circulation*. 2001;103:1177–1179.
169. Tammi A, Ronnemaa T, Miettinen TA, Gylling H, Rask-Nissila L, Viikari J, Tuominen J, Marniemi J, Simell O. Effects of gender, apolipoprotein E phenotype and cholesterol-lowering by plant stanol esters in children: the STRIP study. Special Turku Coronary Risk Factor Intervention Project. *Acta Paediatr*. 2002;91:1155–1162.
170. Davidson MH, Maki KC, Umporowicz DM, Ingram KA, Dicklin MR, Schaefer E, Lane RW, McNamara JR, Ribaya-Mercado JD, Perrone G, Robins SJ, Franke WC. Safety and tolerability of esterified phytosterols administered in reduced-fat spread and salad dressing to healthy adult men and women. *J Am Coll Nutr*. 2001;20:307–319.
171. Homma Y, Ikeda I, Ishikawa T, Tateno M, Sugano M, Nakamura H. Decrease in plasma low-density lipoprotein cholesterol, apolipoprotein B, cholesteryl ester transfer protein, and oxidized low-density lipoprotein by plant stanol ester-containing spread: a randomized, placebo-controlled trial. *Nutrition*. 2003;19:369–374.
172. Ntanios FY, Homma Y, Ushiro S. A spread enriched with plant sterol-esters lowers blood cholesterol and lipoproteins without affecting vitamins A and E in normal and hypercholesterolemic Japanese men and women. *J Nutr*. 2002;132:3650–3655.
173. Volpe R, Niittynen L, Korpela R, Sirtori C, Bucci A, Fraone N, Pazzucconi F. Effects of yoghurt enriched with plant sterols on serum lipids in patients with moderate hypercholesterolaemia. *Br J Nutr*. 2001;86:233–239.
174. Maki KC, Davidson MH, Umporowicz DM, Schaefer EJ, Dicklin MR, Ingram KA, Chen S, McNamara JR, Gebhart BW, Ribaya-Mercado JD, Perrone G, Robins SJ, Franke WC. Lipid responses to plant-sterol-enriched reduced-fat spreads incorporated into a National Cholesterol Education Program Step I diet. *Am J Clin Nutr*. 2001;74:33–43.
175. Miettinen TA, Puska P, Gylling H, Vanhanen H, Vartiainen E. Reduction of serum cholesterol with sitostanol-ester margarine in a mildly hypercholesterolemic population. *N Engl J Med*. 1995;333:1308–1312.
176. Hendriks HF, Brink EJ, Meijer GW, Princen HM, Ntanios FY. Safety of long-term consumption of plant sterol esters-enriched spread. *Eur J Clin Nutr*. 2003;57:681–692.
177. Nestel P, Cehun M, Pomeroy S, Abbey M, Weldon G. Cholesterol-lowering effects of plant sterol esters and non-esterified stanols in margarine, butter and low-fat foods. *Eur J Clin Nutr*. 2001;55:1084–1090.

Dietary Recommendations for Children and Adolescents: A Guide for Practitioners: Consensus Statement From the American Heart Association

Samuel S. Gidding, Barbara A. Dennison, Leann L. Birch, Stephen R. Daniels, Matthew W. Gilman, Alice H. Lichtenstein, Karyl Thomas Rattay, Julia Steinberger, Nicolas Stettler and Linda Van Horn

Endorsed by the American Academy of Pediatrics

Circulation. 2005;112:2061-2075
doi: 10.1161/CIRCULATIONAHA.105.169251
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0009-7322. Online ISSN: 1524-4539

Correction

In the article "Dietary Recommendations for Children and Adolescents: A Guide for Practitioners: Consensus Statement From the American Heart Association" by Gidding et al (*Circulation*. 2005;112:2061–2075), the following changes were not included in the version that printed in the September 27, 2005, issue:

1. On page 2061, the footnote "This Statement will also appear in *Pediatrics"* has been deleted.
2. On page 2063, in the footnotes to Table 3, footnote ‡ should read: "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."
3. On page 2063, in the footnotes to Table 3, footnote ¶ should read: "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."
4. On page 2064, in Figure 1, panel A represents females and panel B represents males. This information has been appended to the y-axis of each panel.
5. On page 2067, in the second full paragraph, the first sentence should read: "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 benefit during this transition." The third sentence should read, "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]"

These changes have been incorporated into the online version of the article, available at http://circ.ahajournals.org/cgi/content/full/112/13/2061.

DOI: 10.1161/CIRCULATIONAHA.105.170531

(*Circulation.* 2005;112:2375.)

***Circulation* is available at http://www.circulationaha.org**