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Special Report

Cardiovascular Health and Disease in Children: Current Status

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In 1991 the American Heart Association created the Task Force on Children and Youth and charged it with developing a broad outline of the heart health needs of the next generation of young people. One recommendation of the task force was that a position paper be written on the status of cardiovascular health in children and youth.

Introduction
During the past half century there has been major progress in the scientific understanding of cardiovascular conditions in children and youth, and this progress has led to improved prevention and treatment of congenital and acquired heart disease. Following this period of advancement, the current status of our understanding should be reviewed to create a foundation for future scientific efforts.

The focus of research and clinical activity in cardiac disease in children has changed during the past 60 years. In the 1930s the major concern among cardiologists caring for children was rheumatic fever and rheumatic heart disease. Interest in congenital heart disease was just beginning. In the 1940s extracardiac operations for cardiac malformations were developed, and in the 1950s the first open-heart procedures involving cardiopulmonary bypass were performed. In the 1960s and 1970s cardiopulmonary bypass became more widely available, and the pediatric patient group undergoing open-heart procedures was expanded from children to neonates and infants. In the 1970s and 1980s, echocardiography and therapeutic catheterization techniques were used in children with cardiac abnormalities. During the past two decades, two other major areas of emphasis have developed: electrophysiology, which allows improved diagnosis and management of arrhythmias in children, and cardiovascular risk factor evaluation in children. In addition, pediatric cardiologists now recognize the need to slow the development of atherosclerosis, a process that often begins in childhood.

As the 20th century draws to a close, it is appropriate to review the status of both the major cardiovascular diseases of children and the cardiovascular health of children and youth. This report also describes barriers to continued progress in this important area of cardiovascular medicine, and should help direct research, educational, and other efforts by individuals and organizations interested in cardiovascular disease and the health of children.

Current Status of Children’s Cardiovascular Health
Cardiovascular disease occurs more often in children than is generally appreciated by health care professionals or the general public. More than 600 000 children in the United States have an abnormality of the cardiovascular system; approximately 440 000 have a cardiac malformation, an estimated 160 000 have a disturbance of cardiac rhythm or conduction, and 40 000 have an acquired disease such as cardiomyopathy, rheumatic heart disease, or Kawasaki disease. Furthermore, if the current rate of development of atherosclerosis continues, nearly half of the approximately 80 million American children under age 21 will ultimately die of complications of atherosclerosis such as coronary artery disease and stroke. With this overall perspective, each of the major conditions are discussed below.

Cardiac Malformations
Congenital malformations are the leading cause of neonatal mortality (death at less than 28 days of age), and cardiac malformations are the leading cause of neonatal deaths due to congenital malformations. The prevalence of cardiac malformations is approximately 8 per 1000 live births, or about 32 000 new cases of congenital heart disease every year in the United States. Of these, about 25% are first seen in early infancy with life-threatening illness requiring immediate attention. As many as 20% of these neonates die of their cardiac conditions during the first year of life (J.H.M., personal observation, 1993), a decrease from the 40% mortality seen in the late 1960s. The number of deaths occurring after the age of 1 is unknown, but in one study 71% of patients referred to pediatric cardiologists were alive 26 to 37 years later. Furthermore, data from natural history studies indicated that 80% of patients with certain conditions were alive after 30 years of follow-up. One consequence of this

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survival rate is the increasing number of young adults with treated or untreated congenital heart disease. By the year 2000, the population of adults with heart defects will exceed 900,000.11

Despite the wide variety of cardiac malformations, the distribution of anomalies has been relatively constant over the past two decades.4 Cardiac malformations vary in severity. Many patients have little clinical dysfunction while others require surgery, and for a few the malformation may be incompatible with life.

Even though cardiac malformations occur in few live births and the mortality rate is low, the number of years of potential life lost because of cardiac malformations is great because most deaths occur in infancy and early childhood: for coronary heart disease the number of years lost is 8 per 1000 population and for congenital heart disease approximately 2 per 1000 population.12-14 This is a startling statistic considering that 375 of 1000 people die of coronary heart disease and only 2 of 1000 die of congenital heart disease. The relatively large number of years of potential life lost because of congenital heart disease has a major impact in terms of lost contribution to the gross national product.

Etiology. The cause of most cardiac malformations is unknown; however, several factors have been identified. Chromosomal abnormalities account for nearly 10% of cardiac malformations. The most common such abnormality, trisomy 21 (Down syndrome), is present in 6% to 8% of all patients with a cardiac malformation. Other recognized chromosomal abnormalities, including Turner's syndrome, are present in 1% to 2%. Recently, deletion of chromosome 22 has been associated with tetralogy of Fallot and DiGeorge syndrome.15 Familial occurrence of congenital heart disease (ie, in more than one member of a family) varies with the specific malformation and ranges from 3% to 10%.10,16 With advances in molecular genetics comes an excellent opportunity to study candidate genes that may affect cardiac development. Other causes of cardiac malformations include maternal factors, specifically maternal rubella and maternal diabetes mellitus. Ingestion of certain substances during pregnancy has been associated with cardiac malformations. In the late 1950s and early 1960s, about 10% of fetuses exposed to thalidomide had limb reduction, cardiac malformation, or both.17 Maternal ingestion of alcohol is associated with a 30% occurrence rate of congenital malformations in offspring.18,19 Diphenylhydantoin is associated with fetal hydantoin syndrome, which significantly increases the risk of congenital heart disease.20

With improvements in diagnosis and treatment, the number of infants and children surviving cardiac surgery is increasing. Cardiac care is costly and requires extensive resources, but the long-term investment in children who will become productive adults is justified. Both short- and long-term morbidity and mortality occur and add to costs. Therefore, the focus should be on understanding the etiology and mechanisms of development of cardiac malformations with the hope of preventing them. Advances in molecular biology may be used in the study of factors controlling development of the cardiac structures, and models may be developed. In the meantime, study of the developing fetus, particularly with echocardiography and Doppler techniques, provides new insights about the fetal circulation and allows the identification of abnormalities of cardiac structure and function. Medical treatment of fetal cardiac arrhythmias is now possible, and ultimately it may be possible to treat abnormalities of cardiac structure in utero.

Rheumatic Fever

Internationally, rheumatic fever remains the leading cause of cardiac disease during the first four decades of life.21 In some less developed countries the incidence of rheumatic fever is still as high as 100 per 100,000 children,21 although it has declined strikingly in industrialized countries since the early 1920s. The marked difference between countries in incidence of rheumatic fever has been attributed at least in part to socioeconomic variations, because rheumatic fever is associated with poverty. However, the epidemiology and microbiology of acute rheumatic fever in the United States have changed since the 1970s, when incidence was 1 per 100,000 per year.22 Recent outbreaks of acute rheumatic fever in the United States have occurred in more affluent suburbs and are associated with a group A streptococcus that has a more mucoid appearance than did previously encountered strains. This is consistent with the proposed hypotheses that rheumatogenic strains of group A streptococci are highly encapsulated and form mucoid colonies, and that when present in a community certain serotypes, particularly M1, M3, and M18, are associated with increased occurrence of acute rheumatic fever.23 Schwartz and colleagues24 recently reported that the proportions of isolates of serotypes M1, M3, and M18 have increased significantly in the United States between 1972 and 1988. Nevertheless, even in the United States rheumatic fever is predominately a disease of the poor.25,26 The epidemiology of rheumatic fever in poor neighborhoods mimics the international picture of the disease.

Acute rheumatic fever is preventable by penicillin treatment of streptococcal pharyngitis. Secondary prevention, through long-term antibiotic treatment of the patient who has had rheumatic fever, is also possible. The factors in the organism or host that lead to development of acute rheumatic fever and the reason for the disease's relation to poverty are unknown. Efforts should be made to understand this important disease that affects millions of people throughout the world so that its occurrence can be prevented, perhaps through the development of a vaccine.

Kawasaki Disease

Kawasaki disease is a generalized vasculitis of unknown origin affecting more than 2000 children per year in the United States.27 Eighty percent of cases occur in children less than 5 years old, and most in children less than 2 years old. Children of all racial backgrounds are affected, although the highest incidence is in children of Asian ancestry. Kawasaki disease occurs throughout the year, most frequently in winter and spring.

Kawasaki disease causes coronary artery abnormalities (ectasia or aneurysms) in about 20% of children who contract it. Aneurysms usually appear between 10 and 28 days after the onset of symptoms. Some of these are giant aneurysms (internal diameter of at least 8 mm), and these do not usually resolve, whereas smaller aneurysms appear to decrease in size. "Improvement"
may actually be due to sclerosis\textsuperscript{28} and may be less favorable than previously thought.

Because Kawasaki disease is relatively new, initially described in 1967 in Japan, long-term follow-up data are not available. Studies have indicated that the disease may have a long-term effect on the coronary arteries, even in children who do not have giant aneurysms.\textsuperscript{29,30} A natural history study is needed to establish the role of Kawasaki disease as a risk factor for adult coronary artery disease.

The cause of Kawasaki disease is presently unknown, although it appears to be an infectious agent. Specific therapy for this disease will not be available until the etiologic agent is discovered. Therefore, more research in this area is needed.

**Infective Endocarditis**

The incidence of endocarditis in children is between 0.56 and 0.83 per 1000 hospital admissions\textsuperscript{31,32} and has been rising, perhaps because of improved survival of children with cardiac malformations. Although endocarditis is more common in older children, it has been reported in children of all ages, including neonates.

Approximately 80\% of cases of infective endocarditis in children occur in those with congenital heart disease.\textsuperscript{33,34} The incidence varies with the cardiac condition, being higher in patients with prosthetic heart valves, systemic-pulmonary artery shunts, tetralogy of Fallot, unrepaired ventricular septal defect, or aortic stenosis.\textsuperscript{7,33-35}

**Cardiomyopathy**

Cardiomyopathy in children is usually either hypertrophic or dilated and is rarely restrictive. The prevalence of cardiomyopathy among children in the United States is unknown. Many systemic conditions, including neuromuscular diseases, disorders of intermediate energy metabolism, metabolic storage diseases, mitochondrial diseases, and infection, can affect the myocardium. Cardiomyopathy is associated with cardiac arrhythmias, but the precise relation is unclear. Other than these conditions, many of which may be familial or genetic, there is a familial occurrence of "idiopathic" cardiomyopathy. The best-identified familial occurrence is hypertrophic cardiomyopathy,\textsuperscript{56} but familial dilated cardiomyopathy has been reported as well.\textsuperscript{37} Eventually more precise classification based on genetic advances will allow detection of people at risk and provide information about the basis of the disease. In the future, fetal myocytes may be used in treatment, replacing the current symptomatic medical treatment or cardiac transplantation. With improved understanding of precise etiology, more effective and specific treatment can be developed.

**Marfan's Syndrome**

Marfan's syndrome is a heritable disorder of connective tissue such as the cardiovascular, skeletal, and ocular systems. First described by Antonin Marfan, a French pediatrician, in 1896, it occurs in five to eight people per 100 000. In this syndrome, the walls of the major arteries show microscopic disruption and disorganization. The aorta is often affected, and the process of aortic medial disruption predisposes to the development of aortic dissection. It has been reported that 90\% of mortality attributable to Marfan's syndrome is related to cardiovascular abnormalities.\textsuperscript{38} The genetic abnormality has been localized to fibrillin genes of chromosome 15\textsuperscript{39,40}; this finding will permit identification of carriers and improve future understanding of the syndrome.

**Cardiac Rhythm Disturbances**

During the last decade, disturbances of cardiac rhythm have been recognized and evaluated with increasing frequency. Diagnostic techniques have improved, a wider range of pharmacologic agents is available, and new ablation methods and pacemakers have been developed. Few epidemiologic studies have been performed to determine the incidence of various rhythm disturbances, but data are available from which reasonable estimates can be made.

Paroxysmal tachycardia can be due to several mechanisms. At least three children per 1000 without a structural anomaly of the heart have symptomatic tachycardia. Wolff-Parkinson-White syndrome occurs in one to three people per 1000,\textsuperscript{41} and a similar proportion of the population has concealed preexcitation. Half of these people are symptomatic, so two people per 1000 (including children) have symptoms of a preexcitation mechanism. About one child per 1000 has paroxysmal tachycardia from atrioventricular nodal reentry. In addition, a small number of children have tachycardia from another mechanism.

Abnormally slow heart rate is usually due to complete heart block. It occurs in one per 20 000 children without structural abnormality of the heart and in one per 1000 with a cardiac malformation.\textsuperscript{42} Maternal lupus erythematosus is the cause in some infants and children. Rarely, a slow heart rate occurs secondary to conditions such as polymyositis, myocarditis, or Kearns-Sayer syndrome.

Syncope is a common symptom in children that may prompt a cardiac evaluation because it may be related to an intrinsic cardiac condition. Perhaps 15\% of children have at least one syncopal episode,\textsuperscript{43} with few having an underlying cardiac anomaly or a second episode. Tilt-table testing in patients with true syncope often discloses a vasodepressor origin that can be successfully treated with fluid loading or beta-blockade.

Sudden death during childhood is uncommon, occurring 2.5 to 8.5 times per 100 000 patient-years.\textsuperscript{44} Among the causes is the prolonged QT interval syndrome, for which a genetic abnormality has been described.

Cardiac rhythm disturbances occur secondary to cardiac operations and are believed to be the cause of sudden death in some patients years after surgery. The recorded incidence of this problem will probably increase as more patients are followed for longer periods after operation.

The successful treatment of cardiac rhythm disturbances awaits the development of new and more specific pharmacologic agents. In the case of the young this process is hindered by the restriction on drug testing in children. Many of the agents that are used in children will have undergone efficacy and safety testing in adults, with the results of these trials being used to direct and guide treatment of children.

**Cerebrovascular Problems**

Cerebrovascular problems and strokes are uncommon during childhood. Because of their rarity, epidemiologic data on these events are limited. One study indicated an
occurrence rate of acute cerebrovascular disease in children of 2.52 acute episodes per 100 000 per year, with more events being hemorrhagic than ischemic.\(^4\) In a study in Japan, the occurrence rate in children of cerebral infarction secondary to ischemia was 0.2 per 100 000 per year.\(^5\) In adults, the principal causes of stroke are atherosclerotic cerebrovascular disease, ischemic heart disease, and atrial fibrillation, and there is increasing attention to relations between stroke and patent foramen ovale and between stroke and right to left shunting of emboli. The causes in children are different and more varied. Because of the small number of cases, it is difficult to determine the relative frequency of etiologic factors. In one study involving 95 children, there was no known preexisting cause in 42 subjects, blood dyscrasias in 18, malignancy in 10, cardiac anomaly in 9, and miscellaneous causes in the remaining 16. Factors implicated as a cause of stroke in this study were infection (21%), cerebrovascular malformation (18%), a hematoletic problem (15%), cardiac malformation (13%), minor trauma (8%), and miscellaneous causes (14%).\(^6\) A variety of unusual childhood conditions, including genetic and metabolic disorders, cause stroke and must be considered in the evaluation of a child with a stroke, because without identification of the underlying cause the risk of recurrence is great. Two particular causes of stroke in children deserve special attention. Homozygous sickle cell disease is associated with a 7.8% occurrence of stroke by the age of 14 years.\(^7\) HIV infection, which is occurring in greater numbers in the young, causes both hemorrhagic and ischemic strokes in children.\(^8\) These two causes of stroke will probably increase in the coming decade, and will help draw the attention of investigators and clinicians to this devastating vascular cause of mortality and morbidity in children.

**Risk Factors**

Many adult cardiovascular diseases have their origin in childhood. The cardiovascular risk factors identified in adults are already present in many children. Fatty streaks are found in children as young as 3,\(^9\) and occur in a progressively greater proportion of children with increasing age. Intimal plaques have been found in adolescents.\(^10\)

Pathological studies have correlated the extent of these changes with the presence of risk factors in children. Behaviors including smoking, excess fat intake, excess sodium intake, and sedentary lifestyle are modifiable. Attention must be directed to the effects of these factors in children.

**Dietary Fat and Cholesterol Intake**

Children from countries where there is lower consumption of saturated fat and a lower incidence of coronary heart disease have lower levels of blood cholesterol.\(^11\) Blood cholesterol levels show familial clustering because of shared environmental and genetic factors. Children from families with premature coronary events are considered to be at a higher risk of similar events in adulthood and to be more likely to have dyslipoproteinemia.\(^12\) The Expert Panel on Cholesterol in Children and Adolescents of the National Cholesterol Education Program has recommended an individual approach to identification and management of children at high risk of developing coronary heart disease and a population approach to lowering the blood cholesterol levels of all American children.\(^13\) The panel's recommendations for all American children over the age of 2 years are for a diet that contains no more than 30% of total calories from fat, with less than 10% of calories from saturated fats and less than 300 mg cholesterol per day. Fifteen percent of daily calories should come from protein and the remaining 55% from carbohydrates, preferably complex. These recommendations are for children over the age of 2 years; no restrictions on fat intake are recommended for younger children.\(^14\)

Data to indicate the effectiveness of treatment during childhood are lacking. Children at increased risk of developing cardiovascular disease when older would be more easily identified by molecular biology techniques than they are at present. Treatment could then be targeted toward these patients. Furthermore, clinical drug trials of cholesterol-lowering agents have not been performed in children, so the acute and long-term safety and efficacy of these agents in pediatric patients is unknown.

**Smoking**

Tobacco use increases the risk of coronary heart disease and other atherosclerotic disease and is a modifiable risk factor. The smoking habit is usually acquired during adolescence, and an estimated 4 000 000 adolescents smoke.\(^15\) Primary prevention programs against smoking have been created and are effective,\(^16,17\) but methods of implementing programs also need to be developed. The tobacco industry has directed strong, successful advertising toward children, as well as residents of poorer urban areas,\(^18,19\) with the result that major changes in market share resulting from cigarette advertising have occurred primarily in younger smokers.\(^20\)

Children's health is also adversely affected by environmental smoke.\(^21\) Respiratory diseases and asthma occur more frequently in households in which parents smoke. Neonates who are small for gestational age are more likely to be born to mothers who smoke than to nonsmoking mothers. The increased cardiovascular risk of adults exposed to secondary cigarette smoke is well documented.\(^22\) The AHA and the Environmental Protection Agency have indicated that environmental tobacco smoke is a health hazard.\(^23\)

Although education has some effect on modification of the smoking habit, public policy approaches are much more effective in reducing cigarette smoking by adolescents. The excise tax on a pack of cigarettes in Canada is $3, and with the implementation of this level of taxation the number of adolescents in Canada who began smoking was reduced by two thirds.\(^24\) The recent passage of Proposition 99 in California, in which the excise tax was increased by 25¢ to 35¢ per pack, was associated with a 13.8% reduction in the number of smokers.\(^25\) The price elasticity of cigarettes could be a major weapon against acquisition of the cigarette smoking habit by adolescents. Other major public policy efforts must be directed at the advertising, promotion, sales, and distribution of tobacco products. Cigarettes are still not regulated by the major congressional health and safety acts, acts that regulate other products such as food, drugs, and cosmetics.
Obesity

It is estimated that between 6 and 15 million children are obese, based on triceps skinfold measurements. This is an increase of 39% (in 12- to 17-year-olds) to 54% (in 6- to 11-year-olds) since the 1960s.74 Though not considered an independent cardiovascular risk factor, obesity is associated with other risk factors, including elevation of blood pressure, elevation of total cholesterol level, physical inactivity, and low high-density lipoprotein cholesterol, that contribute to cardiovascular risk. The etiologic factors for obesity are largely unknown, although it has an inherited basis in some children. Studies have indicated the presence of a gene for obesity in some children, with 35% carrying the gene and 6% being homozygous.75 Research is needed to define other causes of obesity and to facilitate the identification of causes with a genetic basis so proper treatment can be carried out.

Physical Inactivity

Physical inactivity is an independent risk factor for cardiovascular disease and also contributes to the risk factors of elevated cholesterol, hypertension, and obesity. In adults regular physical activity is associated with a longer life span and reduced risk of cardiovascular disease.

The proportion of children who are not physically active may be increasing. During the past decade, the percentage of high school students who participate in vigorous physical activity at least three times per week has declined from 61.7% to 36.1%.76,77 The National Children and Youth Fitness Studies I76 and II78 provide excellent information about physical fitness in American youth. They highlight the connection between parents' level of physical activity and that of their children, the relation between physical fitness and amount of time spent watching television, and the inadequacy of physical education classes in many schools. A recent report from the AHA directs attention to a number of actions that can be undertaken to increase and promote physical activity in youth.79

Hypertension

High blood pressure is one of the major risk factors for coronary artery disease, stroke, and renal failure. Hypertension is usually identified in adulthood, but it can also occur in children. Both the Second Task Force on Blood Pressure Control in Children of the National Heart, Lung, and Blood Institute80 and the Council on Cardiovascular Disease in Children of the American Heart Association81 have issued reports about hypertension in children. Both reports state that early detection, evaluation, and treatment of primary or secondary hypertension in children will improve their long-term health. Physicians and nurses must think of hypertension as a risk factor in the young, even if clinical manifestations of the disease are not evident.

Children 3 years old or older should have their blood pressure measured by their physician once a year, typically during a routine physical examination when the child is well. The report of the Second Task Force on Blood Pressure Control in Children included age- and sex-specific percentiles of blood pressure measurements from birth to 18 years.80 "Normal" blood pressure is systolic and diastolic blood pressures less than the 90th percentile, "high normal" blood pressure is average systolic and/or average diastolic blood pressure between the 90th and 95th percentiles, "high" blood pressure (significant hypertension) is average systolic and/or diastolic pressure greater than or equal to the 95th percentile (with measurements obtained on at least three occasions), and "severe" hypertension is average systolic and/or average diastolic blood pressure above the 99th percentile.

If a child has high blood pressure, nonpharmacologic therapies should be instituted first. These include dietary intervention, weight control, and physical activity. Pharmacologic therapy always has some side effects and therefore should be reserved for children whose blood pressure cannot be controlled by rigorous nonpharmacologic measures. Because no studies have been done of the long-term efficacy or safety of blood pressure lowering in childhood by hygienic or pharmacologic methods, such studies are urgently required.

Barriers to Progress in Cardiovascular Disease Prevention in Children and Youth

Adequate resources must be available for research, education, and patient care if there is to be continued progress in cardiovascular disease and health of children and youth. Many advances in cardiovascular medicine can be attributed to the growth of biomedical research since the late 1940s, particularly that sponsored by the National Institutes of Health and the AHA. At that time and subsequently, the United States made a commitment to research into major diseases affecting millions of Americans and to training both research scientists and medical specialists. To increase our understanding of disease mechanisms and improve methods of treatment, continued support for the national biomedical research effort and the training of basic and physician scientists is required. However, federal budgetary limitations over the last decade have limited the number of new NIH grants despite a continued increase in the number of meritorious proposals. These limitations restrict the scientific community's ability to study basic disease processes and causes of cardiovascular diseases in general, including those relevant to children. Review of NIH funding of proposals of cardiovascular disease has shown that about 10% of all research grants are for pediatric research.81

The paucity of funding for research in cardiovascular diseases of children and youth is partly related to the small number of pediatric cardiovascular scientists. There are less than 1000 certified specialists in pediatric cardiology in the United States, and only a limited number of those devote a substantial effort to either clinical or basic biomedical research.82 In a manpower study of board-certified pediatric cardiologists, only 18 of 570 respondents had had at least 2 years of research training during their fellowship training.82 Furthermore, because of the small number of pediatric cardiovascular scientists and specialists, their ability to obtain specialized center grants or establish collaborative research with basic scientists is limited. The incidence of coronary artery disease, compared with that of congenital heart disease, and the perceived importance of cardiac risk factors have influenced the funding of research and
training for specialists and scientists in the areas of coronary and congenital heart disease.

One direct effect is the reduced capability to train future pediatric cardiologists in biomedical research. The nature of current pediatric cardiovascular research is evident in the study design and content of research presentations at national meetings.86 There is a broad interest in research related to cardiovascular disease in children, but often the studies are retrospective, descriptive of phenomena, and not controlled. Basic science presentations related to pediatric heart disease more often test hypotheses and therefore are controlled studies. The limited research efforts in cardiovascular conditions of children is occurring in an era of major advances in molecular biology. New techniques could be applied to the study of conditions of children and to the developing cardiovascular system: research tools, but not researchers, are available.

**Control of Cardiovascular Risk Factors in Children**

It may be easier to change a young child's health behavior than an older child's or adult's. If so, it should be easier to modify a child's cardiovascular risk factors, and this improved cardiovascular health will be present over a longer period of life. Research on evaluation and improvement of the cardiovascular health of children has important public health implications. Risk factor modification can take place in three major settings—the school, the home, and the physician's office.

**Schools.** Schools are an important site for development of healthy habits through classroom activities, school lunch programs, and physical education. However, not all states have requirements for health education or physical education; 39 states mandate physical education and 22 to 31 mandate health education depending on the grade level.84 Even if physical education is required, there is no guarantee that a child will participate or that the activity is sustained and aerobic.

Many children take part in the national school lunch program. In one study of school lunches, 37% of total calories were from fat and 14% from saturated fat.85 The classroom is an ideal site for health education, but teachers must have sufficient training and information to teach cardiovascular health and be role models office for cardiovascular fitness as well.

**Physician's Office.** One of the major roles of a child's primary care physician, whether pediatrician or family practitioner, is health care supervision that includes preventive care. Traditionally, physicians have focused such care on areas of immediate concern such as accident prevention or immunization. Prevention of chronic diseases such as atherosclerosis has not been stressed. The reason is perhaps related to physicians' training and to the lack of reimbursement for the time required for such preventive care. However, a recent survey by the American Academy of Pediatrics indicated that, despite these limitations, 73% of pediatricians routinely inquired about diet or nutrition, 57% formulated a diet or nutrition plan for their patients, 50% asked about patients' smoking behavior, and 35% discussed specific strategies to quit smoking.86 Unfortunately, because of financial and other barriers, many children do not receive supervisory health care.

**Home.** The third important site for development of desirable health habits and health education is the home. The typical American family is no longer the two-parent unit in which the father works and the mother stays at home. In many families both parents work. Furthermore, the number of single-parent households has increased, and that parent often works outside the home. This probably affects children's dietary habits, with consumption of more fast foods and prepackaged foods. The number of hours of television viewed per day by American youth is increasing and correlates with the level of serum cholesterol and obesity.87 Parents can be influential role models, and their behaviors, particularly with respect to smoking, are important.

**Socioeconomic Barriers**

Poverty is a barrier to adequate health care of children in the United States. In a recent article by Allen and colleagues88 poverty and cardiac disease in children are discussed. At least one of five children lives at or below the poverty level, defined by the US government as $13,950 for a family of four in 1992. Certain cardiovascular diseases are associated with lower socioeconomic status, although the relation of socioeconomic status to congenital heart disease has not been defined. As discussed previously, one disease associated with lower socioeconomic status is acute rheumatic fever. Another problem is infant mortality, which in the United States is 8.9 per 1000 live births, a rate 23rd in the world.89 Among the causes of infant mortality are cardiovascular disorders, which in turn may be due to financial and nonfinancial barriers to prenatal care. Prenatal recognition of cardiovascular defects may preserve the fetus. Another barrier is lack of health insurance; 25% of all children and 51% of young adults who have heart disease do not have health insurance for all or part of the year. This lack influences access to health care. Universal access to health care for children has been advocated by the AHA.88,92

**Summary**

More than 600,000 children in the United States have a congenital or acquired cardiac abnormality, and millions more are at risk of developing atherosclerotic disease in adulthood, a risk made particularly evident by the prevalence of cardiovascular risk factors in the young. There are barriers to optimum prevention and treatment of these conditions in children and youth. The AHA's Task Force on Children and Youth has described these barriers and outlined a series of recommendations and strategies to meet the challenges they impose.93 More research is needed, and research initiatives will be developed at scientific conferences designed to review critical areas of cardiac development and etiology of disease in children. Financial support for such research initiatives must be increased. Educational programs on cardiovascular risk factors will be extended to children and their families. When these programs are coordinated with efforts in the community and in schools, they will reduce the prevalence of cardiovascular risk factors. The task force recommends that various departments and committees of the AHA use their resources for the benefit of children; for example, by developing more research initiatives for funding by the AHA or NHLBI and increasing legislative and regulatory efforts in the areas such as mandatory school health programs and tobacco advertising.
It is hoped that in the next decade, through research and educational efforts, many advances in the prevention and treatment of cardiovascular diseases in the young will be realized.

References
