# AHA SCIENTIFIC STATEMENT

# Forecasting the Burden of Cardiovascular Disease and Stroke in Women in the United States Through 2050: A Scientific Statement From the American Heart Association

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**BACKGROUND:** Forecasts for the future prevalence of cardiovascular disease and stroke are crucial to guide efforts to improve health outcomes across the life course for women.

**METHODS:** Using historical trends from the 2015 to 2020 National Health and Nutrition Examination Survey, 2015 to 2019 Medical Expenditure Panel Survey, and census estimates for population growth, we estimated trends in prevalence through 2050 for cardiovascular risk factors based on suboptimal levels of Life's Essential 8 and clinical cardiovascular disease and stroke, overall and by age and race and ethnicity.

**RESULTS:** Among adult women overall, the prevalence of hypertension is estimated to increase from 48.6% in 2020 to 59.1% in 2050. Diabetes (14.9% to 25.3%) and obesity (43.9% to 61.2%) will increase, whereas hypercholesterolemia will decline (42.1% to 22.3%). Prevalences of suboptimal diet, inadequate physical activity, and smoking will decline over time, and inadequate sleep will increase. Prevalences of coronary disease (6.85% to 8.21%), heart failure (2.45% to 3.60%), stroke (4.14% to 6.74%), atrial fibrillation (1.58% to 2.31%), and total cardiovascular disease and stroke (10.7% to 14.4%) will rise. Similar trends are projected in girls 2 to 19 years of age, with an increase from 19.6% to 32.0% projected in obesity. Most adverse trends are projected to be more pronounced among women and girls identifying as American Indian/Alaska Native or multiracial, Black, or Hispanic.

**CONCLUSIONS:** The prevalence of cardiovascular risk factors and disease in women and girls will increase over the next 30 years. Focused clinical and public health interventions are needed across the life course to address these adverse trends.

**Key Words:** AHA Scientific Statements ■ cardiovascular diseases ■ heart disease risk factors ■ population forecast ■ stroke

Cardiovascular disease (CVD) and stroke are the leading causes of morbidity and mortality for women in the United States[1] and globally.[2] In the United States between 2017 and 2020, >62 million women had some form of CVD (coronary heart disease [CHD], heart failure [HF], atrial fibrillation [AF], or stroke) or hypertension, with an overall prevalence of almost 45%.[3] In addition to the clinical burden of CVD, the economic burden is massive, with estimated direct and indirect spending in 2020 to 2021 of $417.9 billion.[4] Given that women make up just under half of the total incident and prevalent CVD cases in the United States and typically outlive their male counterparts,[5,6] spending for women likely exceeds $200 billion annually.

Although heart disease mortality declined precipitously from the 1970s to the early 2000s, it has since plateaued.[7] Indeed, recent studies suggest worsening trends not only in premature mortality from cardiac disease[8] but also in health factors and health behaviors that influence the development of CVD as contained in the American Heart Association's Life's Essential 8[9]: healthy blood pressure, body weight, blood sugar, and blood cholesterol; adequate sleep and physical activity; refraining from smoking; and a healthy diet.[10,11] The biological and social underpinnings of CVD incidence and progression are different in women and men, and unique interventions may be needed to improve women's cardiovascular health.[12–14] Furthermore, deep inequities associated with race and ethnicity remain in women's cardiovascular health outcomes. In the United States, Black, Hispanic, and American Indian/Alaska Native (AI/AN) women[15–18] and subgroups of Asian Americans have higher rates of cardiovascular risk factors,[19] adverse pregnancy outcomes, and incident and prevalent CVD and higher cardiovascular mortality.[20] Intersectionality, described as the compounding burden of co-occurring adverse social determinants of health (SDOH) such as racial and gender identity, poverty, low literacy, rural residence, and other psychosocial stressors,[21] creates unique negative social experiences that contribute to poor cardiovascular outcomes.[22] Intersectionality occurs more often in Black women, which contributes to the higher risk for incident CVD.[23,24]

As the population continues to age and diversify,[25] projections for CVD in women will allow clinical leaders and policymakers to make strategic decisions about health care resources, future areas for research, and program development. Building on prior work by the American Heart Association projecting the future prevalence of disease[5,6,26–29] and using national survey and epidemiological data, we aimed to estimate the prevalence and number of women with CVD risk factors and clinical disease from 2020 to 2050 for both women and girls and across different racial and ethnic populations. For the purposes of this document, we use "women" and "girls" to imply mostly sex-specific (rather than gender-specific) criteria.

## METHODS
### Baseline Prevalence

Detailed methods have been previously published.[5,6] Briefly, we estimated the prevalence of suboptimal levels of each of the elements of American Heart Association's Life's Essential 8.[9] We also estimated the prevalence of 4 diseases—CHD, HF, stroke, and AF—and a composite outcome henceforth referred to as total CVD that included any of these 4 diseases. We estimated the baseline prevalence of each outcome (except AF) using data from the 2015 to March 2020 prepandemic NHANES (National Health and Nutrition Examination Survey).[30] Lists of qualifying measures and questions used to define

each outcome for women and girls are given in Supplemental Table 1a and 1b. We estimated the prevalence of AF using the 2015 to 2019 MEPS (Medical Expenditure Panel Survey).[31]

We estimated the prevalence of each outcome using logit regression models adjusted for demographics (age, sex, and race and ethnicity). We predicted the prevalence of each outcome in each age/sex/race and ethnicity cell using coefficients from the logit regressions for the 2017 to March 2020 NHANES cycle (or the 2019 MEPS for AF). Age groups for women were 20 to 44, 45 to 64, 65 to 79, and ≥80 years. Age groups for girls were 2 to 5, 6 to 11, and 12 to 19 years. Race and ethnicity categories were Hispanic, non-Hispanic Black, non-Hispanic White, non-Hispanic Asian, and combined AI/AN/multiracial based on NHANES categories. We generated bootstrapped SEs for the estimates of total CVD and stroke prevalence. We repeated the analyses of logit regression models, replacing the race and ethnicity stratifications with sex and age categories.

### Prevalence Projections

We considered the baseline prevalence of each outcome from NHANES to represent prevalence for 2018. We used NHANES data from 2010 to 2020 to estimate growth or decline rates in age-adjusted prevalence of the risk factors and clinical CVD (except AF, see later discussion), and applied those rates to age/sex/race and ethnicity–specific prevalence for the years 2020 to 2050. The growth or decline rates were calculated overall rather than separately by sex. Growth and decline rates were estimated separately for adults and children given differences in variable definitions and cutoffs between the 2 populations. For adults, we did not estimate a growth or decline rate for inadequate sleep or poor diet because of insufficient historical data. For AF, we could not calculate a growth rate because of MEPS data limitations, so we rescaled the hypertension growth rate to the AF baseline prevalence given the relationship between these 2 clinical conditions and used that as the AF growth rate. For children, we did not estimate a growth or decline rate for hypertension, inadequate physical activity, tobacco use, or poor diet because of changes in definitions and limitations in data availability.

We combined estimates of prevalence by age/sex/race and ethnicity with the 2010 Census projections of population counts for 2020 through 2050 to generate the projected number of women and girls with each condition for 2020 through 2050. Projected population counts for 2020 through 2050 were obtained from the 2017 Population Projections of the US resident population by age, sex, race, and Hispanic origin generated by the US Census Bureau. Uncertainty was projected around the prevalence and counts estimates with a

bootstrapping approach. We ran 1000 iterations estimating the number of individuals with each condition in each year of the forecast, redrawing logit coefficients used to predict prevalence of the condition in each subgroup from a multivariate normal distribution, with the estimated coefficients as the mean and the estimated variance-covariance matrix as the variance. We also redrew linear regression coefficients that were used to calculate prevalence growth and decline rates using normal distributions. The lower and upper bounds of uncertainty intervals around estimated prevalence and count estimates were the 5th and 95th percentile, respectively, of the bootstrapped results. The 90% credible ranges for the results were generated with these boundaries. Statistical analyses were conducted with Stata version 17.0 (StataCorp LLC, 2021).

Analyses were conducted by the Research Triangle Institute International under a contract from the American Heart Association. The study was exempt from Institutional Review Board review because of the deidentified nature of the data.[32]

## RESULTS

### Prevalence and Number of Adult Women With Cardiovascular Risk Factors and CVD

First, adverse levels of Life's Essential 8 were estimated among adult women. Figure 1A demonstrates adverse levels of the health factors over time. According to current trends, the prevalence of hypertension will increase from 48.6% in 2020 to 59.1% in 2050. Increases were also projected for diabetes (14.9% to 25.3%) and obesity (43.9% to 61.2%). There was a projected decline in hypercholesterolemia (42.1% to 22.3%). Figure 1B shows levels of suboptimal health behaviors over time. Suboptimal diet (49.0% to 47.6%), inadequate physical activity (39.8% to 28.6%), and current smoking (13.8% to 7.2%) were estimated to improve over time, whereas inadequate sleep (40.3% to 42.2%) was projected to worsen. Figure 1C shows overall rates of CVD, with the prevalence of CHD (6.85% to 8.21%), HF (2.45% to 3.60%), stroke (4.14% to 6.74%), AF (1.58% to 2.31%), and total CVD (10.7% to 14.4%) expected to rise. Results for each factor and disease, along with the number of adult women affected and accompanying uncertainty intervals, are given in Supplemental Tables 2 and 3.

### Prevalence and Number of Women With Cardiovascular Risk Factors and CVD, by Demographic Group

Figure 2 shows the projected prevalence for health behaviors by racial, ethnic, and age group. Black women (olive green bars) had the highest baseline and projected prevalence of inadequate sleep and poor diet; Asian women (pink bars) had the highest projected prevalence



**Figure 1. Proportion of US adult women with adverse levels of cardiovascular health factors, health behaviors, and CVD and stroke, 2020 to 2050.**
For adults, we did not estimate a growth or decline rate for inadequate sleep or poor diet because of insufficient historical data. CVD indicates cardiovascular disease.

of inadequate physical activity; and the aggregated group of AI/AN/multiracial women (blue bars) had the highest projected prevalence of smoking. The youngest women (20–44 years of age, pink bars) had the highest prevalence of poor diet and smoking but the lowest prevalence of inadequate physical activity. Poor sleep was particularly prevalent among the oldest women (≥80 years of age, purple bars), but smoking was the least prevalent.

Figure 3 shows the projected prevalence for heath factors by racial, ethnic, and age group. Black women had the highest prevalence of hypertension, diabetes, and obesity at baseline but the lowest prevalence of hypercholesterolemia. Projected absolute increases in prevalence were generally greatest in Hispanic women (turquoise bars), although growth was also high in Asian women. The oldest women had the lowest baseline prevalence of obesity but the highest prevalence of hypertension and diabetes. The youngest women had the lowest prevalence of hypertension and diabetes but were projected to have the greatest increase in these conditions.

Figure 4 shows the projected prevalence for clinical CVD by racial, ethnic, and age group. Black women and AI/AN/multiracial women had the highest prevalence of total CVD plus hypertension, whereas all groups, particularly Hispanic and Asian women, had significant projected growth in this measure. Black women had the highest rates of HF and stroke and the greatest projected increases in prevalence; White women had the highest rates of AF; and AI/AN/multiracial women had the highest rate of CHD. In terms of age differences, the prevalence of CHD, stroke, HF, AF, and total CVD was markedly higher among the oldest women. The greatest projected increase, however, was among the youngest women, particularly for stroke and total CVD.

Full results for each factor and condition by age are given in Supplemental Table 4 (prevalence) and Supplemental Table 5 (number). Full results for each factor and condition by race and ethnicity are given in Supplemental Table 6 (prevalence) and Supplemental Table 7 (number).
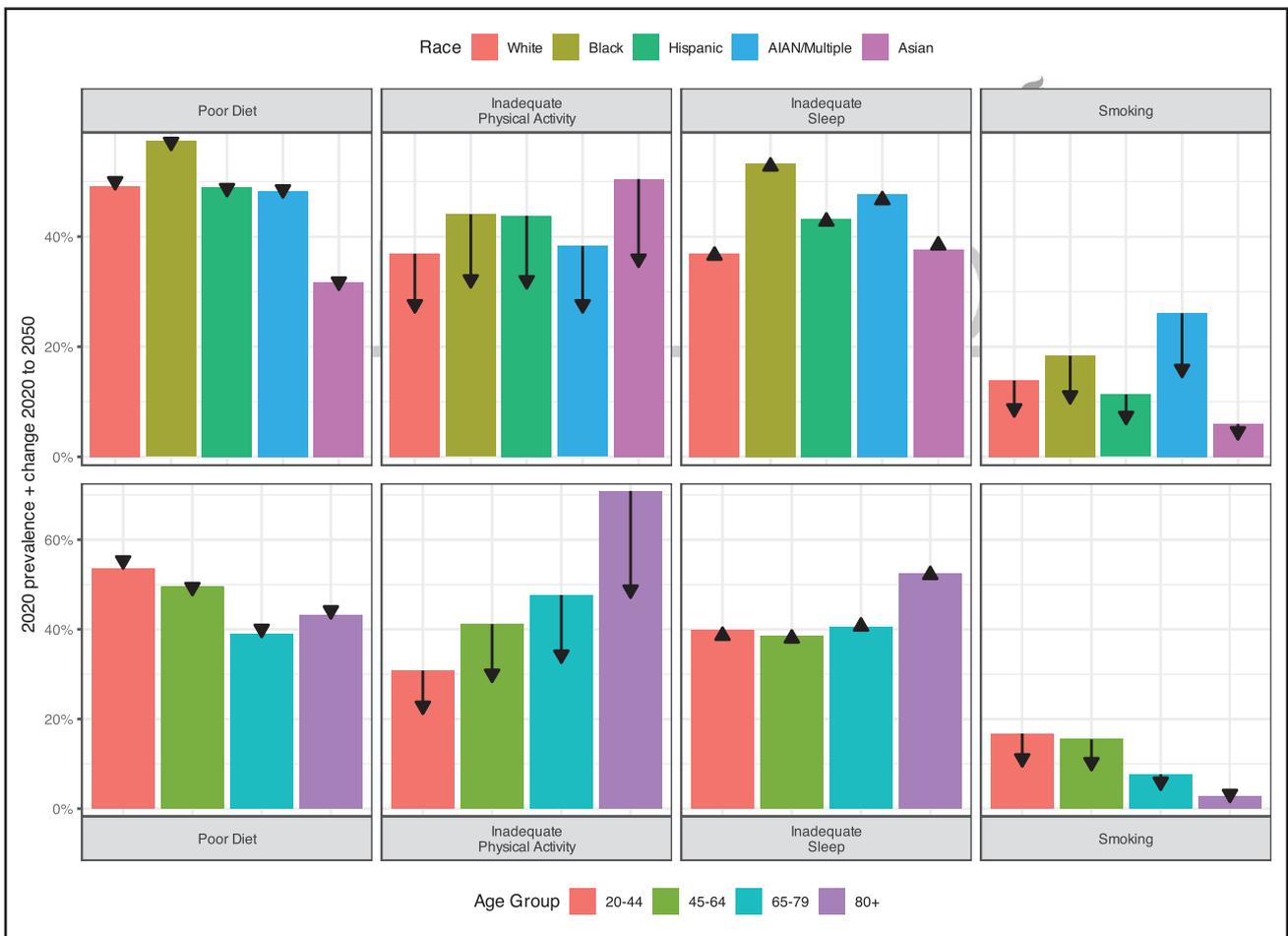


**Figure 2.** Trends in prevalence of adverse levels of cardiovascular health behaviors in US women, by race, ethnicity, and age.
Bars represent the baseline estimate for 2020 for each factor; arrows represent the change from 2020 to 2050 and end at the 2050 estimate. For adults, we did not estimate a growth or decline rate for inadequate sleep or poor diet because of insufficient historical data, so the markers are centered around the 2020 baseline. AIAN indicates American Indian/Alaska Native.
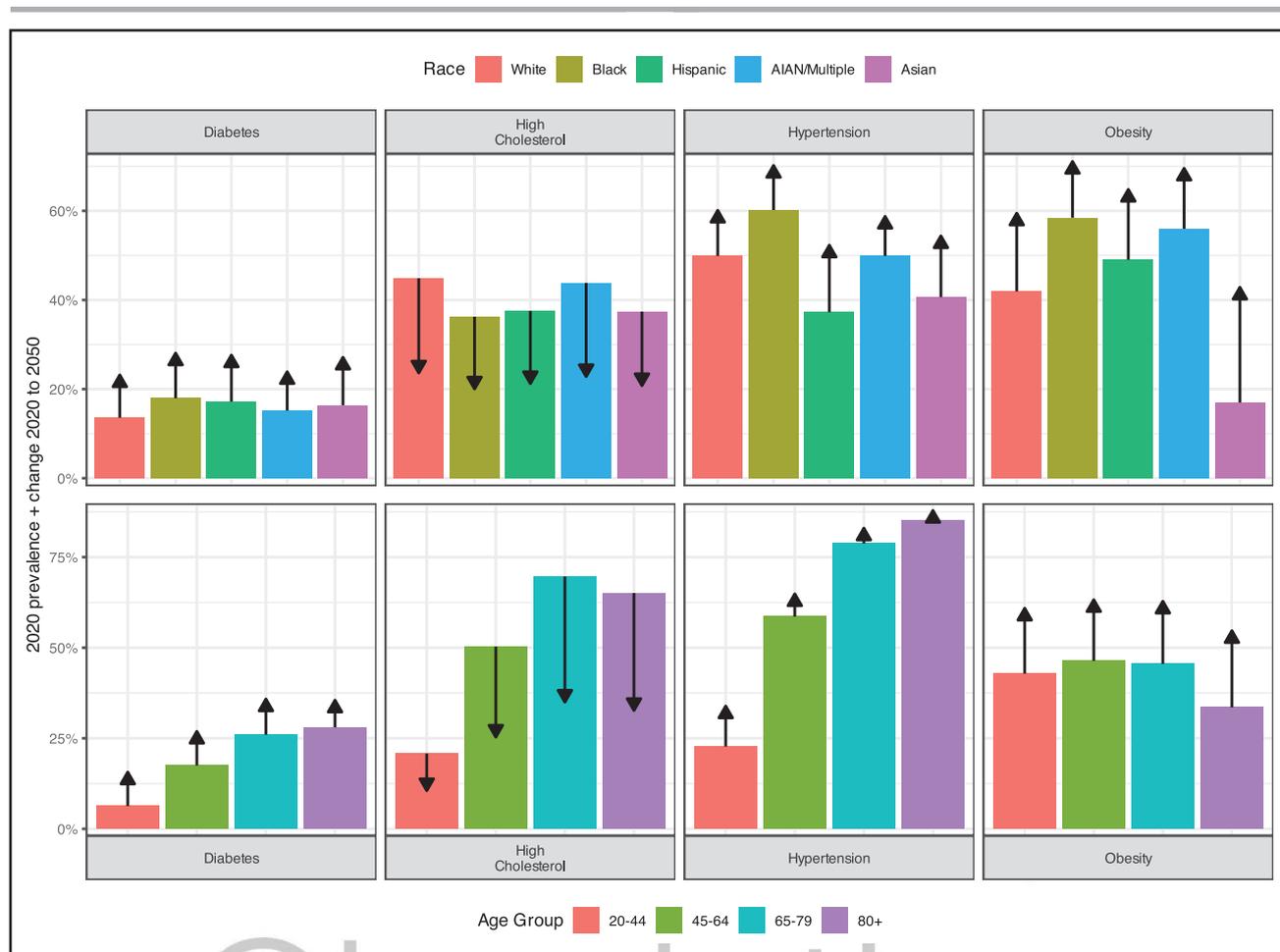
**Figure 3. Trends in prevalence of adverse cardiovascular health factors in US women by race, ethnicity, and age.**
Bars represent the baseline estimate for 2020 for each factor; arrows represent the change from 2020 to 2050 and end at the 2050 estimate.
AIAN indicates American Indian/Alaska Native.

## Prevalence and Number of Girls With Cardiovascular Risk Factors, Overall and by Race and Ethnicity

Figure 5 shows projected prevalence for the adverse health factors and behaviors among girls. The prevalences of hypertension (3.3% to 3.2%) and diabetes (1.1% to 1.2%) are estimated to be stable from 2020 to 2050. A significant increase was projected for obesity (19.6% to 32.0%) and a decline for hypercholesterolemia (7.1% to 3.2%). The prevalences of poor diet (56.3% to 55.6%) and inadequate physical activity (63.4% to 63.9%) were high but stable; current smoking (7.3% to 7.0%) was also estimated to be stable. Sleep data are not available for girls. Full results for each factor are given in Supplemental Table 8 (prevalence) and Supplemental Table 9 (number).

Figure 6 disaggregates these projections by racial and ethnic group among girls. Black girls are projected to have the highest prevalence of hypertension and diabetes, whereas Hispanic girls are projected to have the highest prevalence of obesity. Asian girls are projected to have the highest prevalence of hypercholesterolemia, although the prevalence in all groups is projected to decline over time. Inadequate physical activity is high for all racial and ethnic groups but is projected to be highest in Hispanic girls. Poor diet is projected to be highest in Black girls, whereas tobacco use is projected to be highest in AI/AN/multiracial girls. Full results for each factor are given in Supplemental Table 10 (prevalence) and Supplemental Table 11 (number).

## DISCUSSION

The forecast for cardiovascular health in women and girls through 2050 supports a need for sustained action. The most efficient, most effective, and least costly way to reduce the prevalence and impact of CVD is through prevention.[33,34] These projections signal that current prevention efforts are inadequate, particularly in women of color and younger women. Unique risk factors that pertain to women such as reproductive factors
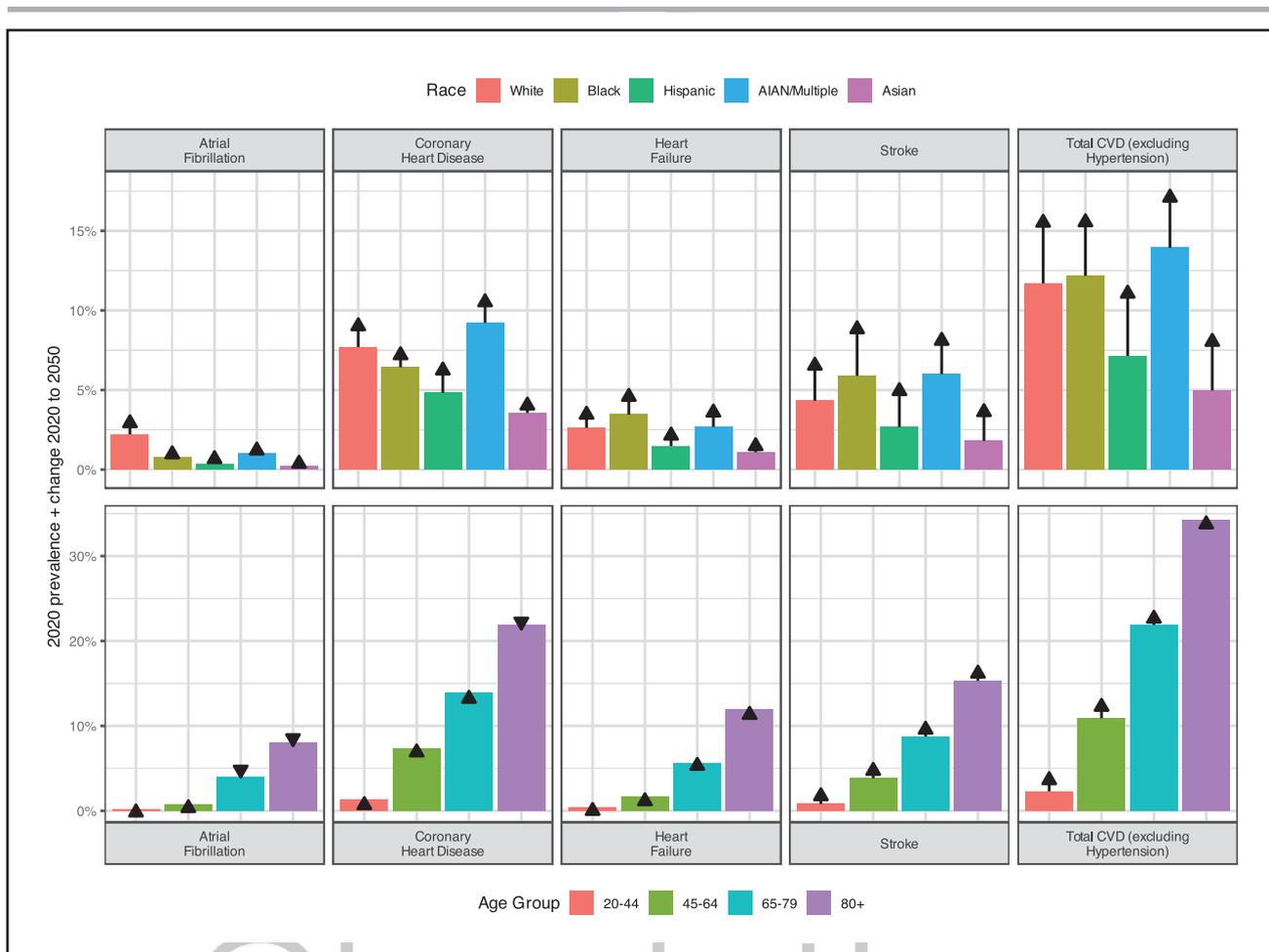
**Figure 4. Trends in prevalence of clinical cardiovascular disease in US women by race, ethnicity, and age.**
Bars represent the baseline estimate for 2020 for each factor; arrows represent the change from 2020 to 2050 and end at the 2050 estimate. AIAN indicates American Indian/Alaska Native; and CVD, cardiovascular disease.

across the life span must be considered in prevention and care delivery.[35] Here, several considerations are outlined, encompassing prevention, treatment, and sustained care across the life course and for women of all racial and ethnic groups, with a focus on how these issues will affect women and girls in the coming 3 decades and beyond.

## Health Behaviors

The prevention of risk factors and disease before they occur is crucial for any strategy to reverse worsening CVD trends, and health behaviors are key to this approach.[36] Women who reach midlife with optimal physical activity, dietary, and sleep patterns who have never smoked will have low rates of CVD in the decades that follow.[37–39] Evidence-based public health efforts to promote and sustain optimal cardiovascular health behaviors in women are thus essential.[40] Environmental and physiological drivers[41] of worsening sleep trends in women such as screen time, stress, and hormonal changes must be identified and miti-

gated. Early efforts to identify and support behavior change in girls and women with suboptimal cardiovascular health behaviors should occur in schools,[42] community organizations,[40] and pediatric[43] and gynecology[44] offices. Digital engagement strategies will increasingly be part of the landscape for primordial and primary prevention.[45]

Considerations: (1), Focus on supporting healthy behaviors in schools, community organizations, and pediatric and gynecology offices. (2), Encourage digital engagement strategies when appropriate to support positive behavior change.

## Health Factor Management: Hypertension, Diabetes, Obesity, and Cholesterol

Tailored and sustained interventions for chronic disease are needed among high-risk populations earlier in the course of disease.[46–50] Guidelines already recommend blood pressure screening for adults and children,[51] and observational studies suggest the potential for initiating
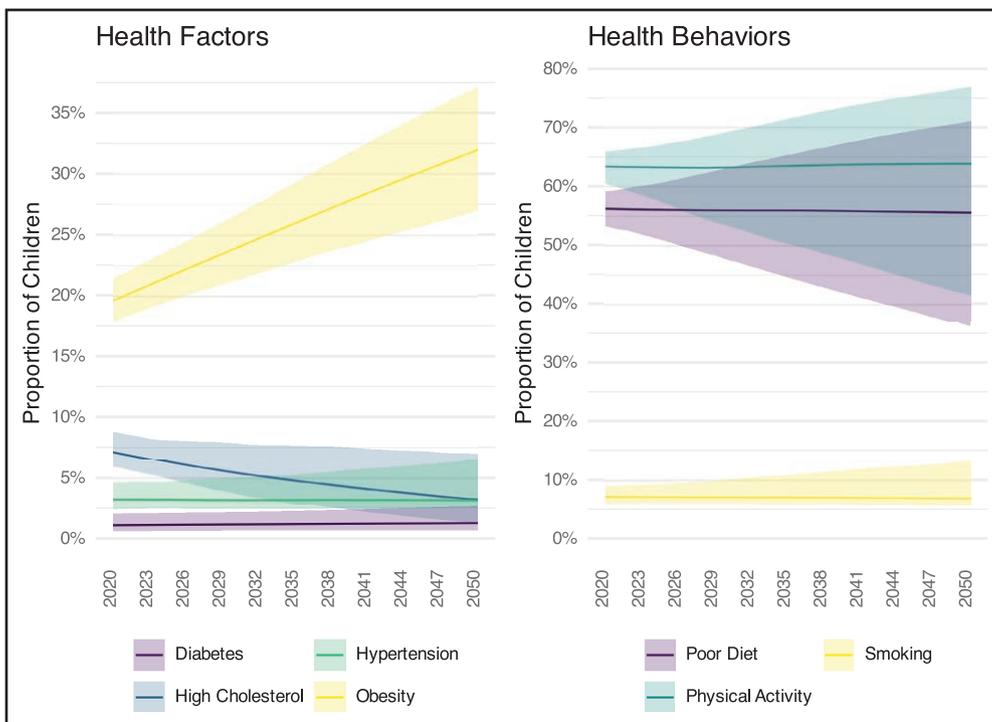
**Figure 5. Prevalence of adverse levels of cardiovascular health behaviors and health factors in US girls, 2020 and 2050, overall.**
For girls, we did not estimate clinical cardiovascular disease because of low prevalence. Girls within the specified age group were included in the corresponding categories: inadequate physical activity, obesity, and poor diet, 2 to 19 years; high cholesterol, 6 to 19 years; hypertension, 8 to 19 years; and diabetes and current tobacco use, 12 to 19 years.

therapy for stage 1 hypertension in appropriate individuals to disproportionately benefit women for stroke and HF risk reduction.[52–54] However, there was no interaction between sex and treatment effect in blood pressure–lowering trials such as SPRINT (Systolic Blood Pressure Intervention Trial)[55] and ACCORD (Action to Control Cardiovascular Risk in Diabetes).[56] Given that only a minority of patients have their blood pressure controlled, there is massive opportunity for improving outcomes simply through better management of this chronic disease. Team-based care and digitally enabled monitoring and medication titration have shown good evidence of success and could be pursued much more broadly.

There is also a need for better chronic disease management in diabetes. Diabetes is a particularly potent risk factor for women, conferring excess risk compared with men for a range of cardiovascular conditions, including CHD, HF, and stroke.[57–59] Women also experience greater cardiovascular risk associated with undiagnosed diabetes and prediabetes than men and derive similar benefit from treatment as men.[60,61] The recently developed Predicting Risk of Cardiovascular Disease Events calculator highlights the growing focus on cardio-kidney-metabolic health, which includes diabetes, obesity, and chronic kidney disease, and its role in the progression of CVD.[62,63] Similar to hypertension, team-based, digitally enabled care has great potential to improve disease management.

Obesity is a chronic disease that affects women to a greater degree than men, particularly at the most severe levels,[64] and the treatment landscape for obesity is rapidly changing. Given the recent development of highly effective medications to treat obesity, in particular the glucagon-like peptide receptor agonists, and a growing understanding of the hormonal and genetic underpinnings of obesity, it is possible that the coming decades could see meaningful changes in the prevalence of obesity. However, much remains to be learned about the long-term effects of these medications, about whether their safety or efficacy differs by sex,[65] about the most effective ways to use them in concert with changes in diet and physical activity, and about their use in childhood and adolescence. Furthermore, issues of cost, access, and tolerability may affect the population impact of these medications and should be studied.

The projected decline in the prevalence of hypercholesterolemia in women may be surprising but has been demonstrated in multiple prior studies.[3,66–69] Increased screening for hypercholesterolemia and a shift toward risk-based approaches instead of targeting specific lipid levels may account for continued decline in cholesterol levels nationally.[70] Despite these declines, ongoing attention should be paid to ensuring that women are equitably treated with statins and other lipid-lowering therapies, particularly because treatment benefits women and men
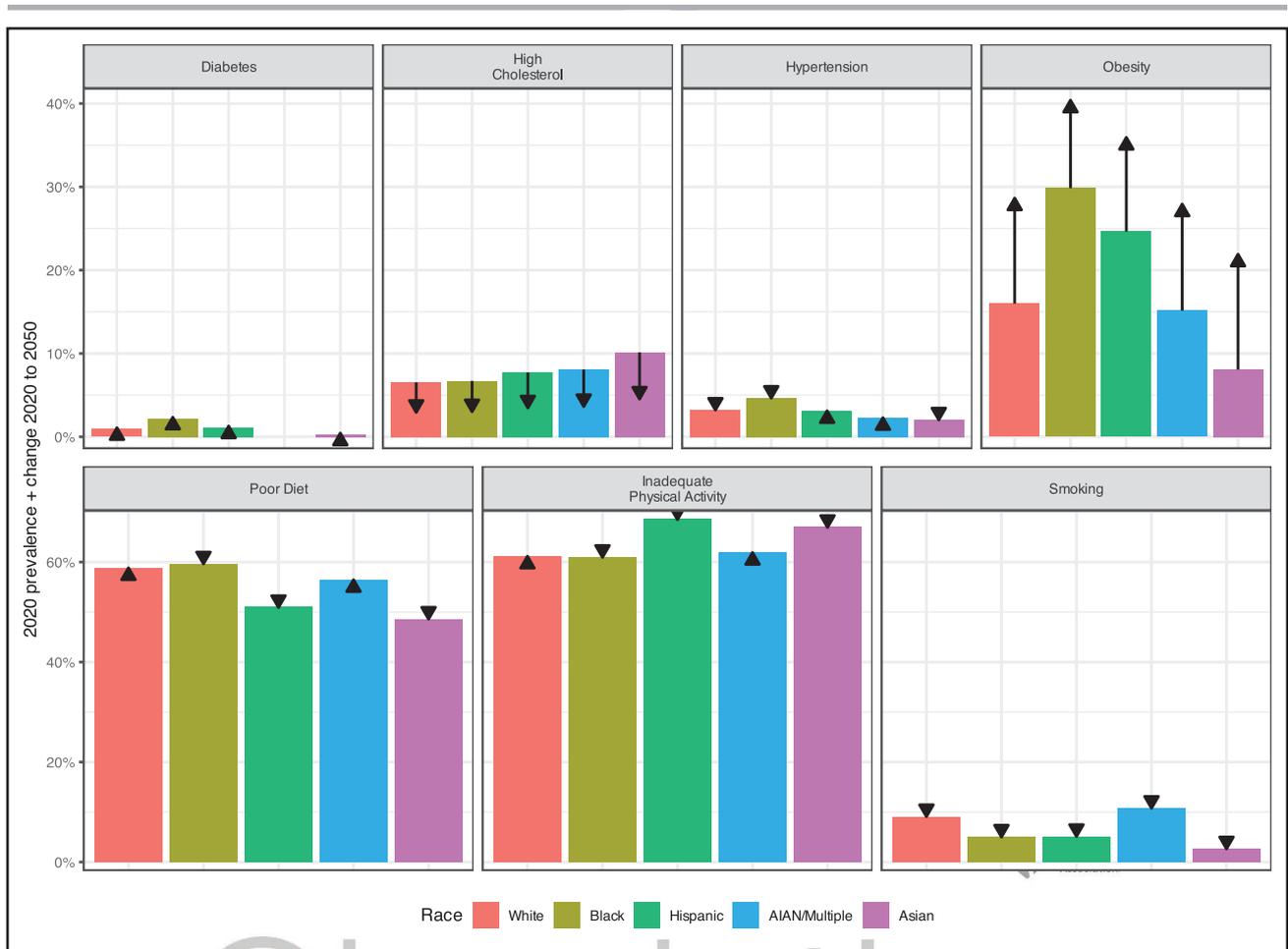
**Figure 6. Prevalence of adverse levels of cardiovascular health behaviors and health factors in U.S. girls, 2020 and 2050, by racial or ethnic group.**
Bars represent the baseline estimate for 2020 for each factor; arrows represent the change from 2020 to 2050 and end at the 2050 estimate. For girls, we did not estimate clinical cardiovascular disease because of low prevalence. Girls within the specified age group were included in the corresponding categories: inadequate physical activity, obesity, and poor diet, 2 to 19 years; high cholesterol, 6 to 19 years; hypertension, 8 to 19 years; and diabetes and current tobacco use, 12 to 19 years. AIAN indicates American Indian/Alaska Native.

to a similar degree.[71] Furthermore, the decline in hypercholesterolemia in concert with a rise in obesity, other CVD risk factors, and CVD overall may relate to a shift in American diets toward highly processed, high-sugar foods and suggests a need for more attention in this area.

Considerations: (1), Chronic disease management should be a focus of ongoing clinical and policy efforts toward improving women's health, including supporting early intervention, team-based care, and digitally enabled care. (2), The sex-specific effects and safety of emerging obesity therapies should be studied.

## Clinical CVD

### Coronary Heart Disease

In association with adverse trends in risk factors, the prevalence of CHD is projected to rise in every age cat-egory and race and ethnicity group through 2050. Historically, women have had lower rates of revascularization and received less evidence-based care for CHD events than men.[72,73] Although these gaps have narrowed, they remain particularly salient for younger women.[8] However, attention needs to remain on optimizing care for women experiencing acute myocardial infarction and other forms of CHD to ensure high-quality treatment for all.

## Heart Failure

The rising prevalence of HF in women reflects the combined impact of an increasing burden of risk factors and the rising prevalences of CHD and AF. Risk factors such as diabetes, hypertension, and obesity are more likely to lead to HF among women than men.[74] Women with HF are more likely than men with HF to have preserved left ventricular ejection fraction, a form of HF with fewer treatment options.[75] New, possibly sex-specific approaches to prevention, diagnosis, and

management will be needed to limit the burden of HF for women, particularly among those with preserved ejection fraction.[74] Clinical trials in women of medical therapies for the management of HF for preserved ejection fraction are sorely needed and should include attention to potential heterogeneity of treatment effect for women compared with men and to different rates of adverse drug events and medication discontinuation for women compared with men.

### Stroke

Women have a higher burden of stroke than men, are less likely to receive treatments such as thrombolysis and thrombectomy, and are more likely to have poor outcomes than men.[76,77] In addition, stroke in midlife has profound economic implications with regard to health care use and lowered quality of life, as well as implications for caregiving, particularly among women.[27,78] Drivers of increased stroke incidence in younger women may include the concomitant increased prevalence of hypertension in this age group and increases in hypertensive disorders of pregnancy,[79] which are associated with short- and long-term risk of stroke.[80] In addition to prevention, as discussed previously, it is important to ensure that women experiencing strokes have adequate access to thrombolysis, thrombectomy, and other interventions.

## Atrial Fibrillation

Women are at higher risk of stroke with AF than men[81] yet receive less anticoagulation[82] and less rhythm control[83] than men, which can lead to poor outcomes, including both stroke and HF. The increasing prevalence of AF is related in part to increases in hypertension and obesity; thus, management of chronic disease is important for preventing AF. Further interventions are needed to improve rates of use of anticoagulation when indicated, and shared decision-making should incorporate sex-specific risk factors.

## Brain Health

The increasing prevalence of cardiovascular risk factors and clinical CVD, particularly hypertension and stroke, has major implications for brain health in women. Strokes cause cognitive impairment and dementia directly but can also signal underlying cerebral small-vessel disease, a contributor to both vascular dementia and Alzheimer disease.[84] Conversely, optimizing cardiovascular health through hypertension control, exercise, and diet effectively supports brain health by reducing the risk of mild cognitive impairment.[85–88] Sex differences exist for dementia risk,[89] and tailored strategies for maintaining optimal brain health in women should be investigated.

Considerations: (1), For the acute presentation of illness for myocardial infarction and stroke, quality improvement programs are needed to ensure that women receive high-quality care and adequate treatment. (2), For chronic disease management in AF and HF, new approaches to management may be needed that incorporate sex-specific factors into shared decision-making and treatment. (3), Brain health, particularly dementia, should be considered an important part of CVD prevention and treatment in women.

## Cardiovascular Risk Throughout the Reproductive Life Span: Opportunities for Intervention

### Puberty, Menarche, and Adolescence

Understanding risk factor development in girls is crucial, and markers of differential risk appear early. Menarche before 12 years of age is associated with increased risk for CVD[90] and is mediated by higher risks for obesity, hypertension, and impaired glucose metabolism as women age.[91,92] The median age at menarche continues to decrease in the United States and at 11.9 years[93] may portend worsening CVD trends beyond 2050. Women with irregular or absent menstrual cycles in adolescence and young adulthood also have higher risks of CVD, even after adjustment for other CVD risk factors.[94] These findings reinforce the importance of menstrual history assessment for cardiovascular health promotion.

### Women of Reproductive Age and Pregnancy

An especially concerning finding of our study is the projected rise in many adverse health behaviors and factors in women of reproductive age. This is a life stage during which women are more likely than men to attend primary care visits, leaving ample opportunity for risk factor detection and control.[95] Intervention in the reproductive years through multidisciplinary collaboration between obstetrician-gynecologists, internists, and subspecialists should improve the screening and treatment of diabetes, lipid abnormalities, hypertension, mental health issues, and subclinical CVD.[96,97] Coronary calcium scoring could further risk stratify women in this age group, who are often overlooked for cardiovascular screening but who have particularly poor outcomes when cardiac events do occur.[98,99]

Prepregnancy cardiovascular health affects pregnancy and obstetric outcomes.[100–102] In addition, suboptimal maternal cardiovascular health, including excessive weight gain during pregnancy, has intergenerational impact with short-term and long-term effects on the offspring such as macrosomia, congenital abnormalities, obesity and excessive weight gain, hypertension, impaired glucose tolerance, and increased risk of future

CVD.[103–105] Hypertension screening, diagnosis, and control during pregnancy is an increasingly important issue, with a need for continued codification of postpartum hypertension management as more evidence emerges about the short- and long-term consequences of the hypertensive diseases of pregnancy, including coronary calcification and HF.[106,107] There is a need to focus on addressing adverse SDOH, improving health literacy, reducing barriers to attaining adequate physical activity, providing access to health care and food, and reducing psychological stressors in girls and women of reproductive age to mitigate these concerns.[108]

### Menopause

Individuals entering the menopause transition (perimenopause and menopause, 45–64 years of age) also demonstrated adverse trends in disease prevalence. Over the past 2 decades, longitudinal studies of women going through menopause[109–113] have helped differentiate the influence of chronological aging from ovarian aging on cardiovascular health and identified adverse shifts in body composition, lipids and lipoproteins, and vascular function accompanying menopause.[110–119] In addition to the pronounced sex hormone changes, vasomotor symptoms, sleep problems, and adverse changes in mental health have implications for women's cardiovascular health.[120–123] Although multiple adverse changes in cardiometabolic health parameters occur simultaneously during menopause, clinical trials incorporating multiple interventions focused on symptoms or lifestyle measures to reverse risk of CVD are lacking, and the best timing of lifestyle interventions remains unclear. The impact of hormone therapy on risk also remains unclear, with newer hormone formulations requiring investigation, especially in women with vasomotor symptoms and low risk.[109]

Considerations: (1), Pediatricians should be aware that early menarche may carry adverse prognostic information, and menstrual history should be considered part of a cardiovascular risk assessment. (2), Multidisciplinary collaborations in women's health should allow integrated care for prepregnancy, peripartum, and postpartum care across disciplines. (3), Studies should assess lifestyle interventions and hormone therapy in terms of their effect on CVD risk and outcomes around the time of menopause.

## Considerations for Demographic Determinants of Health and SDOH

### Race and Ethnicity

Specific attention should be paid to differences in cardiovascular risk factors and outcomes in different racial and ethnic groups. Black girls and Black women have more cardiovascular risk factors; are less likely to have access to care, to be diagnosed, and to receive treatment; and have higher rates of morbidity and mortality compared with their White counterparts.[124,125] Despite decades of knowledge of these health inequities, major gaps remain, suggesting that we need broad interventions across the life span to address inequities in cardiovascular risk factors in girls and women.

### Social Determinants of Health

SDOH are recognized as important drivers of health outcomes and represent crucial targets for cardiovascular health interventions.[126–128] Women disproportionately bear the burden of poverty in the United States and are more likely to delay or forego health care because of costs.[129] Independent contributors to increased HF risk in Black women include a lower household income,[130] whereas residing in a rural area is a risk factor for both Black women and White women.[131] Among adults <75 years of age, greater SDOH burden is associated with higher stroke risk.[132] To mitigate the future risk of CVD in women, it will be essential to implement targeted interventions that address both traditional risk factors and SDOH.[127]

Considerations: (1), Specific programs should be developed that acknowledge and address the elevated risk of CVD in Black women. (2), Attention should be paid to the intersection of SDOH and medical risk factors, and setting-specific interventions should be developed to improve cardiovascular health.

## Broader Policy and Public Health Implications

This sobering forecast of CVD risk factors and disease in women is consistent with other forecasting efforts,[133,134] albeit not sex-specific ones, and has enormous public health and societal implications. These findings are combined with an overall decreased awareness that CHD is the number 1 killer of women, especially among the women at highest risk.[135] It is important to note that these trends related to modifiable risk factors are not set in stone: Simulation studies suggest that incident CVD and stroke events, including death, could be reduced by 17% to 23% by reducing the prevalence of health factors such as hypertension, hypercholesterolemia, diabetes, and obesity by 10%.[5] Strategies for screening in women across the life span, including attention to both traditional and female-specific risk factors, can alert clinicians to these enhanced risks, increase awareness in both women and their clinicians, and allow early implementation of interventions to improve the health factors and behaviors that are identified.[80] The *Lancet* Women and CVD Commission recommendations for reducing the global burden of CVD by 2030 support targeting public health strategies that increase awareness of CVD in women; targeting established, sex-specific, and

underrecognized risk factors; and strengthening health-care systems and engaging health-care professionals about these risks.[136] Reversing the trends of CVD in women would positively affect families, the workplace, and society as a whole.

## Limitations and Knowledge Gaps

In addition to methodological limitations as published,[5] we acknowledge that this analysis does not include prevalence estimates for other cardiovascular conditions with known sex differences in prevalence and outcomes, including valvular heart disease and specific cardiomyopathies. Cardiac arrhythmias (excluding AF) and conduction disorders are not addressed here. Growth and decline factors were not calculated separately by sex. Thus, differences in projections between males and females reflect differences in prevalence and demographics alone; trend differences by sex were not examined in this study. We were not able to incorporate sex-specific risk factors into this analysis. Race and ethnicity are social constructs and do not necessarily imply biological differences. These broad categories, however, offer valuable insights into social factors such as racial identity and lived experiences that influence cardiovascular health. Results presented here do not account for other SDOH at the individual (educational attainment, income, employment), interpersonal, community, or societal level.[128] The interplay between gender and sex and issues specific to the transgender community were not included in our modeling because of data limitations and represent areas of important future work. Our projections did not account for the COVID-19 pandemic or the potential impact of new pharmaceuticals or procedures. These projections should be updated at regular intervals to capture evolving changes in the treatment landscape.

## Conclusions

The high burden of CVD in women in the United States is a major problem that will continue to grow over the next 25 years, fueled by an increasing prevalence of multiple risk factors in women across the life span in every demographic group. Sex-specific studies, including clinical trials, would be beneficial to improve the understanding of the causes, manifestations, treatments, and outcomes in women. Public health interventions are needed to limit the impact of CVD on women, along with broad innovations in data collection, screening, diagnosis, and treatment that can be effectively applied to women in all areas of the country, across life stages, and with a diversity of life experiences.

## Disclosures

### Writing Group Disclosures

| Writing group member | Employment | Research grant | Other research support | Speakers' bureau/ honoraria | Expert witness | Ownership interest | Consultant/ advisory board | Other |
|---|---|---|---|---|---|---|---|---|
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†Significant.

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| Sadiya S. Khan | Northwestern University Feinberg School of Medicine | None | None | None | None | None | None | None |
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*Modest.

†Significant.

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