Increased blood cholesterol levels have been found to be a risk factor for coronary vascular disease in adult populations, and the reduction of cholesterol levels in adults decreases the risk. Because no comparable studies have been carried out in childhood populations, the significance of cholesterol as a risk factor for coronary vascular disease must be inferred from less direct evidence. It is also important to note that a number of other factors including cigarette smoking, hypertension, obesity, and diabetes mellitus are important in their causative relationship to atherosclerotic vascular disease. A family history of premature coronary vascular disease is also a risk factor for early onset coronary vascular disease.

The American Academy of Pediatrics (AAP) last published its recommendations regarding dietary fat and cholesterol in 1986 and suggested indications for cholesterol testing in children and adolescents in 1989. Very recently the Expert Panel on Blood Cholesterol Levels in Children and Adolescents of the National Cholesterol Education Program (NCEP), in a comprehensive report, recommended that all children and adolescents eat a diet that on average contains no more than 30% of total calories from fat, less than 10% of total calories from saturated fat, and less than 300 mg of cholesterol per day. The panel recommended screening blood cholesterol levels only in those children and adolescents whose risk of developing coronary vascular disease as adults could be identified by family history or by the coexistence of several risk factors. In this statement the earlier recommendations of the AAP are reviewed in the context of the recent NCEP report and provide current guidelines regarding dietary fat and cholesterol, cholesterol screening, and management of elevated blood cholesterol levels in children. These guidelines should be regarded as an effort by the Committee on Nutrition to define an interim approach to this important issue that takes into account the substantial uncertainty concerning the pathophysiology of atherogenesis in childhood and the related inaccuracies in predicting which children will ultimately require intervention for coronary artery disease as adults, based on current diagnostic techniques applied during childhood.

The AAP and NCEP report both endorse the principle that the diet of children and adolescents should be adequate to support normal growth and development. A varied diet including foods from each of the major food groups provides the best assurance of nutritional adequacy. Dietary guidelines that restrict fat and cholesterol should not apply to infants from birth to age 2 years.

**RATIONALE FOR ATTENTION TO BLOOD CHOLESTEROL LEVELS IN CHILDHOOD**

A diet rich in saturated fat and cholesterol is one of several factors that influence the development of coronary vascular disease in adults. Heredity, physical inactivity, smoking, obesity, and diabetes mellitus along with diet affect serum cholesterol levels. In several large-scale and geographically diverse studies, serum cholesterol has been shown to be a powerful and independent risk factor for coronary vascular disease in adults. Ethnic populations such as the Masai in Africa and the Inuit of North America, ingest diets high in total fat, saturated fat, and cholesterol but have a low prevalence of coronary vascular disease, demonstrating the importance of these other risk or protective factors. It is for this reason that previous statements from the AAP have emphasized diet in the context of a “Prudent Lifestyle for Children” and have recommended that efforts be made to reduce or eliminate when possible all contributing risk factors for coronary vascular disease and other chronic illnesses.

Children and adolescents in the United States, like their adult counterparts, have higher saturated fat intakes and blood cholesterol levels than children in many other developed nations. The school-aged children participating in the Bogalusa Heart Study who consumed a diet higher in fat had higher mean serum cholesterol values than children eating a lower fat diet. Obesity and aerobic capacity also strongly influence the serum lipid profiles during adolescence.

Several autopsy studies of children published during the past 5 years demonstrate the presence of raised lesions in coronary vessels that progress with age and correlate with blood lipid levels as well as other known risk factors, such as smoking and hypertension. In one study 7% of those examined between ages 10 and 15 years had these lesions in coronary vessels, 14% of those between ages 15 and 20 years and 21% of those between ages 20 and 25 years demonstrated similar lesions. By ages 35 to 40 years, 66% of individuals in the study demonstrated some atherosclerotic changes.

Diet intervention alone reduces serum cholesterol levels in children and adults, although the individual

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The recommendations in this publication do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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response is variable. Both diet modification and drugs given to lower serum lipid values cause regression of coronary vascular lesions and reduce the morbidity and mortality from coronary vascular disease in adults. Longitudinal studies have not been reported that examine what effect beginning diets containing lower fat and cholesterol during childhood can have in preventing the development and progression of coronary atherosclerosis. The diet and heart disease hypothesis has not been examined systematically in children. A cautious approach to aggressive lowering of serum cholesterol values in children is suggested by recent studies in adults that indicate that individuals with low serum cholesterol values and those with serum cholesterol values reduced by diet and drugs experienced increased rates of noncardiac deaths relative to control populations. Hence, total death rates between groups with low and high cholesterol values may not be different.

Concerns about the effects of severe dietary fat restriction on growth and development led the AAP to recommend in 1986 that the optimal total fat intake cannot be determined, but 30% to 40% of calories seems sensible for adequate growth and development. Diets that avoid extremes are safe for children for whom there is no evidence of special vulnerability. Any recommendations for changing toward a more restrictive dietary pattern during the first two decades of life should await demonstration that such dietary restrictions would support adequate growth and development for children and adolescents.

During the past 25 years the consumption of saturated fats, cholesterol, and total fat has decreased in the United States. Recent food consumption surveys show that children and adolescents in the United States on average now consume about 35% of their total calories as fat, with 14% to 15% of total calories from saturated fat and less than 300 mg/day of cholesterol. During the same period, the mean weight and height of children and adolescents in the United States has continued to increase; the prevalence of obesity has also increased. A diet that restricts saturated fat to less than 10% of total calories, total fat to approximately 30% of total calories, and dietary cholesterol to less than 300 mg/d concurs with previous recommendations from the AAP and falls within the range of the current eating habits of children and adolescents in the United States. Such a diet can support the nutrient needs of this population. McPherson et al in a survey of food intake and food sources in middle class school children documented that a substantial proportion of these children were already consuming a diet containing 30% of total calories from fat and were meeting all of their nutritional requirements. A larger multicenter study, supported by the National Heart, Lung, and Blood Institute, is examining this question and will be completed in 1993.

As a result of the recommendations from the American Heart Association, National Cholesterol Education Program, National Institutes of Health Consensus Conference on Lowering Blood Cholesterol to Prevent Heart Disease, the American Cancer Society, and many other groups, foods are increasingly being prepared with a lower total fat, saturated fat, and cholesterol content. A 1990 survey conducted by the National Restaurant Association revealed that 89% of fast food restaurants now fry with vegetable oils in place of animal fats. Thus, children and adolescents are likely to have increasingly leaner food choices. The early studies of Davis and more recently Birch et al suggest that if ample and varied food choices are available, children will adjust their energy intake to meet their needs. Children and adolescents are themselves increasingly aware of the fat and cholesterol content of various foods and of the guidelines for limiting dietary fat and cholesterol and for ensuring good nutrition.

Although dietary fat can be safely limited to approximately 30% of total calories, some will attempt to restrict fat intake further, to well below 30%. Recent reports of growth failure among children and adolescents testify to the dangers of excessive restriction of dietary fat. The adequacy of mineral absorption from diets rich in complex carbohydrates has also not been established. It should be emphasized that the primary goal of the diet in childhood is to achieve normal growth and development. Within the context of a balanced diet, no single food should be considered unhealthy regardless of its fat content. In particular, where the food supply is limited and children are at greater risk for undernutrition, foods containing higher amounts of fat are appropriate to meet energy and other specific nutrient requirements. No restriction should be placed on the fat and cholesterol content of the diet of infants from birth to 2 years of age, a period of rapid growth and development and high nutritional requirements.

The transition to a lower fat diet beginning at the age of 2 years requires special consideration. Approximately 50% of the calories in the diet of the exclusively breast-fed infant come from the fat content of the milk. As solids are introduced during the first and second year of age, the percentage of calories in the diet contributed by fat decreases. At ages 2 to 3 years, if only 30% of total calories are derived from fat, then the protein content would have to provide as much as 17% to 20% of calories for the diet to meet the recommended daily allowances for minerals. Early childhood then should be considered a transition period during which the fat and cholesterol content of the diet should gradually decrease to the recommended amounts. Particular care should be taken at this time to avoid excessive restriction of dietary fat. The consumption of lower fat dairy products and lean meats—critical sources of protein, iron, and calcium—should be encouraged throughout childhood and adolescence.

SCREENING OF BLOOD CHOLESTEROL LEVELS

The AAP continues to endorse an individualized approach to identify and treat children and adolescents whose risk of developing coronary vascular disease as adults can be identified through family history. If the family history cannot be ascertained and other risk factors are present, screening should be at the discretion of the physician. The poor predic-
Fig 1. Risk assessment. *Positive family history is defined as a history of premature (before age 55 years) cardiovascular disease in a parent or grandparent (from National Cholesterol Education Program).

Fig 2. Classification, education, and follow-up based on low-density lipoprotein cholesterol (from National Cholesterol Education Program). HDL, high-density lipoprotein; LDL, low-density lipoprotein.

The American Academy of Pediatrics recommends the following:

1. An elevated serum cholesterol value, cigarette smoking, hypertension, obesity, diabetes mellitus, and lack of physical activity are independent risk factors for coronary vascular disease. The risk of coronary artery disease in adults can be reduced by adopting a prudent lifestyle in which smoking is avoided, intake of saturated fat and cholesterol is decreased, weight is controlled, physical activity is increased, and treatment for hypertension and diabetes is obtained.

2. Atherosclerosis begins in childhood, and the degree of atherosclerotic changes correlates with blood cholesterol levels, smoking, and hypertension. However, coronary vascular disease is rare before the third decade, and coronary vascular lesions appear to be reversible during the third and fourth decade of life or later with appropriate diet and drug treatment. Serum cholesterol level is an imperfect predictor of future coronary vascular disease.

3. Nutritional adequacy should be achieved by eating a wide variety of foods, and energy (calories) should be adequate to support growth and to reach or maintain desirable body weight. Recommended dietary goals for all children more than 2 years of age include: an average daily intake of 30% of total calories from fat, less than 10% of total calories from saturated fatty acids, and less than 300 mg of cholesterol per day. A lower intake of fat is not recommended. The AAP believes that recommendations that call for "less than" 30% of calories from fat may lead to the inappropriate use of more restrictive diets. Skim or low-fat milk is not recommended in the first 2 years of life because of the high protein and
electrolyte content and low calorie density of these milks.

4. The Academy continues to endorse the selective screening of children more than 2 years of age whose risk of developing coronary vascular disease can be identified by family history. This screening should include the following groups:

(1) Children whose parents or grandparents have a history of coronary or peripheral vascular disease before the age of 55 years should have a serum lipid profile that includes determination of low density lipoprotein (LDL) cholesterol value. Blood should be drawn after a 12-hour fast.

(2) Children whose parents have a blood cholesterol level greater than or equal to 240 mg/dL should be screened for total blood cholesterol level (nonfasting).

(3) Children and adolescents with several risk factors for future coronary vascular disease (eg, smoking, hypertension, physical inactivity, obesity, and diabetes mellitus) whose family history cannot be ascertained may be screened at the discretion of the physician for a total blood cholesterol level.

5. When possible, identification and elimination of other risk factors for coronary vascular disease (eg, smoking, hypertension, obesity, diabetes mellitus) are recommended for everyone, including those who are screened, regardless of the results. A diet (Step I Diet) supervised by a health professional is the first therapy recommended for hypercholesterolemic children. The diet is one in which the intake of saturated fats is less than 10% of total calories, with no more than 30% of calories as fat and less than 300 mg of cholesterol per day. If after repeated testing the desired serum lipid levels are not achieved, the intake of saturated fats should be reduced to less than 7% of total calories, with no more than 30% of calories as fat and the cholesterol amount reduced to less than 200 mg/day (Step II Diet).

6. Drug therapy can be considered in children more than 10 years of age if after an adequate trial of diet therapy (6 months to 1 year) the LDL cholesterol value remains greater than 190 mg/dL in the absence of other risk factors. If the level remains greater than 160 mg/dL in children with a family history of heart disease or two or more risk factors of cardiovascular disease, drug therapy is also recommended. Bile acid sequestrants such as cholestyramine and colestipol are the only drugs recommended because there is limited experience in the use of other cholesterol-lowering agents in children. Other drugs such as niacin, hydroxymethylglutaryl coenzyme A (HMG CoA) reductase inhibitors, probucol, gemfibrozil, thyrroxine, and clofibrate are not recommended for routine use because very little data exist concerning safety and efficacy of these drugs in children. The AAP recommends that all lipid-lowering agents, including the bile acid sequestrants, be used with caution because they all have the potential for interfering with growth as well as producing other significant side effects. Clinical trials of these agents should be carried out in children to determine both safety and efficacy before their widespread use is endorsed. If lipid-lowering drugs are required, children should be monitored closely, particularly during the vulnerable period of adolescent growth.

REFERENCES

Statement on Cholesterol

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