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Preserving Optimal Cardiovascular Health in Children

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Abstract

The origins of cardiovascular disease are at the beginning of life, and national guidelines recommend evaluation for cardiovascular risk factors such as obesity and hypertension as part of general pediatric care. In this review, a simple plan is proposed for clear and consistent monitoring and messaging throughout childhood, based upon the American Heart Association's "cardiovascular health" construct. A framework is provided for age-appropriate scoring of the cardiovascular health components, including diet, physical activity and screen time, sleep, smoking exposure, body mass index, blood pressure, cholesterol, and glucose. Guidance is provided for evidence-based, efficient intervention by pediatric clinicians to preserve or restore cardiovascular health. Finally, anticipated near-term advances in pediatric cardiovascular health promotion are previewed.

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death in the US.¹ The origins of CVD are clearly at the beginning of life, as autopsy studies show that atherosclerosis is already present in childhood.² It is therefore solidly within the domain of pediatric providers to support families in setting their children on a course that will help them avoid CVD and maximize their healthy longevity. Furthermore, since 33% of US youth ages 2 to 19 years are overweight or obese,¹ traditional CVD risk factors – for example, dietary intake and blood pressure – are unavoidable topics in pediatric primary care, as contributors to and consequences of excess weight.

Guidelines from the American Academy of Pediatrics (AAP),³ National Heart, Lung, and Blood Institute (NHLBI),² US Department of Health and Human Services (HHS),⁴ US

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Preventive Services Task Force (USPSTF),⁵ and other national groups provide guidance on evaluating individual CVD risk factors such as obesity during the pediatric healthcare visit. However, assembling these guidelines into a simple plan for consistent CVD risk factor monitoring and optimization throughout childhood may represent a sizable challenge for the busy practitioner.

The American Heart Association (AHA)-defined concept of “cardiovascular health,” or CVH, provides a simple platform for clear and consistent CVD risk factor measurement, monitoring, and messaging across the life course.^{6,7} The present document defines CVH, suggests a practical CVH tool for use in routine primary care, offers recommendations for how to intervene on CVH, and highlights emerging developments in CVH that are expected to impact pediatric care in the near future.

REVIEW

What is CVH?

CVH is a broader, more positive construct than just the absence of disease.⁶ The AHA defines CVH through health behaviors and health factors known as “Life’s Simple 7:” diet, physical activity, smoking, body mass index (BMI), blood pressure, blood cholesterol, and blood glucose.^{6,7} For a given individual, each CVH metric can be categorized as ideal, intermediate, or poor based on thresholds from national guidelines, and a score can be calculated to summarize overall CVH (see Table and description, next section). The special status of “ideal CVH” refers to optimal levels of all 7 health behaviors and factors simultaneously.¹

A large body of evidence supports the relevance of CVH as a clinical target in adults and children. Better CVH in adulthood is associated with not only markedly better CVD-free survival, but also a variety of non-cardiovascular benefits, including lower rates of cancer and other chronic diseases of aging, longer overall longevity and healthy longevity (compression of morbidity), better cognitive function, less depression and superior quality of life, and reduced healthcare costs.^{1,6} Better CVH in childhood is associated with better CVH in adulthood⁸ as well as lower risks of subclinical CVD, such as coronary artery calcification,⁹ adverse cardiac structure and function,¹⁰ high-risk carotid intima-media thickness,^{8,9} and high-risk carotid distensibility.⁹ Moreover, childhood intervention can improve CVH and vascular function in adulthood. In the Special Turku Coronary Risk Intervention Project for Children (STRIP) study, repeated dietary counseling starting in infancy led to better CVH in adolescence, and better CVH was associated with better aortic elasticity and 44% lower risk of high aortic intima-media thickness.¹¹

On a population level, the current status of CVH in US youth is far from ideal, but is better than in US adults (Figure). At the youngest ages, nationally representative estimates from the National Health and Nutrition Examination Surveys (NHANES) are available for only a subset of CVH metrics. At ages 2–5 years, ~75% of US children have ideal BMI (the only CVH metric measured in NHANES at that age).¹² At ages 8–11 years, just 39% of children have 3 of the 4 measured metrics (diet, BMI, cholesterol, and blood pressure) at ideal levels, while essentially none have all 4 at ideal levels.¹² For US adolescents ages 12 to 19 years,

41% of adolescents have at least 5 of the 7 metrics at ideal levels, but <1% have all 7 metrics at ideal levels.¹ In adults, just 17% have at least 5 of 7 metrics at ideal levels.¹ Thus, CVH is generally the highest early in life and then declines with age. Comparing the 7 metrics, ideal status is lowest for diet in both children and adults, followed by physical activity and BMI, then cholesterol (Figure).^{1,13}

How should pediatric providers assess CVH?

Routine assessment of CVH can easily be incorporated in all well-child visits across childhood and adolescence. This provides an opportunity for clear and consistent messaging to children and families, while addressing national guidelines for health monitoring. CVH also offers a unique advantage for addressing the prevalent risk factors of overweight and obesity. CVH assessment replaces a singular focus on weight, which is not directly modifiable and can be a source of embarrassment and distress that contribute to disordered eating.¹⁴ CVH instead emphasizes directly modifiable behaviors (e.g., diet and physical activity) that contribute to excess weight but also to other adverse health outcomes. It also highlights tangible consequences (e.g., dyslipidemia and hypertension) to increase understanding and motivation for families to make lifestyle changes.

The Table offers a suggested template for practical assessment and scoring of CVH factors across childhood and adolescence. For a given child, each of the CVH factors can be categorized as ideal, intermediate, or poor, and a total CVH score can be calculated. From the prenatal consultation through adolescence, each visit can include an assessment and brief discussion of CVH. Prenatally, the CVH assessment and discussion will focus primarily on family lifestyle habits (and heritable CVD risk factors). For example, the family's diet quality and exercise habits can be scored and discussed using the same metric definitions as for the child. As the child grows, more of his or her own CVH metrics are measured and become the focus. By age 9–11 years (after universal cholesterol screening²), the child's own measurements are available for all but fasting glucose (which is only measured in children with certain risk factors¹⁵), and glucose can be omitted from the score but discussed as an important outcome of the CVH behaviors. Thus across the spectrum of ages, the CVH metrics and messaging are consistent, which reinforces education for the family and simplifies assessment and counseling for the practitioner.

In the authors' opinion, this consistent messaging is the key to CVH's utility in general practice, and the pediatric provider should worry less about precise categorization for health behavior metric levels where this is less straightforward (as opposed to health factors – BMI, blood pressure, cholesterol, and glucose – where clear thresholds are established for ideal, intermediate, and poor). Taking diet as an example, the pediatric provider might focus effort on becoming familiar with overall the Dietary Approaches to Stop Hypertension (DASH) pattern, as outlined in the NHLBI Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children (Table 5–3, pages 56–57 of the full report; see also next section).² The child's dietary pattern can be assessed qualitatively as ideal (essentially meeting all DASH goals), intermediate, or poor based on information about each meal and snack of a typical day. In the authors' practice, families are often given a printout of this DASH table with a range of calorie levels circled based on an estimate of the child's needs (using Table

5–1, page 34 of the same NHLBI guideline), which provides a framework for counseling. However, precise serving sizes and numbers are not calculated and compared against the DASH table to assess the diet. CVH is thus used as a messaging tool – an opportunity to evaluate the diet qualitatively – and precise scoring is therefore less important.

With this in mind, the Table is based on AHA’s CVH definition but also includes modifications aimed at increasing the utility of the CVH construct in pediatric practice. The AHA defined CVH to be not only evidence-based but also measurable in the population using NHANES data,^{6,7} so some important metrics could not be included in the initial “Life’s Simple 7” (updates are expected; see later in this review). Thus, in the Table, sleep has been added as an 8th CVH metric. A solid body of evidence supports the association between sleep patterns and health in childhood¹⁶ and adulthood,¹⁷ and it has been suggested that sleep may eventually be added to the CVH metrics to make an “Essential Eight.” Additionally, in the Table, some of the AHA definitions of CVH metric categories are expanded to be more inclusive in ways particularly relevant to children. For example, the physical activity metric is expanded to address leisure screen time,^{18,19} the cholesterol metric is expanded beyond total cholesterol to include its components (low- and high-density lipoprotein cholesterol and triglycerides),² and the smoking metric is expanded to include secondhand smoke.²⁰

CVH behaviors (diet, physical activity, sleep, and smoking exposure) can be incorporated into paper surveys that families can complete in the waiting room at the pediatric office. This can increase efficiency, facilitate subsequent discussion between the pediatric provider and family, and reinforce the importance of these behaviors throughout childhood.

How can a pediatric provider intervene on CVH?

Each metric provides an opportunity not only to assess the child’s own risk and family history and environment, but moreover to offer intervention recommendations and/or anticipatory guidance. Even brief motivational interviewing by pediatric providers can positively impact behaviors, and the AAP has published free resources on the motivational interviewing technique, including the mobile app “Change Talk.”^{21,22} Most primary care counseling will be focused on the 4 CVH behaviors (diet, physical activity, sleep, and smoking exposure), whereas children with poor levels of CVH factors (BMI, blood pressure, cholesterol, and glucose) may sometimes require referral for intensive management, as described below.

Diet —Based on population-level estimates (see Figure), essentially every US child needs improvement in his/her dietary quality. While assessment and counseling about dietary intake is nothing new for the pediatric provider (e.g., breastmilk vs. formula, ensuring adequate vitamin D and calcium intake), recent guidelines have shifted the focus away from nutrients in favor of overall dietary *patterns*, given the synergistic and cumulative health effects of the totality of diet and the need for easier translation for patients.^{23,24} The DASH dietary pattern is recommended by the NHLBI guidelines for children² and is essentially identical to the “healthy US-style” pattern recommended for children by the 2015 Dietary Guidelines for Americans.²⁵ These patterns emphasize adequate intakes of fruits, vegetables,

whole grains, nuts, seeds, legumes, and low-fat dairy, and restricted intake of added sugars (practically speaking, the AHA recommends <25 grams of added sugars per day for all children and adolescents).²⁶ Fish, unprocessed meats, and unsaturated oils are also part of the healthy dietary patterns, whereas saturated fats are limited, and processed foods (high in sodium) and refined grains are discouraged. Both the NHLBI guidelines (Tables 5–1 and 5–3)² and Dietary Guidelines for Americans (Tables A2–1 and A3–1;²³ [choosemyplate.gov/children](https://www.choosemyplate.gov/children)) offer resources to help with dietary counseling. For example, the “plate” method of eating ensures that half of every meal and snack consists of vegetables and fruits, which are preferably consumed before the rest of the meal and are also drawn on for “seconds” if hunger persists. The other half of the plate consists of age-appropriate portions of whole grains and lean proteins. Families can be encouraged to use this simple method when eating and to read labels when shopping, particularly for added sugars in children’s cereals and snacks. These patterns and recommendations are applicable across ages, including in adulthood, and thus are highly relevant to entire families. Of course, at the youngest ages (0–24 months), the focus should be on encouraging breastfeeding (and healthy maternal diet) and age-appropriate introduction of the healthy dietary pattern.² The pediatric provider might focus effort on becoming familiar with the DASH or healthy US-style pattern and consider including questions about relevant food groups on patient surveys that can be completed in the waiting room.

Physical activity —Children and adolescents should get at least 60 minutes per day of moderate to vigorous intensity aerobic exercise.⁴ Practically speaking, this level of exercise is expected to result in heavy breathing and sweating, and it can be useful to clarify this with older children and adolescents. Additionally, children should include muscle- and bone-strengthening exercise at least 3 days per week each. Since active play, physical education classes, and school sports are unfortunately not universally available, the pediatric provider should keep in mind a few age-appropriate exercise options that require minimal new resources. For example, dancing (vigorously!) is something many children enjoy and can easily do at home with no equipment, jumping rope requires minimal equipment and space, and active video games are a good option for children who already have consoles. Older children and adolescents may enjoy aerobic and body-weight resistance exercise videos, of which many are freely available online (e.g., 7 minute workout apps). Park districts, Boys and Girls Clubs of America, and YMCA centers offer options for group fitness. Independent of physical activity, sedentary time is another important contributor to health,¹⁹ and in children screen time is the most relevant sedentary time. In fact, simply having a TV in the bedroom is associated with higher risk of obesity,¹⁹ and removing that TV may be a good first step for families with poor screen time habits. Adherence to screen time limits (see Table) also frees up needed time for exercise and sleep, particularly in older children with extracurricular activities and homework. Families can be counseled about exercise and screen time concurrently as two important contributors to activity levels.

Sleep —Parental concern about sleep may be weighted toward infancy and toddlerhood, but sleep is critical for health at all ages. Recommendations regarding appropriate amounts of sleep for children have been made by the American Academy of Sleep Medicine and endorsed by the AAP,²⁷ and are shown in the Table. Pediatric providers can encourage

healthy sleep habits first by educating families about recommended amounts, which may be surprising to some. Practically speaking, regular routines are key. Daytime routines should include plenty of physical exercise, and bedtime routines should ensure that all screens are off at least 1 hour before bedtime.²⁸ Pediatric providers can also help families recognize when their older children and adolescents are overscheduled and need to reprioritize to allow healthy sleep habits.

Smoking exposure —Although tobacco smoking prevalence has decreased among both youth and adults over the past decade, it remains the largest preventable cause of death in the US, and nearly 10% of those deaths are attributed to secondhand smoke exposure.¹ Secondhand smoke exposure is of particular relevance in childhood, with approximately 1 in 3 US children exposed.²⁰ Additionally, e-cigarette use is increasing among adults and youth in the US,¹ and the limited data available suggest that both firsthand and secondhand e-cigarette exposure may have detrimental effects on CVH. E-cigarette use may also initiate nicotine addiction, serve as a gateway to cigarette smoking, and reverse the gains in “de-normalizing” smoking behavior that have been made by anti-tobacco campaigns in recent decades.²⁹ Pediatric providers can help promote a smoke-free environment and lifestyle by reinforcing a strong anti-smoking message for both children and parents at every visit. It is recommended that pediatric health care practices be established as a resource for smoking cessation, including provision of quit line numbers, links to community cessation resources, and information about pharmacotherapy for cessation.^{2,20}

BMI, blood pressure, cholesterol, and glucose —For each of these health factors, significant disturbances may necessitate referral for more dedicated, time-intensive behavioral and pharmacologic management. Still, the pediatric provider retains an important role in consistently reinforcing lifestyle messaging about the 4 contributing CVH behaviors described above and reminding children and families about their critical importance for the 4 CVH factors. National guidelines outline the diagnosis and management strategies for each of these CVH factors, including recommendations on when to refer.^{2,15,30–32}

What new information about CVH can pediatric healthcare providers expect in coming years?

It is expected that the AHA definition of CVH for children will be expanded and refined significantly over the next several years.⁷ The AHA has recently funded a Strategically Focused Children’s Research Network, which includes several projects designed to improve the assessment of CVH from the very beginning of life. CVH may be expanded to include new metrics (e.g., sleep, completely novel components such as neurocognitive function), existing metrics may be modified to improve their relevance to children (e.g., formally incorporating secondhand smoke exposure in the smoking metric, including specific guidance for pregnant women aimed at breaking intergenerational cycles of poor CVH), and scales may be made more granular to accommodate repeated evaluation in children (for whom small changes may be more relevant). Additionally, for the first time, the forthcoming 2020 Dietary Guidelines for Americans will address diet in pregnant women and in children ages 0 to 24 months,³³ and this may influence future CVH definitions and provide valuable resources for pediatric providers regarding CVH-promoting infant dietary exposures and

caregiver feeding practices. Finally, updated guidance on assessment and management of blood lipids in children is expected to be included in the next edition of the AHA/American College of Cardiology guidelines for adults.

CONCLUSION

The CVH construct provides a simple, universal method for consistent health messaging across the life course. Given the decline in ideal CVH metrics with age, and the known extensive health benefits of maintaining ideal CVH metrics, pediatric providers can play a critical role in improving population CVH and preventing morbidity and mortality from CVD.

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Abbreviations:

AHA	American Heart Association
CVH	Cardiovascular Health

REFERENCES

1. Benjamin EJ, Virani SS, Callaway CW, et al. Heart Disease and Stroke Statistics-2018 Update: A Report From the American Heart Association. *Circulation*. 2018.
2. National Heart, Lung and Blood Institute. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children: full report. 2011 <https://www.nhlbi.nih.gov/health-pro/guidelines/current/cardiovascular-health-pediatric-guidelines>. Accessed February 6, 2017.
3. Committee On P, Ambulatory M, Bright Futures Periodicity Schedule W. 2017 Recommendations for Preventive Pediatric Health Care. *Pediatrics*. 2017;139(4).
4. Services UDoHaH. Physical Activity Guidelines for Americans. 2008.
5. Force USPST, Grossman DC, Bibbins-Domingo K, et al. Screening for Obesity in Children and Adolescents: US Preventive Services Task Force Recommendation Statement. *Jama*. 2017;317(23):2417–2426. [PubMed: 28632874]
6. Lloyd-Jones DM, Hong Y, Labarthe D, et al. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic Impact Goal through 2020 and beyond. *Circulation*. 2010;121(4):586–613. [PubMed: 20089546]
7. Steinberger J, Daniels SR, Hagberg N, et al. Cardiovascular Health Promotion in Children: Challenges and Opportunities for 2020 and Beyond: A Scientific Statement from the American Heart Association. *Circulation*. 2016;134(12):e236–e255. [PubMed: 27515136]
8. Laitinen TT, Pakkala K, Magnussen CG, et al. Ideal cardiovascular health in childhood and cardiometabolic outcomes in adulthood: the Cardiovascular Risk in Young Finns Study. *Circulation*. 2012;125(16):1971–1978. [PubMed: 22452832]
9. Laitinen TT, Pakkala K, Magnussen CG, et al. Lifetime measures of ideal cardiovascular health and their association with subclinical atherosclerosis: The Cardiovascular Risk in Young Finns Study. *International journal of cardiology*. 2015;185:186–191. [PubMed: 25797675]
10. Laitinen TT, Ruohonen S, Juonala M, et al. Ideal cardiovascular health in childhood-Longitudinal associations with cardiac structure and function: The Special Turku Coronary Risk Factor Intervention Project (STRIP) and the Cardiovascular Risk in Young Finns Study (YFS). *International journal of cardiology*. 2017;230:304–309. [PubMed: 28040279]

11. Pakkala K, Hietalampi H, Laitinen TT, et al. Ideal cardiovascular health in adolescence: effect of lifestyle intervention and association with vascular intima-media thickness and elasticity (the Special Turku Coronary Risk Factor Intervention Project for Children [STRIP] study). *Circulation*. 2013;127(21):2088–2096. [PubMed: 23613255]
12. Ning HY, Labarthe DR, Shay CM, et al. Status of Cardiovascular Health in US Children Up to 11 Years of Age The National Health and Nutrition Examination Surveys 2003–2010. *Circulation-Cardiovascular Quality and Outcomes*. 2015;8(2):164–171. [PubMed: 25782775]
13. Ning H, Labarthe DR, Shay CM, et al. Status of cardiovascular health in US children up to 11 years of age: the National Health and Nutrition Examination Surveys 2003–2010. *Circ Cardiovasc Qual Outcomes*. 2015;8(2):164–171. [PubMed: 25782775]
14. Golden NH, Schneider M, Wood C, Committee On N, Committee On A, Section On O. Preventing Obesity and Eating Disorders in Adolescents. *Pediatrics*. 2016;138(3).
15. American Diabetes A. Standards of Medical Care in Diabetes-2016 Abridged for Primary Care Providers. *Clin Diabetes*. 2016;34(1):3–21. [PubMed: 26807004]
16. Paruthi S, Brooks LJ, D'Ambrosio C, et al. Consensus Statement of the American Academy of Sleep Medicine on the Recommended Amount of Sleep for Healthy Children: Methodology and Discussion. *J Clin Sleep Med*. 2016;12(11):1549–1561. [PubMed: 27707447]
17. St-Onge MP, Grandner MA, Brown D, et al. Sleep Duration and Quality: Impact on Lifestyle Behaviors and Cardiometabolic Health: A Scientific Statement From the American Heart Association. *Circulation*. 2016;134(18):e367–e386. [PubMed: 27647451]
18. Council On C, Media. Media and Young Minds. *Pediatrics*. 2016;138(5).
19. Council On C, Media. Media Use in School-Aged Children and Adolescents. *Pediatrics*. 2016;138(5).
20. Raghuvver G, White DA, Hayman LL, et al. Cardiovascular Consequences of Childhood Secondhand Tobacco Smoke Exposure: Prevailing Evidence, Burden, and Racial and Socioeconomic Disparities: A Scientific Statement From the American Heart Association. *Circulation*. 2016;134(16):e336–e359. [PubMed: 27619923]
21. American Academy of Pediatrics. Motivational Interviewing: Healthy Active Living for Families Implementation Guide. 2018.
22. American Academy of Pediatrics Institute for Healthy Child Weight. Resources: Changing the Conversation about Childhood Obesity. 2018.
23. US Department of Health and Human Services; US Department of Agriculture. 2015–2020 Dietary Guidelines for Americans. 8th ed ed. Washington, DC: US Department of Health and Human Services; 2015.
24. Van Horn L, Carson JA, Appel LJ, et al. Recommended Dietary Pattern to Achieve Adherence to the American Heart Association/American College of Cardiology (AHA/ACC) Guidelines: A Scientific Statement From the American Heart Association. *Circulation*. 2016;134(22):e505–e529. [PubMed: 27789558]
25. 2015 Dietary Guidelines Advisory Committee. Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture. 2015.
26. Vos MB, Kaar JL, Welsh JA, et al. Added Sugars and Cardiovascular Disease Risk in Children: A Scientific Statement From the American Heart Association. *Circulation*. 2016.
27. Paruthi S, Brooks LJ, D'Ambrosio C, et al. Recommended Amount of Sleep for Pediatric Populations: A Consensus Statement of the American Academy of Sleep Medicine. *J Clin Sleep Med*. 2016;12(6):785–786. [PubMed: 27250809]
28. American Academy of Pediatrics.
29. Bhatnagar A, Whitsel LP, Ribisl KM, et al. Electronic cigarettes: a policy statement from the American Heart Association. *Circulation*. 2014;130(16):1418–1436. [PubMed: 25156991]
30. Spear BA, Barlow SE, Ervin C, et al. Recommendations for treatment of child and adolescent overweight and obesity. *Pediatrics*. 2007;120 Suppl 4:S254–288. [PubMed: 18055654]
31. Flynn JT, Kaelber DC, Baker-Smith CM, et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. *Pediatrics*. 2017;140(3).

32. Copeland KC, Silverstein J, Moore KR, et al. Management of newly diagnosed type 2 Diabetes Mellitus (T2DM) in children and adolescents. *Pediatrics*. 2013;131(2):364–382. [PubMed: 23359574]
33. United States Department of Agriculture CfNPAP. Pregnancy and Birth to 24 Months Project.

Figure.

Status of CVH in US Children, Adolescents, and Adults. Proportions of individuals with metrics categorized as ideal (green), intermediate (yellow), or poor (red) are shown by the bars and overlaid numbers, based on population-weighted National Health and Nutrition Examination Survey (NHANES) data from the indicated years. A shows CVH in children ages 2 to 11 years; diet is shown for ages 5–11, BMI for ages 2–11, blood pressure for ages 8–11, and total cholesterol for ages 6–11 years. B shows CVH in adolescents ages 12 to 19 years. C and D show CVH in younger and older adults, respectively. It is apparent that the prevalence of “ideal”

CVH metrics is generally highest at the youngest ages and declines across the life course. See text for details. CVH, cardiovascular health; BMI, body mass index.

Table.

Suggested Cardiovascular Health Metric Scoring for the General Pediatric Provider

	Ideal = 2 Points	Intermediate = 1 Point	Poor = 0 Points
Diet	Assessed qualitatively against the DASH dietary pattern (see text). Alternatively, particular focus can be given to 5 components: adequate intakes of (1) fruits and vegetables, (2) fiber-rich whole grains, and (3) fish, and limited intakes of (4) sugar-sweetened beverages and (5) sodium, all scaled for caloric intake.		
	4–5 components met	2–3 components met	0–1 components met
Physical activity	Moderate-vigorous intensity exercise screen time: <ul style="list-style-type: none"> • Age 0–24mo: none • Age 2–5y: <1 hour per day • Age 6y: <2 hours per day 	Moderate-vigorous intensity exercise >0 but <60 min/day on average <i>or</i> leisure screen time above ideal limits	No moderate-vigorous intensity exercise
Sleep	Total per 24 hours: <ul style="list-style-type: none"> • Age 4–12mo: 12–16 hours • Age 1–2y: 11–14 hours • Age 3–5y: 10–13 hours • Age 6–12y: 9–12 hours • Age 13–18y: 8–10 hours 	1 hour or less outside the ideal range	More than 1 hour outside the ideal range, or other significant sleep disturbance (e.g., short night sleep and requiring daytime naps in an older child or adolescent)
Smoking	Never smoked whole cigarette <i>and</i> no secondhand smoke exposure	Secondhand smoke exposure <i>and/or</i> remotely tried smoking	Tried smoking in the prior 30 days
Body mass index	<85 th percentile	85 th –95 th percentile	>95 th percentile
Blood pressure	<ul style="list-style-type: none"> • Age 0–<13y: SBP <i>and</i> DBP <90th percentile • Age 13y: <120/<80 mm Hg 	<ul style="list-style-type: none"> • Age 0–<13y: SBP <i>or</i> DBP 90–95th percentile • Age 13y: 120–<130/<80 mm Hg 	<ul style="list-style-type: none"> • Age 0–<13y: SBP <i>or</i> DBP >95th percentile • Age 13y: SBP >130 <i>or</i> DBP >80 mm Hg
Cholesterol	<ul style="list-style-type: none"> • Total cholesterol <170 mg/dL • Non-HDL cholesterol <120 mg/dL • HDL-cholesterol >45 mg/dL • LDL-cholesterol <110 mg/dL • Triglycerides <75 (age 0–9y) or <90 (age 10–19y) mg/dL 	<ul style="list-style-type: none"> • Total cholesterol 170–199 mg/dL • Non-HDL cholesterol 120–144 mg/dL • HDL-cholesterol 40–45 mg/dL • LDL-cholesterol 110–129 mg/dL • Triglycerides 75–99 (age 0–9y) or 90–129 (age 10–19y) mg/dL 	<ul style="list-style-type: none"> • Total cholesterol ≥200 mg/dL • Non-HDL cholesterol ≥145 mg/dL • HDL-cholesterol ≤40 mg/dL • LDL-cholesterol ≥130 mg/dL • Triglycerides ≥100 (age 0–9y) or ≥130 (age 10–19y) mg/dL

	Ideal = 2 Points	Intermediate = 1 Point	Poor = 0 Points
Glucose	Fasting plasma glucose <100 mg/dL, HgbA1C <5.7%	Fasting plasma glucose 100–125 mg/dL, HgbA1C 5.7–6.4%	Fasting plasma glucose 126 mg/dL or HgbA1C 6.5%

Total CVH Score	Ideal CVH 100%	High CVH 75–<100%	Moderate CVH 50–<75%	Low CVH 0–<50%
Possible total score varies according to number of measured metrics available (e.g., glucose not measured routinely). Suggest dividing sum of earned points by sum of possible points, and calculating percent score:				

Adapted from Lloyd-Jones *et al* and Steinberger *et al*, with additions from other guidelines and modifications as described in the text. DASH, Dietary Approaches to Stop Hypertension; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; HgbA1C, hemoglobin A1C; CVH, cardiovascular health; BMI, body mass index.

Example 1: A 4-year-old eats fruits/vegetables at every meal and snack, no sugar-sweetened beverages, rare processed/fast food (sodium), but eats refined grains (not whole) and no fish (intermediate diet=1 point); watches 2 hours of TV/day and plays actively >60 min/day (intermediate activity=1 point), sleeps 12 hours/night (ideal sleep=2 points), is not exposed to secondhand smoke (ideal=2 points), has BMI at the 70th percentile (ideal=2 points), blood pressure at the 50th/60th percentiles (ideal=2 points), and has not had cholesterol or glucose checked. The child has 10 points out of a possible 12 points on the 6 metrics scored, for 83%, thus high CVH. Counseling could focus on changing to whole grains, serving low-mercury fish twice per week, decreasing screen time, and continuing with other healthy habits.

Example 2: A 15-year-old has fruit once per day but no vegetables, a can of soda daily, fast food weekly, refined grains, and no fish (poor diet=0 points); watches 1 hour of TV/day and has sports practice >60 min/day 5 days/week but no weekend exercise (intermediate activity=1 point), sleeps 7.5 hours per night (intermediate sleep=1 point), does not smoke but lives with a smoker (intermediate=1 point), has BMI at the 99th percentile (poor=0 points), blood pressure 125/77 mm Hg (intermediate=1 point), total cholesterol 172 mg/dL, LDL-C 105 mg/dL, HDL-C 32 mg/dL and triglycerides 173 mg/dL (poor [based on triglycerides and HDL-C]=0 points), and fasting plasma glucose 95 mg/dL (ideal=2 points). The adolescent has 6 points of a possible 16 points on the 8 metrics scored, for 38%, thus low CVH. Intensive counseling is merited, and the adolescent may require referral to a lifestyle program (in addition to further evaluation of elevated blood pressure).