Atherosclerotic cardiovascular disease remains the leading cause of both death and disability in North America. Evidence that most cardiovascular disease is preventable led to development of the American Heart Association’s initial “Guide to the Primary Prevention of Cardiovascular Disease” in 1996 and the updated version in 2002. Those guidelines do not address prevention in children, a group for whom primary prevention should hold the most promise. Emergence of multiple lines of evidence with regard to the importance of known risk factors for atherosclerotic disease in children and young adults has provided the impetus to develop guidelines for primary prevention in this young population.

Pathological studies have shown that both the presence and extent of atherosclerotic lesions at autopsy after unexpected death of children and young adults correlate positively and significantly with established risk factors, namely low-density lipoprotein cholesterol, triglycerides, systolic and diastolic blood pressure, body mass index, and presence of cigarette smoking. Findings from the Bogalusa study indicate that as the number of cardiovascular risk factors increases, so does the pathological evidence for atherosclerosis in the aorta and coronary arteries beginning in early childhood. Electron beam computed tomography of coronary artery calcium and increased carotid artery intima-media thickness, an ultrasound measure of carotid artery atherosclerosis, have been evaluated in 29- to 39-year-olds monitored from 4 years of age. Significant risk predictors for coronary artery calcium were obesity and elevated blood pressure in childhood and increased body mass index and dyslipidemia as young adults. Multiple epidemiological studies have demonstrated a disturbing increase in the prevalence of obesity beginning in childhood, with at least 22% of 6- to 17-year-olds diagnosed as overweight. This is a cause for particular concern because of the strong association between obesity and hypertension, dyslipidemia, and type II diabetes mellitus beginning in childhood. Long-term follow-up studies have demonstrated tracking of obesity, hypercholesterolemia, and hypertension from childhood into adult life. There is now substantial scientific evidence documenting the acquisition of behaviors associated with risk factors in childhood; these include dietary habits, physical activity behaviors, and the use of tobacco. Finally, an increasing body of research now documents the safety and success of intervention to reduce risk factors in childhood. These studies include the Dietary Intervention Study in Children trial, which demonstrated the safety and efficacy of a low-fat diet in children with hypercholesterolemia; skill-training programs in smoking prevention in adolescents; the Child and Adolescent Trial for Cardiovascular Health Study, which increased physical activity levels in children by using elementary school–based programs; and other successful long-term family-based treatment programs for childhood obesity.

There has not been nor will likely ever be a controlled trial comparing the effect of risk reductions beginning in childhood on the subsequent development of atherosclerotic disease. The existing evidence indicates that primary prevention of atherosclerotic disease should begin in childhood. The following guidelines represent a practical approach to cardiovascular health promotion and identification and management of known risk factors for cardiovascular disease in children and young adults. These guidelines complement other American Heart Association guidelines and should be useful for primary care providers, specialists, and parents of children and adolescents. The writing group that developed this statement considered the National Cholesterol Education Program Pediatric Panel Report, the second Task Force report on the diagnosis and management of hypertension in childhood, the update of that task force report by the National High Blood Pressure Education Program, and multiple additional publications, which are included in the reading list. Two
major primary prevention strategies for children and adolescents are outlined in the tables below: (1) Population guidelines are directed cardiovascular health promotion for the entire pediatric population, whereas (2) individual guidelines focus on the identification and management of children and adolescents at highest risk for atherosclerotic disease.

The population guidelines, which apply to all children and adolescents, are presented in Table 1. In this table, the goals are presented in the left column and the recommendations for achieving those goals are presented in the right. Table 2 presents general and risk factor–specific guidelines for identifying pediatric patients at high risk of future cardiovascular disease. Finally, Table 3 presents goals and recommendations to achieve the goals of reducing risks in children and adolescents identified at high risk of future cardiovascular disease.

These guidelines present a conservative approach in an easy-to-use format identifying risk factors in childhood and safely modifying those identified without harm to the growing child. The American Heart Association’s Council on Cardiovascular Disease in the Young has developed a cardiovascular health schedule that allows risk factor identification and modification within the framework of routine pediatric care, and this approach is highly recommended (Williams et al, reference 7 in section VI). These guidelines are complementary to the recommendations published by Williams et al. Risk reduction has been shown to delay the onset and modify the course of atherosclerotic disease in adults; with evidence for the extent and importance of identified risk factors in the young, the time for primary prevention beginning in childhood has come.

**Selected Readings by Subject**

I. Pathological Evidence for Risk Factor Impact in the Young


TABLE 2. Guidelines for Identification of Children and Adolescents at High Risk of CVD

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Assessment</td>
<td></td>
</tr>
<tr>
<td><strong>Goals for Pediatric Care Providers</strong></td>
<td></td>
</tr>
<tr>
<td>• Timed, targeted risk factor assessment</td>
<td></td>
</tr>
<tr>
<td>• Appropriate interpretation of results and communication to families</td>
<td></td>
</tr>
<tr>
<td><strong>Goals for Parents</strong></td>
<td></td>
</tr>
<tr>
<td>• Recognition of risk factor significance for development of cardiovascular disease, especially family history</td>
<td></td>
</tr>
<tr>
<td>Specific Risk Assessment: Levels of Concern</td>
<td></td>
</tr>
<tr>
<td><strong>Lipids and Lipoprotein</strong></td>
<td></td>
</tr>
<tr>
<td>• Total cholesterol &gt;170 mg/dL is borderline; &gt;200 mg/dL is elevated</td>
<td></td>
</tr>
<tr>
<td>• LDL-C &gt;110 mg/dL is borderline; &gt;130 mg/dL is elevated</td>
<td></td>
</tr>
<tr>
<td>• Triglycerides &gt;150 mg/dL</td>
<td></td>
</tr>
<tr>
<td>• HDL-C &lt;35 mg/dL</td>
<td></td>
</tr>
<tr>
<td><strong>Blood Pressure</strong></td>
<td></td>
</tr>
<tr>
<td>• Systolic and diastolic blood pressure &gt;90th percentile for age, sex, and height</td>
<td></td>
</tr>
<tr>
<td><strong>Body Size</strong></td>
<td></td>
</tr>
<tr>
<td>• BMI &gt;85th percentile is at risk of overweight; &gt;95th percentile is overweight</td>
<td></td>
</tr>
</tbody>
</table>

BMI indicates body mass index; CVD, cardiovascular disease; HDL-C, high-density lipoprotein cholesterol; and LDL-C, low-density lipoprotein cholesterol.

II. Prevalence of Obesity/Type 2 Diabetes Mellitus

III. Tracking of Risk Factors From Childhood Into Adult Life

IV. Acquisition of Risk Behaviors in Childhood

V. Intervention Trials
Risk Intervention Recommendations

### Blood Cholesterol Management

**GOALS:**
- LDL-C <160 mg/dL (<130 mg/dL is even better)
- For patients with diabetes, LDL-C <100 mg/dL

- If LDL-C is above goals, initiate additional therapeutic lifestyle changes, including diet (<7% of calories from saturated fat; <200 mg cholesterol per day), in conjunction with a trained diettian.
- Consider LDL-lowering dietary options (increase soluble fiber by using age [in years] plus 5 to 10 g up to age 15, when the total remains at 25 g per day) in conjunction with a trained diettian.
- Emphasize weight management and increased physical activity.
- If LDL-C is persistently above goals, evaluate for secondary causes (thyroid-stimulating hormone, liver function tests, renal function tests, urinalysis).
- Consider pharmacological therapy for individuals with LDL >190 mg/dL with no other risk factors for CVD; or >160 mg/dL with other risk factors present (blood pressure elevation, diabetes, obesity, strong family history of premature CVD).
- bile acid–binding resins or statins are usual first-line agents.
- Pharmacological intervention for dyslipidemia should be accomplished in collaboration with a physician experienced in treatment of disorders of cholesterol in pediatric patients.

### Other Lipids and Lipoprotein

**GOALS:**
- Fasting TG <150 mg/dL
- HDL-C >35 mg/dL

- Elevated fasting TG and reduced HDL-C are often seen in the context of overweight with insulin resistance. Therapeutic lifestyle change should include weight management with appropriate energy intake and expenditure. Decrease intake of simple sugars.
- If fasting TG are persistently elevated, evaluate for secondary causes such as diabetes, thyroid disease, renal disease, and alcohol abuse.
- No pharmacological interventions are recommended in children for isolated elevation of fasting TG unless this is very marked (treatment may be initiated at TG >400 mg/dL to protect against postprandial TG of 1000 mg/dL or greater, which may be associated with an increased risk of pancreatitis).

### Management of Blood Pressure Elevation

**GOAL:**
- Systolic and diastolic blood pressure <95th percentile for age, sex, and height

- Promote achievement of appropriate weight.
- Reduce sodium in the diet. Emphasize increased consumption of fruits and vegetables.
- If blood pressure is persistently above the 95th percentile, consider possible secondary causes (eg, renal disease, coarctation of the aorta).
- Consider pharmacological therapy for individuals above the 95th percentile if lifestyle modification brings no improvement and there is evidence of target organ changes (left ventricular hypertrophy, microalbuminuria, retinal vascular abnormalities). Start blood pressure medication individualized to other patient requirements and characteristics (ie, age, race, need for drugs with specific benefits).
- Pharmacological management of hypertension should be accomplished in collaboration with a physician experienced in pediatric hypertension.

### Weight Management

**GOAL:**
- Achieve and maintain BMI <95th percentile for age and sex

- For children who are at risk of overweight (>85th percentile) or obesity (>95th percentile), a weight management program should be initiated with appropriate energy balance achieved through changes in diet and physical activity.
- For children of normal height, a secondary cause of obesity is unlikely.
- Weight management should be directed at all family members who are overweight, using a family-centered, behavioral management approach.
- Weight management should be done in collaboration with a trained diettian.

### Diabetes Management

**GOALS:**
- Near normal fasting plasma glucose (<120 mg/dL)
- Near normal HgA1c (<7%) (goals for fasting glucose and HgA1c should take into consideration age and risk of hypoglycemia)

- Management of type 1 and type 2 diabetes in children and adolescents should be accomplished in collaboration with a pediatric endocrinologist.
- For type 2 diabetes, the first step is weight management with improved diet and exercise.
- Because of risk for accelerated vascular disease, other risk factors (eg, blood pressure, lipid abnormalities) should be treated more aggressively in patients with diabetes.

### Cigarette Smoking Cessation

**GOAL:**
- Complete cessation of smoking for children and parents who smoke

- Advise every tobacco user (parents and children) to quit and be prepared to provide assistance with this (counseling/referral to develop a plan for quitting using available community resources to help with smoking cessation).

TG indicates triglycerides.

VI. Pediatric Consensus Statements


Key Words: AHA Scientific Statements ■ pediatrics ■ atherosclerosis ■ cardiovascular diseases ■ prevention
American Heart Association Guidelines for Primary Prevention of Atherosclerotic Cardiovascular Disease Beginning in Childhood
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