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Ideal Cardiovascular Health:

Start Young, Finish Strong

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Landmark developments during the second half of the 20th century established that smoking, hypertension, and hypercholesterolemia constituted cardinal risk factors for cardiovascular morbidity and mortality.¹ These insights proved critical in reversing decades of increases in the mortality rate from coronary heart disease in the United States starting in the late 1960s. As knowledge concerning the pathogenesis and pathophysiology of cardiovascular disease evolved rapidly during ensuing decades, research tended to focus on how much risk for adverse cardiovascular events increased in function of levels of risk factors (high-risk emphasis). However, this paradigm has shifted as research increasingly emphasized that low-risk cardiovascular risk factor profiles were associated with large reductions in cardiovascular mortality and improvements in other outcomes (low-risk emphasis).² Thus, the conceptual framework for preventing cardiovascular disease that had been anchored largely in primary prevention increasingly embraced primordial prevention.³

In 2010, the American Heart Association released a set of 7 cardiovascular health metrics for adults and children that put cardiovascular health, as opposed to cardiovascular disease, front and center.⁴ These metrics were divided into 4 health behaviors (smoking, weight, physical activity, and diet) and 3 health factors (blood pressure, total cholesterol, and glycemia). For each health metric, 3 levels of cardiovascular health were defined: poor, intermediate, and ideal cardiovascular health. Although the choice of the metrics and the definition of levels of cardiovascular health for each metric rested on sound science, the utility of these metrics when combined into an index had not been previously tested. Recent studies have substantiated the AHA cardiovascular health metrics in adults.^{5,6} Hitherto, information about the utility of these metrics in children and adolescents was lacking.

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None.

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In this issue of *Circulation*, Laitinen and colleagues⁷ report the results of a study that examined the effects of the AHA's cardiovascular health metrics for children, which adhered mostly but not completely to the AHA definitions, on a series of incident cardiometabolic events (mentioned below) and carotid intima-media thickness among 856 Finnish participants 12 to 18 years of age who were followed up for 21 years. To create the index, the authors assigned a value of 0 to poor or intermediate cardiovascular health and 1 to ideal health for each metric and summed the values. For each unit of increase in the cardiovascular health index that ranged from 0 (worst) to 7 (best), the largest reduction in risk was observed for metabolic syndrome (adjusted odds ratio=0.63; 95% confidence interval=0.52– 0.77). Furthermore, significant reductions in the adjusted odds ratio were noted for hypertension, elevated concentrations of low-density lipoprotein cholesterol, elevated concentrations of triglycerides, and increased intima-media thickness. No significant relationships emerged for type 2 diabetes mellitus and low concentrations of high-density lipoprotein cholesterol. As cohorts such as the Cardiovascular Risk in Young Finns Study mature and hard cardiovascular events accumulate, powerful relationships between cardiovascular health in childhood and cardiovascular events in adulthood will likely emerge.

An important finding of the study was the absence of a single child who met all 7 metrics for ideal cardiovascular health. Studies in adults have also reported very low percentages of adults meeting all 7 criteria.^{5,6,8,9} These sobering statistics underscore the sizable amount of progress in improving cardiovascular health that awaits realization. At the same time, these statistics are a reminder that considerable improvement in lowering cardiovascular morbidity and mortality remains feasible.

Another highlight was that cardiovascular health in children tracked into adulthood, albeit with some regression to the mean. Perhaps this should not be too surprising given the available literature that has shown substantial tracking of cardiovascular disease risk factors and behaviors from childhood onward.¹⁰ This finding reaffirms the wisdom of helping children get off to a healthy start by guiding them to adopt healthy lifestyle behaviors that will serve them well throughout their lives. After all, the seeds of cardiovascular health are sown in childhood.¹¹

The study also illustrates the difficulty in applying newly developed constructs retroactively in cohort studies. Of the original 3596 participants who entered the study in 1980, only 856 had the requisite information to conduct the study. Furthermore, the exact replication of the AHA cardiovascular health metrics, particularly diet and physical activity, remains challenging in many studies. The authors did not provide results of analyses relating the individual metrics to the study outcomes. Such information would have been helpful in gauging the impact of the individual metrics. In addition, such information can be useful in prioritizing approaches to improving cardiovascular health and mortality, especially when resources are scarce.

Given that the study by Laitinen and colleagues produced strong evidence of the benefits of ideal cardiovascular health in childhood, a cursory reflection on the current state of cardiovascular health in children and adolescents in the United States may be instructive.

Little information using the AHA metrics is currently available. The prevalence of smoking defined as smoking cigarettes on 1 or more of the previous 30 days among high school students dropped from 27.5% in 1991 to 19.5% in 2009.¹² Recent data showed that mean concentrations of total cholesterol, low-density lipoprotein cholesterol, and triglycerides decreased among adolescents 12 to 17 years of age between 1999 to 2000 and 2007 to 2008.¹³ Furthermore, mean arterial blood pressure decreased, whereas concentrations of glucose increased. Among children and adolescents 2 to 19 years of age, the prevalence of obesity increased between 1999 to 2000 and 2009 to 2010 among male but not female individuals.¹⁴ Among students in grades 9 through 12, participation in regular moderate to vigorous physical activity and physical education remained essentially unchanged between 1999 and 2007.¹⁵ Energy intake among children and adolescents 2 to 19 years of age did not increase significantly from 1988 to 1994 to 2003 to 2008.¹⁶ Thus, the available data portray a mixed picture about cardiovascular health in US children and adolescents. Given these conflicting trends in health behaviors and factors, speculating about the net effect of the current state of cardiovascular health among children and adolescents on future cardiovascular morbidity and mortality is a task best suited for the intrepid few.

The field of cardiovascular health promotion among children and adolescents is a highly complicated and evolving one, and consequently, only a few general thoughts are possible here. Clinical-based and population-based strategies addressing at a minimum 3 lifestyle behaviors are key: smoking, diet, and physical activity. Because diet and physical activity are major determinants of blood pressure, concentrations of lipids and glucose, and weight, addressing these 2 lifestyle behaviors is fundamental to optimizing cardiovascular health among youth. Manifest cardiovascular disease is uncommon in the pediatric population; therefore, primordial prevention and primary prevention constitute the principal pathways to promoting cardiovascular health. Settings for reaching children and adolescents include the general community, families, schools, faith-based institutions, and community-based organizations such as the YMCA. Because school attendance is essentially universal, developing and testing school-based health promotion programs has been highly popular. Evidence-based guidance for conducting school health promotion programs has been summarized elsewhere.¹⁷⁻¹⁹

Healthcare providers have a central role in identifying and controlling abnormal levels of cardiovascular risk factors. Furthermore, healthcare providers have a great opportunity to educate the parents and caretakers of children, as well as the children themselves, about the importance of cardiovascular health and to provide direction about starting cardiovascular health at an early age. The report “Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents” equips healthcare providers with a comprehensive, evidence-based set of clinical guidelines.¹¹ Strengthening community-clinical links for cardiovascular health of children and adolescents may also advance both preventive and public health efforts.

Additional pediatric studies such as the one by Laitinen and colleagues conducted in different populations using various cardiovascular outcomes will be valuable in evaluating the generalizability of AHA cardiovascular health metrics. Because few studies conducted in pediatric populations probably will have access to the 7 health metrics and have long follow-

up periods with a sufficient number of hard cardiovascular events, researchers are mostly relegated to studying the relationships between cardiovascular health metrics and various intermediary cardiovascular outcomes, ones that should preferably not incorporate factors used to develop the metrics. In addition, exploring the relationships between the various individual cardiovascular health metrics and outcomes will be instrumental in evaluating the propensity to equally weight the individual metrics that are combined into a single index. Conceivably, weighting schemes may vary by life stage and the time frame for risk projection (eg, 10-year risk versus lifetime risk). Additional supporting evidence from studies with multiple follow-ups allowing researchers to examine how changes in cardiovascular health status affect subsequent cardiovascular morbidity and mortality would reinforce the message that it is never too late to change one's lifestyle behaviors.

Much has already been accomplished in reducing cardiovascular mortality in the United States and elsewhere. Recent studies suggest that the incidence of cardiovascular disease may have declined.²⁰ With full engagement by the public health and clinical communities, progress in improving cardiovascular health and continued reductions in cardiovascular morbidity and mortality are achievable in the United States. The development of the AHA cardiovascular health metrics and goals for 2020 represented an important milestone in charting the direction to a healthier future. Emerging research now shows that pursuing and attaining ideal cardiovascular health as defined by the AHA has the potential to drastically lower future cardiovascular morbidity and mortality in the United States and elsewhere.

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