

REVIEW TOPIC OF THE WEEK

Time to Change Our Focus

Defining, Promoting, and Impacting Cardiovascular Population Health



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ABSTRACT

Despite numerous groundbreaking advances in the field, cardiovascular disease remains the leading cause of mortality in the United States, accounting for more than 787,000 deaths per year. Already leading the world in per capita healthcare expenditure, U.S. medical costs related to cardiovascular disease are projected to triple by 2030, to over \$800 billion annually. The medical community's traditional disproportionate focus on treating cardiovascular disease, relative to promoting cardiovascular health, is an important contributor to these expenses. To ensure continued reductions in the burden of cardiovascular disease, as well as the overall sustainability of the healthcare system, a paradigm shift that places more emphasis on cardiovascular health promotion throughout the life course is required. This review will discuss the current definitions of cardiovascular health, as well as strategies for promoting and impacting cardiovascular health at both the local and national level. (J Am Coll Cardiol 2015;66:960-71) © 2015 by the American College of Cardiology Foundation.

Despite numerous groundbreaking advances, cardiovascular disease (CVD) remains the leading cause of global mortality (1). Within the United States, CVD accounts for more than 787,000 deaths annually (2). Though this number has steadily declined over the years, the economic burden of CVD remains high. CVD accounts for 30% of annual Medicare expenditures and 17% of overall national healthcare costs (3). By the year 2030, direct medical costs for CVD are projected to triple, from \$272.5 billion to \$818.1 billion, as seen in **Figure 1** (4).

As the United States continues to lead the world in per capita healthcare expenditures, efforts have been made to re-examine our approach to addressing cardiovascular health (5). The American Heart

Association (AHA) has set forth a goal “to improve the cardiovascular health of all Americans by 20% while reducing deaths from CVD by 20%” by 2020 (6). Traditionally, there has been a dominant focus on treating disease, which inevitably drives healthcare costs higher; however, in order to achieve the goal defined by the AHA, there is a need for a paradigm shift allowing for more emphasis on comprehensive assessment of cardiovascular health and implementation of health promoting measures. In this review we aim to explore the current definition of cardiovascular health. We then will discuss strategies to promote and impact cardiovascular health in the United States, with an emphasis on the need for a paradigm shift that focuses more on health rather than disease.

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DEFINING CARDIOVASCULAR HEALTH

Properly defining cardiovascular health is essential for both monitoring the state of health over time and guiding efforts in the areas of research and preventive care. The Goals and Metrics Committee of the Strategic Planning Task Force of the AHA has outlined a definition of ideal cardiovascular health which incorporates 3 basic principles: 1) absence of CVD; 2) favorable levels of health factors; and 3) presence of favorable health behaviors (6). Based on these principles, 7 metrics have been designated to create an objective definition for ideal cardiovascular health, which can be applied to the general population at risk for CVD (6). These metrics include smoking status, body mass index (BMI), physical activity level, healthy diet, total cholesterol, blood pressure, and fasting plasma glucose (Table 1). Based on these metrics, individuals can be classified as having poor, intermediate, or ideal cardiovascular health. For adults, ideal cardiovascular health is defined as the absence of CVD along with the presence of all 7 of the following criteria: 1) nonsmoker (never smoker or quit >12 months ago); 2) BMI <25 kg/m²; 3) ≥150 min/week moderate intensity exercise or ≥75 min/week vigorous intensity exercise or combination; 4) favorable healthy diet; 5) total cholesterol <200 mg/dl without treatment; 6) blood pressure <120/80 mm Hg without treatment; and 7) fasting glucose <100 mg/dl without treatment (6).

Fang et al. (7), in a study of 356,441 U.S. adults using a state-based telephone survey of behavioral risk factors, showed that overall, 3.3% of the population was in ideal cardiovascular health and 9.9% in poor cardiovascular health. The distribution of ideal cardiovascular health throughout the United States was variable, ranging from 1.2% in Oklahoma to 6.9% in the District of Columbia. Other major predictors of cardiovascular health were age, sex, ethnicity, and level of education.

In 2011, Folsom et al. (8), published data from the ARIC (Atherosclerosis Risk In Communities) study, a prospective cohort study which examined patient populations from 4 U.S. communities, in an effort to determine the significance of ideal cardiovascular health. The baseline cohort was enrolled from 1987 to 1989 and consisted of 15,792 men and women 45 to 64 years of age determined to be free of CVD at baseline from whom only 0.1% met all criteria for ideal cardiovascular health. In this study only 5.3% of subjects followed the ideal healthy diet and less than one-half of the population had a healthy blood pressure, total cholesterol, and healthy BMI. After a median follow-up of 18.7 years with 3,063 overall CVD events,

almost one-half of the patients with no ideal health factors experienced a CVD event, in contrast to no events in patients who had all 7 ideal health factors at baseline. The NHANES (National Health and Nutrition Examination Survey) study found similar associations between ideal cardiovascular health and outcomes in a nationally representative sample of 44,959 adults (9). In the NHANES study, adults who met 6 or more cardiovascular health metrics had a hazard ratio for CVD mortality of 0.24 compared to adults with 1 or less cardiovascular health metrics.

These studies demonstrate that, when applied to the general population, the AHA definition of ideal cardiovascular health is associated with favorable long-term cardiovascular outcomes in a population free of CVD. Moreover, this illustrates the importance of focusing on prevention and promoting overall health in an effort to shift the health/disease continuum in favor of health (Central Illustration). In many ways, contemporary cardiovascular medicine does an excellent job of identifying and treating disease. However, we would argue that a more effective and sustainable approach would place equal weight on preventive health—attempting to prevent the development of CVD in the first place. There is no “magic bullet” to promote cardiovascular health. Each intervention described in the following pages provides varying degrees of (often small) benefit. However, the cumulative effects of these small changes can lead to substantial improvement.

ABBREVIATIONS AND ACRONYMS

- AHA** = American Heart Association
- BMI** = body mass index
- CDC** = Centers for Disease Control and Prevention
- CVD** = cardiovascular disease
- USDA** = U.S. Department of Agriculture

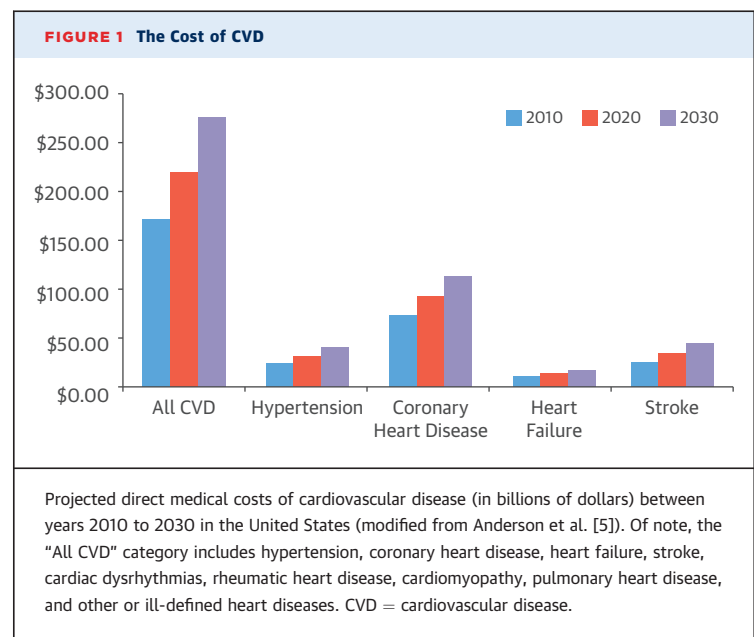


TABLE 1 Definition of Poor, Intermediate, and Ideal Cardiovascular Health in Adults

Goal/Metric	Poor Cardiovascular Health	Intermediate Cardiovascular Health	Ideal Cardiovascular Health
Smoking status	Current smoker	Former smoker, quit ≤12 months ago	Never smoker, or quit >12 months ago
Physical activity	None	1-149 min/week moderate intensity or 1-74 min/week vigorous intensity or 1-149 min/week moderate + vigorous intensity	≥150 min/week moderate intensity or ≥75 min/week vigorous intensity or ≥150 min/week moderate + vigorous intensity
Body mass index	≥30 kg/m ²	25-29.9 kg/m ²	<25 kg/m ²
Healthy diet score*	0-1 components	2-3 components	4-5 components
Total cholesterol	≥240 mg/dl	200-239 mg/dl or treated to goal	<200 mg/dl
Blood pressure	SBP ≥140 or DBP ≥90 mm Hg	SBP 120-139 or DBP 80-89 mm Hg or treated to goal	<120/<80 mm Hg
Fasting glucose	≥126 mg/dl	100-125 mg/dl or treated to goal	<100 mg/dl

*The Goals and Metrics Committee selected 5 aspects of diet to define a healthy dietary score, which is detailed in their American Heart Association Special Report. Modified from Lloyd-Jones et al. (6).
DBP = diastolic blood pressure; SBP = systolic blood pressure.

PROMOTING CARDIOVASCULAR HEALTH

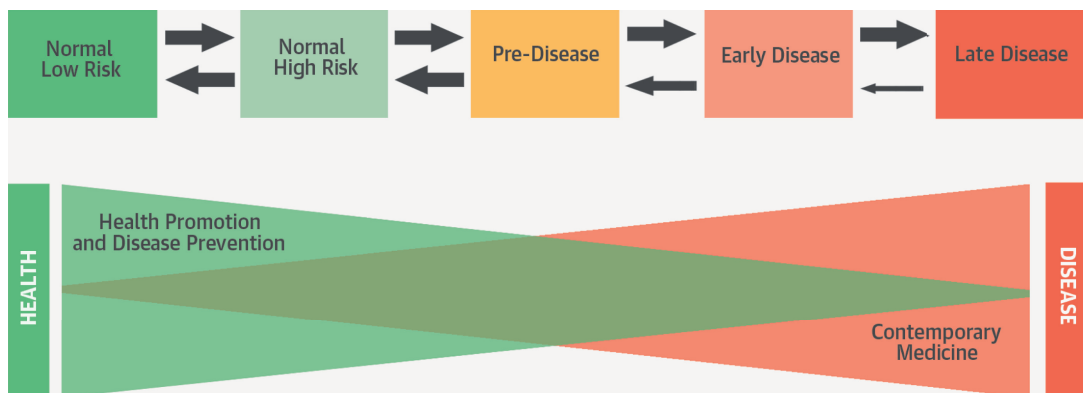
A comprehensive societal approach is needed to improve the cardiovascular health of the population. In this section, we will discuss several approaches to promoting cardiovascular health.

GOVERNMENT INTERVENTIONS/PUBLIC POLICY.

Changes in policy and legislation are among the most powerful methods of promoting public health (10). While the short-term focus of political elections can hinder prevention-oriented legislation, recently there have been a number of important public policy efforts enacted on both national and local levels (10). Perhaps some of the most visible pieces of legislation

are those involving taxation of unhealthy products, particularly cigarettes. In April 2009, the federal government increased its taxes on cigarettes by 61.66 cents per pack, to a total tax of \$1.01 per pack. State governments have frequently implemented even higher taxes on cigarettes. New York State, for instance, charges \$4.35 per pack in taxes, plus another \$1.50 for purchases made within New York City (10). Research has shown that higher cigarette taxes generally decrease cigarette consumption, especially among younger smokers (11). In fact, mathematical models suggest that a 40% increase in cigarette prices could reduce smoking prevalence to 15.2% by 2025, with resultant savings of 13 million quality-adjusted life years and \$682 billion (12).

CENTRAL ILLUSTRATION Focusing on Cardiovascular Health: The Health/Disease Continuum



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In many conditions, including cardiovascular disease, a continuum exists between health and disease. In contemporary medicine, much of the focus has been placed on treating early and late-stage disease (**right side**). However, significant improvements in health can be difficult once disease has progressed to this state. Instead, health promotion and disease prevention focuses on maintaining health (**left side**) and preventing the development of disease.

While cigarette taxes are well established, taxing sugar-sweetened beverages may be the next step in tax policies designed to promote cardiovascular health. A study by Brownell *et al.* (13) suggested that a 1 cent per ounce tax on sugar-sweetened beverages would lead to a minimum 10% reduction in calorie consumption from such beverages, and could generate nearly \$15 billion annually. While New York City's proposed ban on large serving size sugar-sweetened beverages was met with great public outcry, and was eventually overturned by a state Supreme Court justice, a per-ounce sugar-sweetened beverage tax may be received more favorably. In 2008, a poll of New York State residents showed that 72% of respondents would support such a tax if the revenue were used to fund obesity-prevention programs (13). Even more comprehensive programs have been proposed which would levy a flat tax on nearly all fast food restaurants and packaged food products in order to subsidize the cost of healthy foods and school lunch programs (14). If instituted, such a program could result in significant reductions in CVD burden, though political opposition and practical considerations could prove challenging to its implementation.

In addition to its high cigarette taxes and attempts to ban sugar-sweetened beverages, New York City has taken the lead on several other policy efforts designed to improve its citizens' general and cardiovascular health. Some of the more notable policies include mandating calorie counts on chain restaurant menus, restricting trans fat usage in restaurants, increasing available bike lanes, and banning smoking in public places (15,16). Between 1987 and 2009, these efforts helped New York City increase the life expectancy of its citizens. Notably, all 5 boroughs were in the top 1% nationally in life expectancy improvement, with Manhattan's increase of 10 years ranking as the single largest improvement in the country (15). Unfortunately, though improvements have been made, socioeconomic inequities leading to disparities in access to care persist, and have been established as risk factors for CVD. For instance, it has been shown that residents of poor neighborhoods in New York City live 4 years less than residents in the richest areas (15). Further, disparities in access to care also play a role in the fact that African-Americans' life spans are 3 to 4 years less than those of whites (15). Appropriate strategies to reduce disparities in access to care, not only in New York City but across the country, would have a significant impact on our society's overall health.

On a smaller scale, simple changes such as eliminating whole milk in elementary school cafeterias has also shown benefits, saving the average student 382 g

of fat and 3,484 calories each year. Begun in a single Bronx school in 2004, this effective policy has since been adopted by the U.S. Department of Agriculture (USDA) and implemented nationally (15).

Massachusetts' healthcare reform legislation is another example of public policy leading to improvements in health. In July of 2006, Massachusetts mandated that tobacco cessation programs would be covered for all members of its Mass Health Medicaid plan. Within 2 years, 26% of smokers covered by this plan were able to quit smoking, leading to significant declines in hospitalizations for myocardial infarction (17).

Local governments are also employing public-private partnerships to improve the health of their citizens. The Pennsylvania Fresh Food Financing Initiative, designed to improve access to healthy, affordable foods in low-income areas, is 1 successful example. Since its inception in 2004, this collaboration between grocery store chains and local government has led to 83 new or renovated supermarkets. These supermarkets help to provide higher quality meats and produce to approximately 400,000 Pennsylvania residents, and have created or sustained about 5,000 jobs (10).

PUBLIC HEALTH INITIATIVES. Numerous public health initiatives focused on improving cardiovascular health are currently underway on both the national and local level. With the goal of preventing 1 million heart attacks and strokes by the year 2017, the Million Hearts initiative is 1 of the most ambitious. Organized by the Department of Health and Human Services, the campaign coordinates national, state, and local efforts focused on high-yield changes: decreasing tobacco use and secondhand smoke exposure, reducing sodium intake, and cutting trans fat consumption (18,19). The Million Hearts initiative also emphasizes simple yet powerful clinical interventions—what it terms the ABCS of cardiovascular health (appropriate aspirin use, blood pressure control, cholesterol management, and smoking cessation). While each of the ABCS has been strongly correlated with cardiovascular health, these goals have been difficult to meet in practice. For instance, only 47% of patients with ischemic heart disease are taking aspirin or another antiplatelet agent, and only 33% of those with hyperlipidemia are adequately treated (18). Though these numbers are disheartening, they provide an opportunity for great improvement. To enhance ABCS compliance, the Million Hearts initiative advocates less frequent medication dosing, a team-based clinical approach, accountable care organizations, and star ratings for clinicians (19).

Other public health initiatives are focused on specific populations. For instance, the Let's Move campaign, championed by First Lady Michelle Obama, works to fight childhood obesity through an overhaul of USDA nutritional labeling, improvements in school lunch standards, and increased opportunities for physical activity in childhood. Programs such as the National Institutes of Health's Heart Truth campaign and the AHA's Go Red for Women program focus on increasing awareness of the dangers of heart disease among women. Though CVD has long been the number 1 killer of women, only 30% of women recognized this fact in 1997 (20). However, through educational efforts by the National Institutes of Health, AHA, and other organizations, this awareness increased to 56% in 2012 (20). Significant knowledge gaps related to women's CVD also exist among providers, though research has again shown that these deficits are correctable with education (21).

WORKPLACE INTERVENTIONS. Rising employee health-care costs have put a growing financial strain on employers across the country, with about one-sixth of these costs directly related to CVD (22). As a result, there is a significant financial incentive for employers to help improve the collective cardiovascular health of their employees through workplace-based interventions such as tobacco-free zones, worksite wellness programs, and healthier on-site food and beverage options.

Many of the early studies of workplace-based interventions focused on increasing physical activity. While preliminary data suggested little impact of these interventions (23), recent evidence has been more supportive (24). It appears that the type of intervention is critical, with individually tailored programs based on behavior change theory being the most helpful (24). Interestingly, on-site fitness facilities are generally not effective at increasing employee activity levels, as they are typically utilized only by employees who would have exercised anyway (24). There is mixed evidence for simple motivational posters and prompts (i.e., "Take the stairs"), but overall these effects appear to be weak and short-term (24-26). Treadmill desks are more recent innovations to address sedentary patterns in the workplace. In a study of 25 women and 11 men with sedentary jobs, access to treadmill desks was associated with a significant decrease in daily sedentary time ($1,020 \pm 75$ min/day at baseline to 978 ± 95 min/day at 12 months; $p < 0.001$) as well as achievement of significant weight loss (1.4 ± 3.3 kg; $p < 0.05$) (27).

More comprehensive attempts at improving cardiovascular health through workplace interventions

have also been examined. One large study of 1,542 participants across 119 workplaces examined the effect of four 30-min telephone-based coaching sessions per month on 10 risk categories for cardiovascular health (28). The employees were also provided with educational materials and a Web-based health tracking system. After 1 year, the 57.7% of participants who completed the program showed significant reductions in 7 of the 10 risk categories studied, with marked improvement in diet, physical activity, and weight (28). Based on the authors' return-on-investment model, employers experienced a reduction in total expenses of over \$300,000 (28). A recent meta-analysis showed that this type of cost savings is not unusual with employer-based interventions. In fact, with every dollar spent on worksite wellness programs, medical costs fell by \$3.27, and financial losses from lost productivity fell by \$2.73 (29). These savings were typically realized within 12 to 18 months (30).

Worksite wellness programs and other employer-based interventions are still relatively uncommon (10). As these programs have been shown to be both effective and cost saving, widespread implementation of employer-based interventions holds the potential for significant improvements in cardiovascular health.

SCHOOL-BASED INTERVENTIONS. A total of 55 million children spend the majority of their days in schools in the United States (10), providing ample opportunity for early promotion of cardiovascular health. Schools have the framework to provide education on healthy behaviors and to develop an environment that encourages participation in those activities. Several programs have aimed to do just this.

The SPARK (Sports, Play, and Active Recreation for Kids) program is a comprehensive program consisting of teacher training, physical education curricula, and follow-up support, and its outcomes have been extensively studied. SPARK has not only demonstrated improvements in student physical activity and fitness (31), it has also been linked to increased academic performance (32). Notably, SPARK-trained teachers continued to use the program up to 4 years after initial training, suggesting that upfront investments may pay long-term dividends (33).

The CATCH (Coordinated Approach To Child Health) program is another well-studied and successful research-based intervention focused on improving the cardiovascular health of school-aged children. CATCH was started as a controlled clinical trial involving more than 5,000 elementary school students in the early 1990s. Students whose schools implemented the CATCH program showed higher levels of physical activity and consumed less fat than those at the control

schools (34). These results persisted at 3 years follow-up, despite no further CATCH interventions (35). Since its initial success, CATCH programs have been implemented in schools across all 50 states.

Benefits of school-based interventions such as these have not been limited to physical health. They have also been linked to improved academic performance, better attendance, decreased disciplinary problems, and overall improvement in school environment (10). At \$900 to \$4,300 per quality-adjusted life year saved, school-based interventions are cost effective as well (36,37), and would be worthwhile investments even for financially strained school districts. Finally, early results suggest that the positive effects of these programs will be durable. However, more research is needed to determine whether the benefits of school-based interventions can be sustained over the long-term (i.e., into adulthood), and whether these interventions can successfully influence behavior in the home (10).

MEDIA CAMPAIGNS. Media-based campaigns provide an opportunity to promote cardiovascular health to large segments of the population. The largest and most studied media-based, public health campaigns to date have focused on smoking cessation (38). Lessons learned from these smoking cessation campaigns can be used to develop effective mass media campaigns promoting overall cardiovascular health.

In general, smoking cessation campaigns have been successful. In both population studies and field experiments, mass media campaigns have been linked to increased quit rates in adults and decreased smoking initiation in young adults (38). Research has shown that the beneficial effects of media campaigns in smoking cessation may begin to wane once the campaign inevitably ends (39). On the other hand, partnering with community-based efforts, such as school-based antismoking campaigns, smoke-free policies, or tobacco taxation, may help to improve the effectiveness of media-based smoking cessation campaigns (38).

Media campaigns focused on preventing CVD more broadly have also been investigated. Two of the largest studies were the Stanford Heart Disease Prevention Program and the Minnesota Heart Health Program, conducted in the 1970s and 1980s. Results from these studies, as well as those from more recent programs, suggest that mass media campaigns can promote increased awareness of CVD, and can lead to improvements in diet and physical activity (38). Unfortunately, effects of mass media campaigns on the prevention of CVD itself have thus far been small and short-lived (38). Many media interventions designed

specifically to improve diet and physical activity have encountered similar difficulties in sustaining efficacy after the media campaign ends (38). The VERB campaign, which was able to improve physical activity in children 9 to 13 years of age at 2 years follow-up, is an exception—perhaps due to its large budget and commercial-level marketing (38).

The results of previous research should be used to design successful media-based campaigns in the future. Pairing media campaigns with other efforts, such as school-based educational campaigns or public policy changes, is also important. This was shown to be effective in smoking cessation campaigns, and was also likely helpful in large, uncontrolled campaigns such as the National High Blood Pressure Education Program (38). Finally, the results of the VERB campaign and other successful mass media efforts highlight the need for adequate funding, as it appears that both the quality of the media campaign and its level of exposure are important for success (38).

ENVIRONMENTAL INTERVENTIONS. As physical activity has been associated with improved cardiovascular health (10), thoughtful city planning and building designs that promote increased physical activity could theoretically improve cardiovascular health. The Task Force on Community Preventive Services looked at 10 studies examining such environmental interventions. They found that creating or improving access to places where physical activity could take place resulted in a 25% increase in the percentage of people who were physically active at least 3 times per week, and the Task Force strongly recommended such interventions (25). While access to activity-promoting spaces is important, the quality of these spaces is critical as well, as one study found that the aesthetics of recreational facilities was linked to physical activity (40). Further, cross-sectional studies suggest that land use patterns that support walking and cycling are also effective at increasing physical activity (41).

Environmental interventions are appealing methods of promoting cardiovascular health and are often cost effective or cost saving. In fact, one study reported that for every \$1 spent building bike or pedestrian trails, nearly \$3 would be saved in medical costs (42). For cities struggling with tight budgets, one-time investments in community gardens, small parks, and other activity-friendly spaces could promote both cardiovascular health and financial sustainability (10).

IMPACTING CARDIOVASCULAR HEALTH

The major risk factors for CVD are well known and widespread across the population. As an example,

more than 100 million Americans have uncontrolled hyperlipidemia, hypertension, or are active smokers (19). Yet effective interventions to ameliorate these risk factors already exist. In fact, if previously proven interventions were consistently implemented, more than one-half of all heart attacks and strokes could be prevented (19). The following section addresses several of the major risk factors for CVD, and the impact of interventions aimed at reducing their negative effects.

DIET. Diets high in salt, sugar, saturated fats, trans fats, and calories have consistently been linked to CVD and its risk factors. Accordingly, promotion of healthy eating patterns should be a part of an overall strategy aimed at impacting cardiovascular health.

Before consumers can make healthy diet choices, they need to be provided with adequate nutritional information. Research has shown that placing easy-to-understand nutritional information on restaurant menus, grocery store aisles, and vending machines increases the likelihood that people will purchase healthy food (26). New York City has been a leader in the promotion of such strategies, passing legislation requiring all chain restaurants to label their menus with nutritional information (15). The Million Hearts initiative advocates that similar labeling be implemented on a national level (19), providing consumers the information needed to make healthy food choices. Food labeling also has been shown to spur changes within the food industry itself. In 2006, the U.S. Food and Drug Association began requiring the industry to report the levels of trans fats in their products (43). Worried that reporting high levels of trans fats may lead to fewer customers, food companies began voluntarily reformulating their products to reduce trans fats. As a result, Americans now consume only one-half as much trans fat as before (43), a change that could save 50,000 lives a year (43).

Educational campaigns are also important for the promotion of healthy eating. Research has shown that campaigns focused on increasing consumption of fruits, vegetables, and low-fat milk have been more successful in changing eating habits than campaigns focused on promoting low fat diets (38). In an attempt to provide Americans with a framework for healthy eating, multiple agencies have published dietary guidelines. While adherence to dietary guidelines has been shown to lower the risk of developing the metabolic syndrome (44), many in the population have struggled to do so. One important reason for nonadherence is that the dietary guidelines have often been quite complex and difficult to follow (45). The USDA's recent "Choose My Plate" campaign tried

to simplify diet recommendations and make them more accessible. In doing so, however, large-scale changes were made to the familiar "Food Pyramid" model. Frequent changes such as these can potentially be counterproductive and confuse consumers. Adherence to guidelines is made even more difficult by large-budget media campaigns promoting high calorie foods, as well as the easy accessibility and low price of such items.

Favorable modifications in certain dietary elements, such as sodium intake, are particularly high-yield. A recent study found that cutting the average sodium intake by even 400 mg per day would result in 1.5 million less cases of hypertension, and save a total of \$4.8 billion annually in medical costs and lost productivity (46,47). If the average sodium intake could be cut by 3 g per day, this would prevent at least as many cardiovascular events as pharmaceutical treatment of hypertension or hypercholesterolemia (48). New York City is leading the National Sodium Reduction Initiative, a collaboration between government and industry to voluntarily reduce sodium in foods (10). One study showed that this type of collaboration could prevent about 500,000 strokes and 500,000 myocardial infarctions over a lifetime (49). It would also be more cost effective than a tax on sodium, saving about \$32 billion dollars annually in medical costs (49).

It is also important to recognize the cumulative effects of diet throughout the lifespan, beginning with the earliest feedings in infancy. Numerous systematic reviews and meta-analyses have found that breastfeeding is associated with lower blood pressure (50), cholesterol (51), and type-2 diabetes mellitus rates (52) in adulthood, though no consistent association has been found with coronary heart disease or CVD mortality (53). Further, long-term consumption of fruits and vegetables has been independently linked to reductions in CVD and all-cause mortality (54). For each additional combined serving of fruits and vegetables, a 4% decrease in CVD mortality and a 5% decrease in all-cause mortality was observed.

PHYSICAL INACTIVITY. Physical activity has been associated with lower rates of hypertension, diabetes, and obesity (10). In fact, a sedentary lifestyle is 1 of the leading preventable contributors to mortality, responsible for almost 2 million avoidable deaths each year (55). The AHA, Surgeon General, and Centers for Disease Control and Prevention (CDC) recommend 150 min or more of moderate intensity physical activity per week (41), but the majority of adults in all age groups do not report this level of activity (56). Those who did not complete high school

were significantly less likely to meet the recommendations than those with a college degree (21% vs. 46%) (57). A study tracking physical activity using accelerometers was even more sobering, with only 3.8% of adults studied objectively achieving recommended activity levels (58).

Web-based physical activity programs offer a flexible, low-cost, easily sustainable method of reaching a large group of people. One such program, the AHA's "Choose to Move," utilized online modules on motivation and strategies for increasing physical activity (59). Participants in the program reported increased physical activity, energy, and subjective well-being in the short-term, with results most pronounced in those with no baseline physical activity (59). In older adults, campaigns to promote walking have been particularly successful at increasing physical activity (60).

Improvements in physical activity following these campaigns have typically been short-term, and seen mostly in highly motivated individuals (25,41). To reduce CVD in the long term, maintenance of physical activity following any intervention is critical. Unfortunately, structured exercise programs have mean dropout rates approaching 50% (60). As a result, simple lifestyle modifications (i.e., taking the stairs, parking further away) may be more beneficial in sustaining physical activity than structured exercise programs.

Reducing the amount of time spent sedentary is perhaps every bit as important as increasing the amount of time spent exercising, as more evidence accumulates that sedentary behavior itself may increase the risk of CVD (61). The rise in sedentary behavior is a complicated problem stemming in large part from the new environments and demands of a modern society—such as desk jobs, automobile-based transportation, television, and video games. A number of different interventions have been attempted to reduce sedentary time, including treadmill desks, automatic television limits, lifestyle modifications, and city planning. In general, the impacts of these interventions have been small but positive. For instance, a systematic review of lifestyle interventions to reduce sedentary behavior showed an average decrease of 22 min per day of sedentary time after the intervention (62). Even better, a meta-analysis of "activity-permissive workstations," which included standing desks, treadmill desks, and cycle ergometers or other pedal devices, showed that these work stations were able to decrease sedentary time by 77 min per workday (63). For young people, screen time is a large contributor to sedentary behavior, and studies have shown that interventions which improve the child's ability to allocate his or her television

time, as well as interventions implementing an automatic television lock after that time has expired, are both promising options for limiting sedentary behavior (64).

CIGARETTE SMOKING AND ALCOHOL CONSUMPTION.

Smoking costs the U.S. economy over \$300 billion annually, \$116 billion of which is accounted for by direct medical bills (65). Much of this added cost is due to CVD, as a World Health Organization report found that nearly one-half of the total risk for the development of CVD could be attributed to smoking (66). Interventions aimed at smoking cessation have been well studied, and have had varying success rates (67). Clinician counseling has been shown to be 1 of the most effective interventions, with quit rates doubling after even brief counseling sessions (19,68). Other well-supported interventions include aversion therapy, self-help materials, telephone counseling, nurse delivered interventions, and group counseling (68). Internet-based interventions, buddy systems, and biofeedback have less convincing evidence, but may eventually prove to be effective options (68). Finally, numerous observational studies have demonstrated significant reductions in CVD after the implementation of smoke-free legislation in communities. A recent meta-analysis demonstrated a 15% decline in hospitalizations for acute myocardial infarction within 1 year of the implementation of strong smoking bans, and up to a 36% reduction after 3 years, perhaps due to reductions in secondhand smoke exposure (69).

Unfortunately, state and local governments have often fallen victim to short-sighted cost-aversion in their own tobacco cessation programs. Following the landmark 1998 Tobacco Master Settlement Agreement, states began receiving annual payouts from tobacco companies to be used towards tobacco control programs. However, because of financial pressures, only 1 state (North Dakota) is currently funding its tobacco prevention programs at CDC recommended levels, with the rest putting this money towards other government needs (70). Although this may be economically helpful in the short-term, the long-term consequences of these actions are severe: had all states funded their tobacco cessation programs at CDC recommended levels, research suggests that millions of additional smokers could have successfully quit (70).

While cigarette smoking invariably increases CVD risk, the effects of alcohol consumption on CVD risk are nuanced and dose dependent. Daily light to moderate alcohol intake, defined as up to 1 drink per day for women and 1 to 2 drinks for men, has been

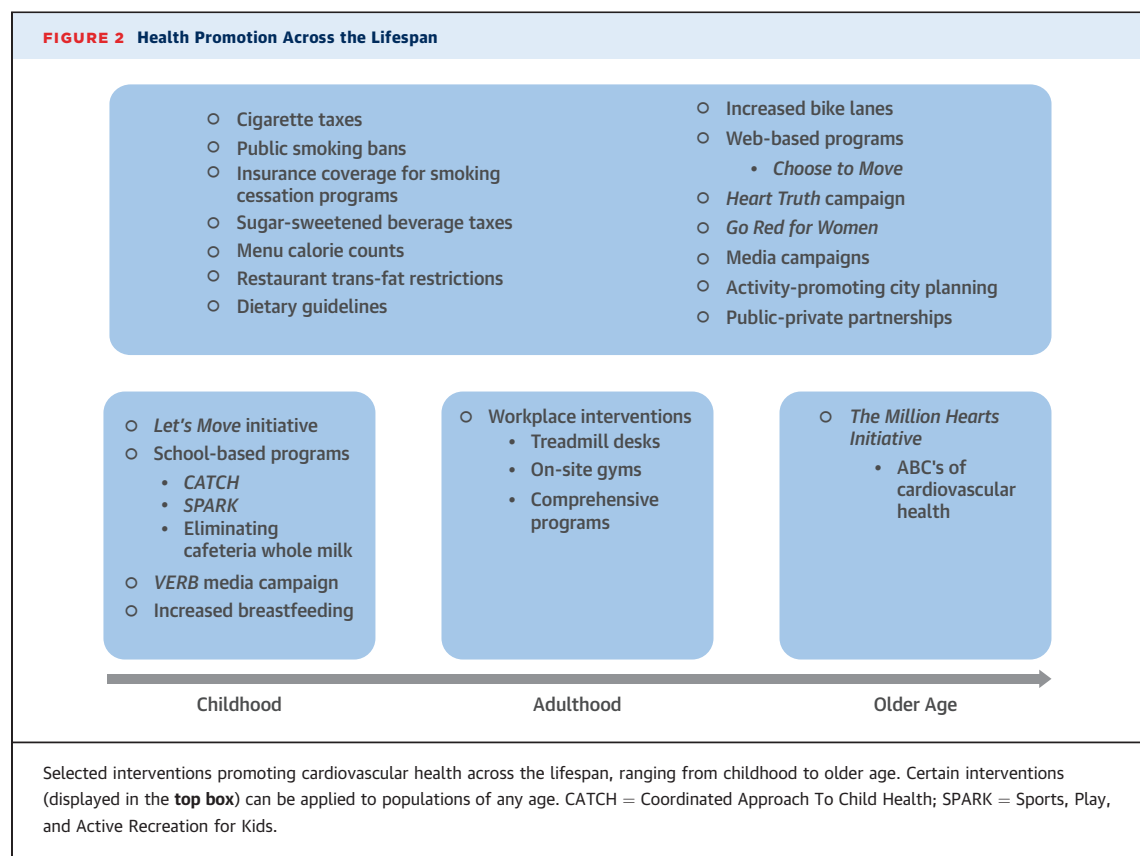
associated with numerous positive health outcomes, including lower rates of diabetes mellitus, congestive heart failure, coronary artery disease, stroke, and all-cause mortality (71). However, these benefits may not be clinically relevant for younger adults due to the lower incidence of CVD in these age groups (72). Further, the beneficial effects of moderate daily alcohol consumption should not obscure the detrimental effects of excessive alcohol intake. Heavy alcohol use accounts for 16% of hypertensive disease around the world (73), predisposes to dilated cardiomyopathy (74), and significantly increases rates of atrial fibrillation (75) and stroke (76). Moreover, while moderate alcohol consumption may reduce the relative risk of all-cause mortality by up to 16% compared to lifetime abstainers, heavy alcohol use is associated with even greater, dose-dependent increases in all-cause mortality (77). Due to these risks, as well as the challenges of predicting future problem-drinking patterns, the initiation of alcohol use for CVD risk prevention is not currently recommended (78).

CONCLUSIONS

There is no doubt that the future discoveries of novel diagnostic and therapeutic approaches will continue.

Over the past 30 years, major improvements in cardiovascular imaging, interventions, and medications have resulted in significant reductions in age-adjusted cardiovascular mortality (79). These gains, however, have been at the cost of increasing health expenditures. In an era of limited resources, an appropriate definition of priorities for improving cardiovascular health must be made. In a 2011 report on noncommunicable diseases, fully one-half (7 of 14) of the World Health Organization's "Best Buys" related to smoking cessation, dietary changes, or increases in physical activity (80). As a result, a more cost-effective strategy for reducing CVD would involve a paradigm shift that focuses more on the identification and promotion of cardiovascular health across the lifespan (**Figure 2**). Simple improvements in diet, physical activity, smoking cessation, and other key areas would lead to significant health benefits and further reduction in cardiovascular outcomes, without the need for innovation of a new drug or device.

Unfortunately, while the benefits of healthy lifestyles have been known for decades, the widespread adoption of these behaviors has been slow. The barriers to implementing healthy lifestyle habits on a larger scale are numerous and complex. Frequently



cited barriers include poor social support, inadequate understanding of healthy lifestyle choices or the benefits these choices confer, high costs of fresh food or exercise facilities, and lengthy commute times or other transportation problems (81,82). While each barrier presents its own unique challenges, strategies exist to address each of them. For instance, as social support is such a critical factor for success in initiating and maintaining lifestyle changes, physicians should inquire about sources of social support whenever counseling patients about lifestyle changes. Further, media campaigns and public health initiatives should purposefully incorporate an emphasis on social support and group participation in their future endeavors. Other barriers, such as long commutes and transportation difficulties, will require more extensive city planning to address—an often unwelcome proposal for strained budgets. However, the successes of previous efforts suggest that thoughtful city planning with an eye towards promoting physical activity can be both effective and cost saving (42).

Regardless of the lifestyle change being proposed or the potential barrier being addressed, a comprehensive approach will be required—one which incorporates patients, health care providers, professional

organizations, government agencies, media outlets, schools, and industry. This type of collaborative strategy is supported by the AHA's recent policy statement on improving cardiovascular health at the community level (83). The end goal of this cooperative effort is a change in the societal norm from unhealthy behaviors to healthy ones. Such cultural shifts are difficult, but not unprecedented. Only 25 years ago, less than one-third of Americans supported restaurant smoking bans; now that number is nearly two-thirds (84). Support for smoking bans in hotels, bars, and workplaces have doubled or even tripled (84). Societal acceptance of cigarette smoking has vastly declined, and similar perception changes must occur for physical inactivity, fatty food intake, and other high-risk health behaviors. To ensure continued reductions in the burden of CVD in our society, a paradigm shift towards the promotion of cardiovascular health is imperative, and will require a concerted effort from all invested parties.

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