

AHA SCIENTIFIC STATEMENT

Status of Maternal Cardiovascular Health in American Indian and Alaska Native Individuals: A Scientific Statement From the American Heart Association

Garima Sharma, MD, FAHA, Chair; Allison Kelliher, MD, Vice Chair; Jason Deen, MD; Tassy Parker, PhD, RN; Tracy Hagerty, MD; Eunjung Esther Choi, MD; Ersilia M. DeFilippis, MD; Kimberly Harn, MEd, RT(R), (MR); Robert J. Dempsey, MD, FAHA; Donald M. Lloyd-Jones, MD, ScM, FAHA; on behalf of the American Heart Association Cardiovascular Disease and Stroke in Women and Underrepresented Populations Committee of the Council on Clinical Cardiology; Council on Hypertension; Council on Cardiovascular and Stroke Nursing; Council on Arteriosclerosis, Thrombosis and Vascular Biology; and Council on Quality of Care and Outcomes Research

ABSTRACT: Cardiovascular disease is the leading cause of pregnancy-related death in the United States. American Indian and Alaska Native individuals have some of the highest maternal death and morbidity rates. Data on the causes of cardiovascular disease-related death in American Indian and Alaska Native individuals are limited, and there are several challenges and opportunities to improve maternal cardiovascular health in this population. This scientific statement provides an overview of the current status of cardiovascular health among American Indian and Alaska Native birthing individuals and causes of maternal death and morbidity and describes a stepwise multidisciplinary framework for addressing cardiovascular disease and cerebrovascular disease during the preconception, pregnancy, and postpartum time frame. This scientific statement highlights the American Heart Association's factors for cardiovascular health assessment known collectively as Life's Essential 8 as they pertain to American Indian and Alaska Native birthing individuals. It summarizes the impact of substance use, adverse mental health conditions, and lifestyle and cardiovascular disease risk factors, as well as the cascading effects of institutional and structural racism and the historical trauma faced by American Indian and Alaska Native individuals. It recognizes the possible impact of systematic acts of colonization and dominance on their social determinants of health, ultimately translating into worse health care outcomes. It focuses on the underreporting of American Indian and Alaska Native disaggregated data in pregnancy and postpartum outcomes and the importance of engaging key stakeholders, designing culturally appropriate care, building trust among communities and health care professionals, and expanding the American Indian and Alaska Native workforce in biomedical research and health care settings to optimize the cardiovascular health of American Indian and Alaska Native birthing individuals.

Key Words: AHA Scientific Statements ■ Alaska Native ■ American Indian ■ cardiovascular risk factors
■ maternal health ■ pregnancy complications

Cardiovascular disease (CVD) is the leading cause of death among American Indian and Alaska Native individuals,¹ affecting them disproportionately compared with other racial and ethnic groups in the United States. CVD rates are higher than 12% among American Indian/Alaska Native individuals and believed to

be underreported by 21%.² CVD rates are particularly high in younger American Indian/Alaska Native pregnancy-capable individuals, for whom early detection and management of CVD remain paramount for improving cardiovascular health (CVH) and reducing premature death.³ Furthermore, non-Hispanic American Indian/

The content of this article is solely the responsibility of the authors and does not necessarily represent the official view of the American Heart Association; National Heart, Lung, and Blood Institute; Indian Health Services; or the National Institutes of Health or the US Department of Health and Human Services. The authors take responsibility for the decision to submit the manuscript for publication.

© 2023 American Heart Association, Inc.

Circulation: Cardiovascular Quality and Outcomes is available at <http://www.ahajournals.org/journal/circoutcomes>

Alaska Native women have the second highest pregnancy-related mortality ratio according to the Pregnancy Mortality Surveillance System data (2007–2016) provided by the Centers for Disease Control and Prevention.⁴ Recently, the American Heart Association (AHA) updated the definition of CVH by reiterating the strong evidence that important established risk factors and behaviors, that is, Life's Essential 8 (hypertension, dyslipidemia, diabetes, obesity, unhealthy diet, sedentary lifestyle, smoking, and inadequate sleep), are associated with premature death, excess morbidity, and increased hospitalizations.⁵ There are underrecognized risks, including psychological, social, economic, and cultural factors, that is, the social determinants of health (SDOH), that require attention.⁶ Examples include neighborhood safety, food insecurity, lack of access to preventive care, and financial and economic depression; these are often further influenced by sex and contribute to CVD in pregnancy-capable individuals.^{5,7}

Psychological health factors such as anxiety, depression, posttraumatic stress disorder, substance abuse, intimate partner violence, socioeconomic status, and sociocultural roles disproportionately affect individuals who identify as women compared with those who identify as men and are emerging as important considerations in the development and manifestation of CVD in American Indian/Alaska Native individuals.⁸ In addition, sex-specific risk factors such as adverse pregnancy outcomes, which include hypertensive disorders of pregnancy, gestational diabetes, preterm delivery, peripartum cardiomyopathy, and other gynecological disorders such as premature menopause and polycystic ovary syndrome, are increasingly recognized as contributors to long-term CVD risk.⁹

Despite a growing recognition of these factors, data on traditional and sex-specific risk factors in American Indian/Alaska Native pregnancy-capable individuals are limited. Moreover, research on mental, physical, behavioral, or social risk for CVD among American Indian/Alaska Native individuals, particularly those of reproductive age, using a culturally relevant theoretical framework (ie, one developed with culture and the distinct historical context of American Indian/Alaska Native peoples in mind) has been scarce.⁸ Recently, the AHA identified the control of risk factors and community-based interventions that address SDOH as a means of early detection, recognition, and treatment of CVD in American Indian/Alaska Native individuals and outlined a multidisciplinary framework to improve maternal health outcomes in the United States.¹⁰ The purpose of this scientific statement is to synthesize available literature concerning CVH in American Indian/Alaska Native birthing individuals, to highlight disparities, and to provide guidance on developing a framework to reduce adverse maternal outcomes. We focus on the status of CVH and recognize the underpinnings of suboptimal CVH and CVD in these individuals. This document provides an overview of the CVH and adverse maternal health outcomes in this group through

a culturally relevant and social framework. It focuses on providing interventions that take the socioecological framework of CVH into consideration.

For the purposes of this scientific statement, we refer to individuals as females or males on the basis of sex assigned at birth and as women or men on the basis of presumed sex identity. We use the term birthing individuals for women and interchangeably when referring to those of reproductive age throughout this document because the data presented here are not disaggregated according to presumed sex identity. There are limited data on American Indian/Alaska Native individuals and those of diverse sex identities, and for the purpose of this scientific statement, we have combined the data on these groups. We recognize that much of the data are from American Indian individuals, but for the purpose of this scientific statement and because of the lack of disaggregated data in this population, we have combined these groups.

CVH IN AMERICAN INDIAN/ALASKA NATIVE INDIVIDUALS

American Indian/Alaska Native individuals are 50% more likely to be diagnosed with premature CVD than their White counterparts.¹ Although higher prevalence and incidence of CVD morbidity and death exist for American Indian/Alaska Native individuals compared with other racial and ethnic groups, the prevalence of CVD in American Indian/Alaska Native women has declined in recent years.^{11,12} This is likely due to primary prevention efforts that target the common diseases of obesity and diabetes.^{13,14} Despite this, CVD remains the second leading cause of death for American Indian/Alaska Native women, the first being cancer,¹⁵ and the life expectancy of American Indian/Alaska Native individuals declined by an unprecedented 6.6 years between 2019 and 2021. Although the coronavirus disease 2019 (COVID-19) pandemic may have partly contributed to this decline, CVDs and neurovascular diseases are the most dominant causes of death.¹⁶ Life's Essential 8 are modifiable health factors and behaviors that can be applied to CVD prevention for those ≥ 2 years of age, as illustrated in Figure 1. These nonpharmacological interventions may be lower cost and have the added benefit of returning the locus of control to the patient through lifestyle choices. As an example, in an observational study, American Indian/Alaska Native individuals who had greater adherence to at least 2 Life's Essential 8 components had significantly lower risk of developing type 2 diabetes (T2D).¹⁷

Recent data show that $>60\%$ of American Indian/Alaska Native women entering pregnancy have suboptimal CVH, which worsened between 2011 and 2019, with the highest burden of suboptimal CVH in non-Hispanic Black women (71.3% in 2019).^{18,19} A limited number of studies have shown that suboptimal maternal CVH

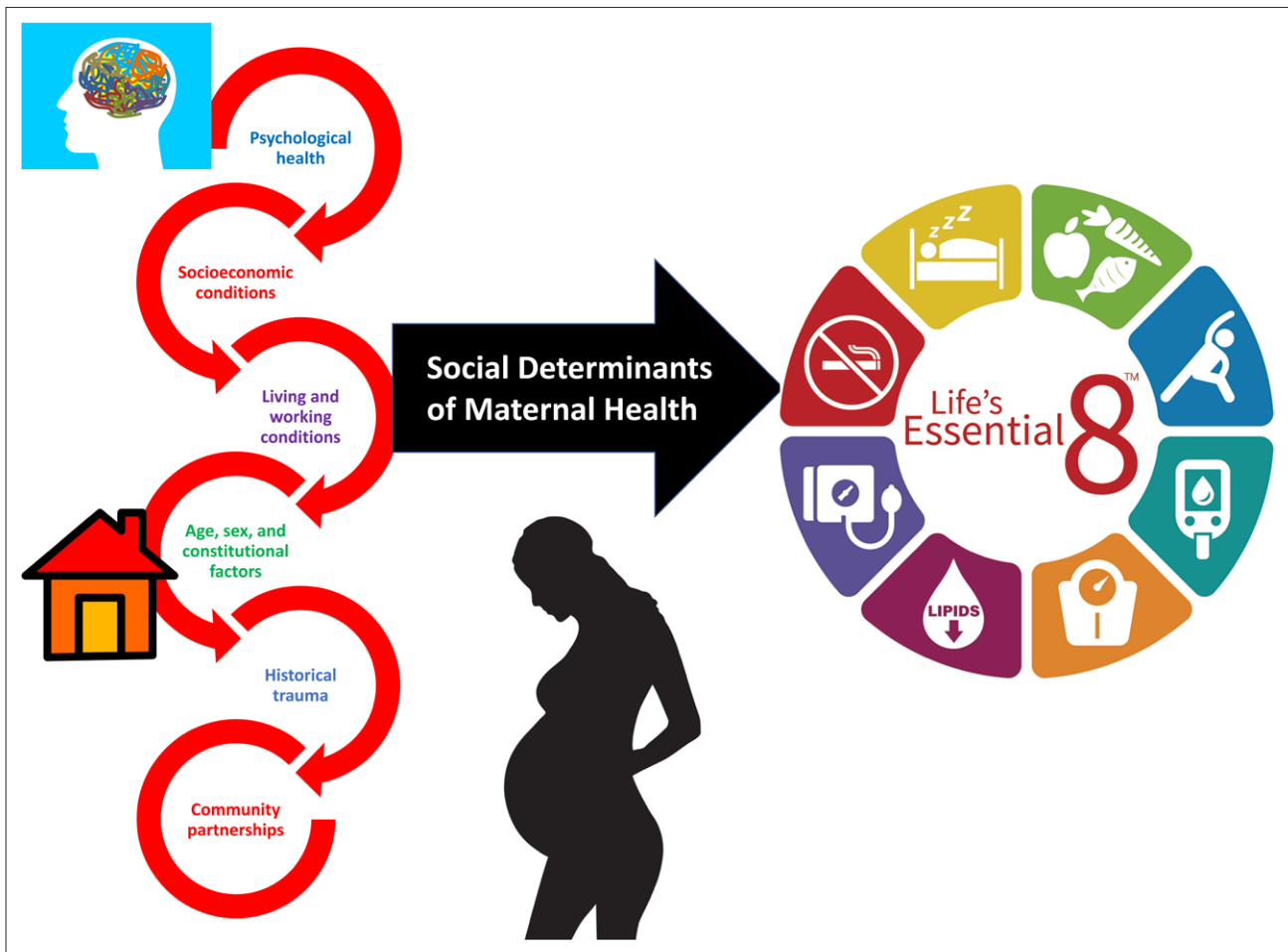


Figure 1. Determinants of cardiovascular health in American Indian/Alaska Native birthing individuals.

Life's Essential 8 image reprinted from Lloyd-Jones et al.⁵ Copyright © 2022 American Heart Association, Inc.

in pregnancy is associated with adverse maternal and fetal outcomes.¹⁹ Suboptimal CVH during pregnancy is also strongly associated with the development of future CVD.²⁰ Hence, there is a critical need to track and characterize CVH from preconception and pregnancy to the postpartum period and to identify modifiable factors and intervention opportunities that can significantly improve pregnancy outcomes. Here, we describe the overall burden of adverse CVH measures in American Indian/Alaska Native pregnancy-capable individuals and their association with other forms of cardiometabolic events, as illustrated in Figure 2.

1. Hypertension: Hypertension is common in American Indian/Alaska Native women, particularly those with T2D and obesity.²¹ When present, hypertension is a strong predictor of CVD.¹² Hypertensive disorders of pregnancy also contribute to maternal death of American Indian/Alaska Native women,²² and those with underlying obesity are at greater risk for developing preeclampsia.²³ Furthermore, American Indian/Alaska Native

women who develop preeclampsia are at risk for developing chronic hypertension.²⁴

2. Dyslipidemia: American Indian/Alaska Native women with T2D display typical diabetic dyslipidemia with high triglycerides and low high-density lipoprotein cholesterol and have an increased risk of CVD and stroke.²⁵ Low-density lipoprotein cholesterol usually is not elevated in these women compared with women of other races with a high prevalence of T2D.²⁵ Despite values below the target of 130 mg/dL, low-density lipoprotein is a significant predictor of CVD in American Indian/Alaska Native women, particularly when typical diabetic dyslipidemia is present. For instance, a 10-mg/dL-higher low-density lipoprotein cholesterol is associated with a 12% higher risk for CVD; however, these data are not specific to this population.²⁶
3. Diabetes: T2D is the predominant CVD risk factor in American Indian/Alaska Native women, with a prevalence of 72% in some communities.²⁷ The T2D age-adjusted prevalence in American Indian/

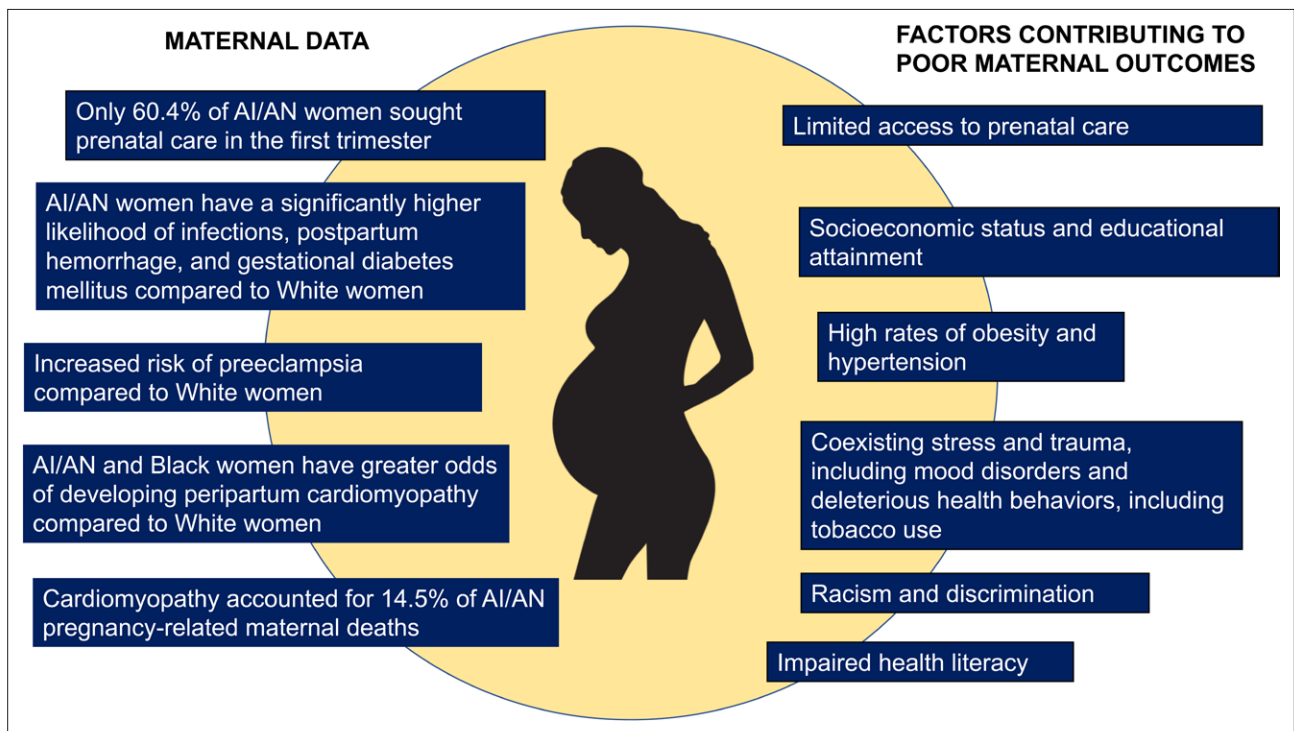


Figure 2. Status of maternal health outcomes in American Indian/Alaska Native individuals.

AI/AN indicates American Indian/Alaska Native.

Alaska Native women is 3 times higher than that in White women, and this disparity begins in the pediatric years.^{28,29} Indeed most of the CVD events in women included in the SHS (Strong Heart Study) of American Indians occurred in those with T2D; such individuals were also more likely to have pathological levels of other CVD risk factors.^{1,30}

4. **Obesity:** Obesity affects almost half of American Indian/Alaska Native women, the pathological beginnings of which start early in life.^{31,32} It contributes to an increased risk for CVD and coexistent CVD risk factors such as hypertension, T2D, sleep apnea, and cardiomyopathies. The confluence of these then leads to increased morbidity and death. Nearly a quarter of American Indian/Alaska Native adolescents meet criteria for metabolic syndrome, increasing death with 2-fold risk of CVD, and a 5-fold risk of developing T2D.¹¹ Further underscoring the risk of obesity, a childhood body mass index in the highest quartile was associated with premature death in American Indian/Alaska Native children.²⁸
5. **Diet:** In addition to limited physical activity, unhealthy diet has contributed to a significant increase in obesity, T2D, and subsequent CVD in American Indian/Alaska Native women.³³ Whereas many communities struggle to meet AHA dietary guidelines, with only 10% of the population meeting recommendations, options are even more limited for American Indian/Alaska Native pregnancy-capable individuals as a result of a multitude of factors

such as living in underresourced, high-need areas with limited access to healthy food options and lack of reliable transportation, as well as economic depression.^{34–36}

6. **Physical activity:** Augmenting physical activity is a cornerstone of CVD prevention programs. Most women in the SHS reported some leisure or occupational activities, most commonly walking, gardening, or dancing.³⁷ Other cohorts have documented waning amounts of physical activity in American Indian/Alaska Native women as they age.³⁸ Women engaging in even modest amounts of physical activity had attenuated prevalence of T2D.^{37,39,40} Addressing the underlying contributors to sedentary lifestyle in American Indian/Alaska Native individuals is key; without safe outdoor space, sidewalks, and access to fitness options for those with morbid obesity and joint limitations, improvements in this area will be limited.
7. **Nicotine exposure:** American Indian/Alaska Native adults report greater cigarette smoking compared with individuals of other races²⁸; approximately one-third of American Indian/Alaska Native women smoke.⁴¹ Of American Indian/Alaska Native birthing individuals in 2016, 7.2% smoked cigarettes during pregnancy, influencing their health and the health of their fetus.²⁸ Approximately half of US children 3 to 11 years of age are exposed to nicotine delivery product secondhand smoke or vapors. Electronic cigarettes are the most commonly used

tobacco product in US adolescents, and more information is needed on the prevalence of use among American Indian/Alaska Native individuals.²⁸

8. Sleep: The new sleep metric suggests that 7 to 9 hours of daily sleep is necessary for optimal CVH for adults, more for children depending on age. Limited sleep duration is associated with both T2D and CVD in American Indian/Alaska Native women.⁴² Obstructive sleep apnea is also more prevalent in American Indian/Alaska Native women, likely because of the high prevalence of obesity, which is subsequently associated with atrial fibrillation, stroke, CVD, sudden death, arterial hypertension, pulmonary hypertension, right-sided heart dysfunction, and heart failure.⁴³

STATUS OF MENTAL HEALTH AND SUBSTANCE USE DISORDERS IN AMERICAN INDIAN/ALASKA NATIVE INDIVIDUALS

Institutional racism operates in mutually reinforcing systems⁴⁴ and increases vulnerability to diseases of despair, including suicidality, drug abuse, and alcoholism.⁴⁴ The systematic acts of colonization, dominance, and exploitation of American Indian/Alaska Native people and lands, in conjunction with the structural determinants of health and SDOH, are the mutually reinforcing systems through which racism and discrimination shape the health of American Indian/Alaska Native individuals. Despite vast geographic and cultural differences among American Indian/Alaska Native women, they often share common experiences of racism and discrimination and the unresolved grief, ongoing abuse, and mistreatment that set the stage for early-onset depression, anxiety, and alcohol and illegal drug use.⁴⁵ Structural racism creates and maintains an environment in which toxic stress leads to adverse childhood experiences (ACEs). Notably, American Indian/Alaska Native women have disproportionately high ACE scores,⁴⁵ which increase the likelihood of high-risk behaviors and chronic diseases in adulthood. Systemic, domestic, and lateral violence can negatively affect their lifelong health and opportunity.⁴⁶

American Indian/Alaska Native adolescents report significantly higher symptoms of depression, generalized anxiety, and racial discrimination and are more likely to initiate substance use compared with all other adolescents of underrepresented races and ethnicities.⁴⁷ These factors widen the gap of greater relative risk for American Indian/Alaska Native youth for the use of cocaine, methamphetamines, and psychedelics.⁴⁸ American Indian/Alaska Native adolescents have a suicide rate 1.5 times higher than that of the general population.⁴⁹ In 2014, suicide rates for American Indian/Alaska Native

birthing individuals 15 to 19 years of age were 3 times higher than for their White peers.⁵⁰

More than 84% of American Indian/Alaska Native women experience some form of violence in their lifetime,⁵¹ including sexual violence and physical violence by intimate partners.⁵¹ Homicide rates for American Indian/Alaska Native women are >10 times the national average in some counties and overall are 2.8 times that of White women.⁵² More than 90% of sexual violence against American Indian/Alaska Native women is committed by non-American Indian/Alaska Native individuals.⁵³ Furthermore, American Indian/Alaska Native women experiencing violence are more likely to be physically injured and to miss work or school and less likely to have access to needed services compared with White women,^{51,53} perpetuating the low socioeconomic status or SDOH of American Indian/Alaska Native women. These staggering statistics of interracial violence against American Indian/Alaska Native women and the disproportionate burden of negative SDOH could not occur without the mutually reinforcing system of federal, state, and local policies and law, Federal Indian law, and jurisdictional conflicts (structural determinants of health) that fail to protect American Indian/Alaska Native women and girls.⁵⁴

American Indian/Alaska Native women's mental and behavioral health disparities reflect the toxic stress and trauma of violence. The lifetime prevalence of mental health conditions such as mood disorders (44%) and anxiety (62.8%) and a lifetime drug and alcohol use disorder prevalence of 65% reflect the colonial stratification that marginalizes American Indian/Alaska Native women across the life span and increases their risk for early onset of coexistent medical conditions such as T2D, hypertension, and liver disease.^{55–57}

STATUS OF MATERNAL HEALTH IN AMERICAN INDIAN/ALASKA NATIVE BIRTHING INDIVIDUALS

Pregnancy Mortality Surveillance System data (2007–2016) provided by the Centers for Disease Control and Prevention show an overall pregnancy-related mortality ratio (pregnancy-related deaths per 100 000 live births) of 17.3 for the general population of US women in 2018, which has been increasing steadily over the past 3 decades.⁴ According to the Pregnancy Mortality Surveillance System data, the pregnancy-related mortality ratio is highest in non-Hispanic Black women (41.4), followed by non-Hispanic American Indian/Alaska Native women (26.5). Higher maternal death in the American Indian/Alaska Native population was consistently observed over time and across all age groups, although the American Indian/Alaska Native to White disparity was most notable in those 35 to 40 years of age (odds ratio, 5.1).⁵⁸ According to the newest data from the Pregnancy Mortality Surveillance

System,^{58a} the maternal mortality ratio has worsened to 176. In non-Hispanic Native Hawaiian or other Pacific Islander individuals, the number of pregnancy-related deaths per 100 000 live births is 62.8; in non-Hispanic Black individuals and American Indian/Alaska Native individuals, it is 39.9 and 32.0, respectively. Cardiomyopathy accounted for 14.5% of American Indian/Alaska Native pregnancy-related maternal deaths, which was higher than in any other racial and ethnic groups (14.2% for Black and 10.2% for White women).⁵⁸ Other cardiovascular complications, including congenital heart disease, accounted for 11.1% of American Indian/Alaska Native maternal deaths, which was a smaller proportionate cause of death than in other racial and ethnic groups.^{4,22} American Indian/Alaska Native women with at least some college education have a higher pregnancy-related mortality ratio than non-Black women with less than a high school diploma.⁵⁸

Despite clear ethnic and racial disparities seen in maternal health, the reported number of pregnancy-related deaths may still be underestimated with the current racial and ethnic classification used in the medical literature. For example, American Indian/Alaska Native women are often classified as other race or ethnicity, and American Indian/Alaska Native birthing individuals with some Hispanic background may be classified as Hispanic, leading to underestimation of American Indian/Alaska Native women affected by maternal death and morbidity.⁵⁹ Therefore, data are needed on American Indian/Alaska Native individuals who identify with more than 1 race to determine accurate maternal death and morbidity rates.

Data from the Indian Health Service (IHS) suggest that American Indian/Alaska Native individuals have long experienced a lower life expectancy (5.5 years less than for all other races) and a higher burden of chronic diseases.⁶⁰ A retrospective cohort study of 206 428 pregnant women examining disparities in maternal morbidities has shown that American Indian/Alaska Native women have a significantly higher likelihood of developing infections, postpartum hemorrhage, and gestational diabetes than White women.⁶¹ According to the Urban Indian Health Program data, American Indian/Alaska Native pregnant women were 1.4 times more likely to be diagnosed with gestational diabetes than non-Hispanic White women, and the likelihood of gestational diabetes increased as maternal age increased.⁶²

In a retrospective study using hospital discharge data from Washington State, American Indian/Alaska Native women were found to have a higher risk of preeclampsia compared with White women (odds ratio, 1.17 [95% CI, 1.06–1.29]), although this racial disparity was attenuated after adjustment for body mass index.²³ In the Urban Indian Health Program service areas, only 60.4% of American Indian/Alaska Native women sought prenatal care in the first trimester compared with 81.6% of non-Hispanic White women. Rural versus urban disparities that exist in maternal health are particularly pervasive in American Indian/Alaska

Native women; 40% live in reservation, rural, or frontier communities with limited access to health care.^{63,64} There is an urgent need to address these growing disparities in maternal health in American Indian/Alaska Native individuals at the community and national levels.⁶⁵

MATERNAL CEREBROVASCULAR EVENTS IN AMERICAN INDIAN/ALASKA NATIVE INDIVIDUALS

Among all racial and ethnic groups, American Indian/Alaska Native individuals have the highest rate of risk factors for stroke, many of which overlap with those for cardiac disease.⁶⁶ The peripartum period represents a time when American Indian/Alaska Native women are at great risk of both ischemic and hemorrhagic strokes.⁶⁵ This is confounded by the ongoing impact of COVID-19, with hospitalization for American Indian/Alaska Native individuals and excess deaths at a rate 3.5 times higher than for White individuals, decreasing their life expectancy by 6 years.⁶⁷

Data also show that the mortality rates in the American Indian/Alaska Native population are skewed toward young individuals, are higher than for any other races and ethnicities, and are affected by racial misclassification and underdiagnosis.⁶⁶

Maternal care for American Indian/Alaska Native women must address traditional as well as social and cultural determinants of health. Common risk factors such as T2D, obesity, smoking, and premature atherosclerosis are aggravated in American Indian/Alaska Native individuals by chronic stress, intergenerational trauma, lateral trauma, ACEs, and food insecurity.

MATERNAL HEART FAILURE OUTCOMES IN AMERICAN INDIAN/ALASKA NATIVE INDIVIDUALS

Data remain limited on heart failure–specific outcomes among American Indian/Alaska Native pregnancy-capable individuals given their underrepresentation in heart failure clinical trials and overall registries. Recent data demonstrated that the age-adjusted heart disease–related death rate was 70.0 per 100 000 for American Indian/Alaska Native women compared with 82.7 for non-Hispanic White females and 88.9 for non-Hispanic Black women, but cause-specific death resulting from heart failure was not well reported.²

Higher rates of obesity, T2D, and hypertension in this population¹ place these patients at higher risk for incident heart failure. Similarly, for pregnancy-capable individuals, chronic hypertension or hypertensive disorders of pregnancy increase the risk for peripartum cardiomyopathy in White, Black, and Hispanic women.⁶⁸ In an analysis of the National Inpatient Sample, after adjustment for

clinical and socioeconomic factors, Black and American Indian/Alaska Native women had greater odds of developing peripartum cardiomyopathy compared with White women.⁶⁹ More data are needed in this area to better inform risk stratification tools and preventive strategies for these women. For select patients with advanced heart failure, heart transplantation remains the gold standard therapy to improve quality of life and survival.⁷⁰ According to the Organ Procurement and Transplantation Network, in 2022, American Indian/Alaska Native individuals accounted for 16 of 4111 (0.4%) of the total heart transplant recipients compared with 26.2% (n=1076) for non-Hispanic Black individuals and 13.1% (n=537) for Hispanic individuals.⁷¹ Similarly, as of February 2023, 12 of 3366 individuals (0.4%) on the wait list for heart transplantations identified as American Indian/Alaska Native compared with 28.3% for non-Hispanic Black individuals and 12.0% for Hispanic individuals.⁷¹ Rather than reflecting a lack of need for advanced heart failure therapies, these numbers more likely reflect a lack of access to specialized care or cultural differences in the management of heart failure.

ADDRESSING CVH IN AMERICAN INDIAN/ALASKA NATIVE INDIVIDUALS WITH MULTILEVEL INTERVENTIONS

A multitude of SDOH and historical determinants of health, including history of genocide, decimation of tribal governance, forced removal from homelands, breach of treaty obligations, and forced boarding school

participation among American Indian/Alaska Native children, have led to intergenerational trauma and its associated poor health outcomes.¹ Unfulfilled treaty agreements and the destruction of peoples and cultures have contributed to a general mistrust in the government among many American Indian/Alaska Native communities.¹ In addition, American Indian/Alaska Native individuals have experienced unethical research practices, including forced sterilization, and culturally insensitive studies have resulted in mistrust of the research community that requires resolution to identify strategies that can improve health outcomes, including CVD and maternal death.¹ Here, we describe a framework for addressing, evaluating, and optimizing the CVH of this population with a focus on prevention, policy, and cultural humility and safety. The health of American Indian/Alaska Native communities depends on the collaborative efforts of policymakers, health care professionals and systems, tribal governing structures, and local community engagement (Table).

1. Addressing mental health and substance abuse and SDOH: Establishing a framework free of stigma and judgment allows a cultural safe harbor to address American Indian/Alaska Native women's mental health and substance use within the context of structural racism and a long history of genocidal policies and poor treatment of American Indian/Alaska Native individuals by the US government. Health systems and community-based organizations that identify trauma and teach and celebrate resilience are essential to address

Table. Policy-Level Framework and Interventions to Optimize Maternal CVH in American Indian/Alaska Native Individuals

Areas of intervention	Suggested solutions	Gaps and challenges
Integrated care delivery models	Provide appropriate screening and transfer of individuals with high-risk pregnancies to higher levels of care with multidisciplinary team-based care in preventive cardiology, maternal-fetal medicine, cardio-obstetrics, and psychiatry. Provide contraceptive care and shared decision making around termination. Initiate first-line management of complications and adherence to quality bundles and initiatives to reduce death and morbidity.	Data collection, aggregation, and transfer of maternal health outcomes Lack of AI/AN disaggregated data in PMSS Rural landscape, lack of access to housing, particularly in tribal settings, and staffing shortages
Organization of care	Develop an available, accessible, affordable, and competent workforce that integrates community voices and AI/AN traditions into culturally sensitive care. Ensure shared decision making that includes AI/AN and tribal representation. Incorporate midwives, social workers, mental health counselors, doulas, AI/AN traditional healers, knowledge bearers, birth workers and peers, community health workers, and physician extenders into care. Expand digital and telehealth in resource-limited areas as a supplement to existing care resources but not as a substitute for care and to provide sufficient resources to these areas.	Increase the financial resources currently being deployed, and strategically increase investment in tribes, IHS facilities, and culturally safe community-based programs by earmarking funds for this purpose. Telemedicine may not reach AI/AN community members with severely limited means. Reimbursement structures are not inclusive of necessary collaborators such as AI/AN traditional healers, birth workers, and midwives.
Innovative practice categories	Improve health education and health promotion in Life's Essential 8 metrics from childhood throughout childbearing age. Improve preconception, antenatal, and postpartum CVH measures.	High burden of cardiovascular comorbidities and low preventive care services
Values and philosophy	Build trust with respect, communication, and community knowledge, and understand the needs of reproductive-aged individuals. Deliver care tailored toward creating understanding historical perspective, childhood trauma, and circumstances unique to maternal needs.	Assess childhood trauma in individuals and population and develop strategies to mitigate it.

AI/AN indicates American Indian/Alaska Native; CVH, cardiovascular health; IHS, Indian Health Service; and PMSS, Pregnancy Mortality Surveillance System.

mental and behavioral health needs and to promote healing of American Indian/Alaska Native women, families, and communities. Numerous social factors have a negative impact on the health of American Indian/Alaska Native adults who have endured long-standing poverty at a much higher rate than other populations. American Indian/Alaska Native peoples also have the lowest educational attainment in the nation.⁷² Racism and discrimination are also linked to poor health outcomes.⁷³ Toxic stress during adulthood, including poverty, racism, substance abuse, and other challenges, has also led to poor health outcomes across the life course. These SDOH can have an impact on intergenerational health disparities, including heart disease and maternal death. A multifaceted collaboration among American Indian/Alaska Native individuals and key stakeholders is needed to address the upstream SDOH such as socioeconomic status, social class, and educational attainment. These stakeholders include tribal nations, the National Indian Health Board, the IHS, the National Indian Education Association, the National Congress of American Indians, the National Council of Urban Indian Health, the AHA, and federal and state policymakers. Improving the education and competency of health care professionals and providing opportunities to address mental health and substance abuse rehabilitation for individuals are of critical importance.

2. Improving preventive health services and cultural competency: The personal stories of American Indian/Alaska Native women living with heart disease can be a rich resource for those trying to shape effective prevention and treatment programs, and they should be considered in the context of the family and community. Health workers and researchers must listen to these real-life stories shared by the ambassadors who tell them. In turn, these women can also help reach others in the community and educate policymakers. Women are stewards of their own health and play important roles as health opinion leaders in safeguarding the health of their families and communities. Reaching out to those who are at risk—directly and indirectly through their personal relationships and service professionals—can be highly effective. Likewise, enlisting help from women who hold traditional leadership roles is critical; they can help guide and implement effective heart-health programs. This approach allows many voices to carry the same messages and spreads the responsibility to protect women's health across the community.
3. Improving maternal care and reducing disparities: Approximately 40% of American Indian/Alaska Native individuals live in rural areas (a substantially

higher percentage than in other racial and ethnic groups), and residents living in rural areas face heightened risks of severe maternal morbidity and death⁷⁴ and lack of access to screening and diagnostic tools. Hence, it is essential to document the problem and to identify contributing factors, but this is difficult because data on maternal death among American Indian/Alaska Native individuals are not consistently reported. American Indian/Alaska Native maternal deaths are classified in an "other" racial and ethnic category in which the American Indian/Alaska Native proportion could be anywhere from 0% to 100%, complicating interpretation of American Indian/Alaska Native maternal death in the Centers for Disease Control and Prevention statistics. The lack of disaggregated data prevents accurate assessment for determining the leading cause(s) of American Indian/Alaska Native pregnancy-related deaths and the design of interventions to reduce them.

There are limited community-based American Indian/Alaska Native voices in policy discussions on maternal health and limited resources and access to local and culturally centered services.⁷⁵ With long-term underfunding of the IHS, many IHS facilities do not provide obstetric care; consequently, many American Indian/Alaska Native individuals give birth outside of the IHS.⁷⁶ These inequities in health care availability, access, and use warrant urgent attention to decrease American Indian/Alaska Native maternal death. Use of trained nurse midwives could play a key role; midwife-led care can be an important contributor to improved quality of care and perinatal outcomes, in addition to improved delivery care coordination, home visiting, and peer support in rural areas.^{64,74,77,78} Empowering and educating the tribal communities to conduct their own community health assessments to prioritize their value and philosophies into maternal care could also be an option.

4. Treating pregnancy as a window of opportunity for CVH promotion: Many American Indian/Alaska Native communities consider pregnancy a sacred time for passing traditional wisdom to the expectant parents. Because women may be more likely to make healthy lifestyle changes—more for their children than for themselves—this can be an ideal time to encourage women to improve their heart health. For expectant mothers, heart disease raises the risk not only of early disability and death but also of passing on risk factors to their children, including obesity and T2D. Improving the status of preventive care, preconception counseling, and postpartum patient and family education on triggers and warning signs of CVD and improving the

early warning triggers of decompensation through systems of care quality improvement are needed, as recently outlined in the AHA maternal health policy statement.¹⁰

5. Addressing ACEs. Compared with other US demographic groups, American Indian/Alaska Native individuals have high rates of ACEs such as neglect, abuse, or parental incarceration.⁴⁵ Because ACEs have been linked to heart disease,⁷⁹ addressing them at the community and individual levels should be an early part of any intervention aimed at improving CVH in American Indian/Alaska Native women and girls.⁸⁰ Strengthening and fortifying existing family connections and improving family functioning by referring youth and parents to mental health services, parenting programs, and social services may help address the effects of trauma and reduce additional family stressors for patients with a history of ACEs.⁸¹
6. Developing community partnerships in research and the American Indian/Alaska Native workforce: Partnerships among American Indian/Alaska Native communities and researchers are essential. Data suggest that American Indian/Alaska Native researchers, teams, and communities are increasingly partnering to develop and test culturally centered, community-driven health promotion interventions to improve health outcomes.¹ The largest study to accomplish this in the American Indian/Alaska Native population is the SHS, in which research teams have incorporated community-based, participatory research processes. They obtain community input and consent for all activities and provide study findings to community members and the tribe.¹ Efforts to address the disproportionate burden of heart disease in American Indian/Alaska Native women cannot succeed without clinicians, educators, and researchers who understand the culture and life experiences of these women. Managing translation research data with increased agency and representation of American Indian/Alaska Native individuals in the biomedical workforce is extremely important. Sovereignty over clinical, genetic, and other biomedical data from research and public health surveillance is a top priority for American Indian/Alaska Native communities. It should be coupled with support from researchers and federal health agencies to analyze, interpret, and translate the data into clear, actionable terms for community leaders. Data ownership and translation can empower leaders to optimize health programs necessary for the individuals in their communities to thrive. Although many gaps in care for CVD continue to challenge American Indian/Alaska Native birthing individuals, many

cultural strengths and systems can be maximized to influence the future health of this population. Female extended family members and mothers play a key role in American Indian/Alaska Native communities. The challenges with data require us to address the underestimations, lack of representation, and misclassification of illness that occur secondary to underreporting.^{28,82} Much of our data and understanding of American Indian/Alaska Native health come from the IHS. Integration of electronic health records across the IHS and harmonizing the data collection help streamline the efforts as well. Improved systems for recruiting and retaining American Indian/Alaska Native individuals into research must be created with American Indian/Alaska Native involvement, incorporating IHS, tribal, urban, and other health settings.

CONCLUSIONS

The CVH of American Indian/Alaska Native pregnancy-capable individuals is affected by a multitude of factors such as structural and institutional racism, ACEs, unresolved grief, and early-onset depression, which likely lead to the documented issues of worse maternal outcomes and increased death. Key stakeholders across the spectrum of government, public health, health care systems, and public policy must recognize these important disparities and work on ways to collaborate and devise policies for improving the CVH of this high-risk group of women, as well as enabling representation of American Indian/Alaska Native pregnancy-capable individuals in clinical research to address the paucity of data and knowledge gaps.

ARTICLE INFORMATION

The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

This statement was approved by the American Heart Association Science Advisory and Coordinating Committee on April 17, 2023, and the American Heart Association Executive Committee on May 17, 2023. A copy of the document is available at <https://professional.heart.org/statements> by using either "Search for Guidelines & Statements" or the "Browse by Topic" area. To purchase additional reprints, call 215-356-2721 or email Meredith.Edelman@wolterskluwer.com

The American Heart Association requests that this document be cited as follows: Sharma G, Kelliher A, Deen J, Parker T, Hagerty T, Choi EE, DeFilippis EM, Harn K, Dempsey RJ, Lloyd-Jones DM; on behalf of the American Heart Association Cardiovascular Disease and Stroke in Women and Underrepresented Populations Committee of the Council on Clinical Cardiology; Council on Hypertension; Council on Cardiovascular and Stroke Nursing; Council on Arteriosclerosis, Thrombosis and Vascular Biology; and Council on Quality of Care and Outcomes Research. Status of maternal cardiovascular health in American Indian and Alaska Native individuals: a scientific statement from the American Heart Association. *Circ Cardiovasc Qual Outcomes*. 2023;16:e000117. doi: 10.1161/HQ.000000000000117

The expert peer review of AHA-commissioned documents (eg, scientific statements, clinical practice guidelines, systematic reviews) is conducted by the AHA Office of Science Operations. For more on AHA statements and guidelines development, visit <https://professional.heart.org/statements>. Select the "Guidelines & Statements" drop-down menu, then click "Publication Development."

Permissions: Multiple copies, modification, alteration, enhancement, and distribution of this document are not permitted without the express permission of the American Heart Association. Instructions for obtaining permission are located at <https://www.heart.org/permissions>. A link to the "Copyright Permissions Request

Form" appears in the second paragraph (<https://www.heart.org/en/about-us/statements-and-policies/copyright-request-form>).

Acknowledgments

The writing group recognizes the tremendous contributions of the American Indian/Alaska Native clinicians and patients in advancing science and medicine of this underrepresented and underresourced population. The writing group thanks AHA staff Ms Anne Leonard and Ms Lacie Pinyan for their support, as well as Dr Danish Iltaf Satti for his support with the manuscript.

Disclosures

Writing Group Disclosures

Writing group member	Employment	Research grant	Other research support	Speakers' bureau/honoraria	Expert witness	Ownership interest	Consultant/advisory board	Other
Garima Sharma	Inova Heart and Vascular Institute, Inova Fairfax Medical Campus	AHA979462 (PI)†	None	None	None	None	None	None
Allison Kelliher	Johns Hopkins	National Institute of General Medical Sciences (award U54GM128729 supports her salary)*; National Institutes of Drug Abuse Subaward CTN-0129 (coinvestigator)*	None	None	None	None	None	None
Eunjung Esther Choi	Johns Hopkins University School of Medicine	None	None	None	None	None	None	None
Jason Deen	Seattle Children's Hospital/University of Washington	None	None	None	None	None	None	None
Ersilia M. DeFilippis	Columbia University College of Physicians and Surgeons	None	None	None	None	None	None	None
Robert J. Dempsey	University of Wisconsin School of Medicine and Public Health	None	None	None	None	None	None	None
Tracy Hagerty	University of Vermont Medical Center	None	None	None	None	None	None	None
Kimberly Harn	Pima Medical	None	None	None	None	None	None	None
Donald M. Lloyd-Jones	Northwestern University Feinberg School of Medicine	None	None	None	None	None	None	None
Tassy Parker	University of New Mexico Family and Community Medicine, Center for Native American Health	None	None	None	None	None	None	None

This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives \$5000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns \$5000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.

Downloaded from <http://ahajournals.org> by on July 11, 2023

Reviewer Disclosures

Reviewer	Employment	Research grant	Other research support	Speakers' bureau/honoraria	Expert witness	Ownership interest	Consultant/advisory board	Other
Jonathan Baines	Mayo Clinic	None	None	None	None	None	None	None
Adriann Begay	UCSF HEAL Initiative	None	None	None	None	None	None	None
Gina P. Lundberg	Division of Cardiology, Emory University	None	None	None	None	None	None	None
Nandita S. Scott	Massachusetts General Hospital	None	None	None	None	None	None	None
Annabelle Volgman	Rush University Medical Center	Novartis (research trial)*; NIH (research trial)*	None	None	None	None	Sanofi*; Janssen*; Pfizer*; Merck*; Winn Diversity in Clinical Trials*	None

This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all reviewers are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives \$5000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns \$5000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

REFERENCES

- Breathett K, Sims M, Gross M, Jackson EA, Jones EJ, Navas-Acien A, Taylor H, Thomas KL, Howard BV; on behalf of the American Heart Association Council on Epidemiology and Prevention; Council on Quality of Care and Outcomes Research; Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; and Council on Lifestyle and Cardiometabolic Health. Cardiovascular health in American Indians and Alaska Natives: a scientific statement from the American Heart Association. *Circulation*. 2020;141:e948–e959. doi: 10.1161/CIR.0000000000000773
- Tsao CW, Aday AW, Almarazoo ZI, Alonso A, Beaton AZ, Bittencourt MS, Boehme AK, Buxton AE, Carson AP, Commodore-Mensah Y, et al. Heart disease and stroke statistics—2022 update: a report from the American Heart Association [published correction appears in *Circulation*. 2022;146:e141]. *Circulation*. 2022;145:e153–e639. doi: 10.1161/CIR.0000000000001052
- Gemmill A, Berger BO, Crane MA, Margerison CE. Mortality rates among U.S. women of reproductive age, 1999–2019. *Am J Prev Med*. 2022;62:548–557. doi: 10.1016/j.amepre.2021.10.009
- Centers for Disease Control and Prevention. Pregnancy Mortality Surveillance System. 2022. Accessed April 13, 2023. <https://cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm>
- Lloyd-Jones DM, Allen NB, Anderson CAM, Black T, Brewer LC, Foraker RE, Grandner MA, Lavretsky H, Perak AM, Sharma G, et al; on behalf of the American Heart Association. Life's Essential 8: updating and enhancing the American Heart Association's construct of cardiovascular health: a presidential advisory from the American Heart Association. *Circulation*. 2022;146:e18–e43. doi: 10.1161/CIR.0000000000001078
- Havranek EP, Mujahid MS, Barr DA, Blair IV, Cohen MS, Cruz-Flores S, Davey-Smith G, Dennison-Himmelfarb CR, Lauer MS, Lockwood DW, et al; on behalf of the American Heart Association Council on Quality of Care and Outcomes Research, Council on Epidemiology and Prevention, Council on Cardiovascular and Stroke Nursing, Council on Lifestyle and Cardiometabolic Health, and Stroke Council. Social determinants of risk and outcomes for cardiovascular disease: a scientific statement from the American Heart Association. *Circulation*. 2015;132:873–898. doi: 10.1161/CIR.0000000000000228
- Vogel B, Acevedo M, Appelman Y, Bairey Merz CN, Chieffo A, Figtree GA, Guerrero M, Kunadian V, Lam CSP, Maas A, et al. *The Lancet Women and Cardiovascular Disease Commission: reducing the global burden by 2030*. *Lancet*. 2021;397:2385–2438. doi: 10.1016/S0140-6736(21)00684-X
- Burnette CE, Ka'apu K, Scarnato JM, Liddell J. Cardiovascular health among U.S. Indigenous peoples: a holistic and sex-specific systematic review. *J Evid Based Soc Work* (2019). 2020;17:24–48. doi: 10.1080/26408066.2019.1617817
- Parikh NI, Gonzalez JM, Anderson CAM, Judd SE, Rexrode KM, Hlatky MA, Gunderson EP, Stuart JJ, Vaidya D; on behalf of the American Heart Association Council on Epidemiology and Prevention; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Cardiovascular and Stroke Nursing; and the Stroke Council. Adverse pregnancy outcomes and cardiovascular disease risk: unique opportunities for cardiovascular disease prevention in women: a scientific statement from the American Heart Association. *Circulation*. 2021;143:e902–e916. doi: 10.1161/CIR.0000000000000961
- Mehta LS, Sharma G, Creanga AA, Hameed AB, Hollier LM, Johnson JC, Leffert L, McCullough LD, Mujahid MS, Watson K, et al; on behalf of the American Heart Association Advocacy Coordinating Committee. Call to action: maternal health and saving mothers: a policy statement from the American Heart Association. *Circulation*. 2021;144:e251–e269. doi: 10.1161/CIR.0000000000001000
- Lewis ME, Volpert-Esmond HI, Deen JF, Modde E, Warne D. Stress and cardiometabolic disease risk for Indigenous populations throughout the lifespan. *Int J Environ Res Public Health*. 2021;18:1821. doi: 10.3390/ijerph18041821
- Muller CJ, Noonan CJ, MacLehose RF, Stoner JA, Lee ET, Best LG, Calhoun D, Jolly SE, Devereux RB, Howard BV. Trends in cardiovascular disease morbidity and mortality in American Indians over 25 years: the Strong Heart Study. *J Am Heart Assoc*. 2019;8:e012289. doi: 10.1161/JAHA.119.012289
- Zhang Y, Lee ET, Devereux RB, Yeh J, Best LG, Fabsitz RR, Howard BV. Prehypertension, diabetes, and cardiovascular disease risk in a population-based sample: the Strong Heart Study. *Hypertension*. 2006;47:410–414. doi: 10.1161/01.HYP.0000205119.19804.08
- Bullock A, Sheff K, Hora I, Burrows NR, Benoit SR, Saydah SH, Hardin CL, Gregg EW. Prevalence of diagnosed diabetes in American Indian and Alaska Native adults, 2006–2017. *BMJ Open Diabetes Res Care*. 2020;8:e001218. doi: 10.1136/bmjdc-2020-001218
- Arias E, Xu J, Curtin S, Bastian B, Tejada-Vera B. Mortality profile of the non-Hispanic American Indian or Alaska Native population, 2019. *Natl Vital Stat Rep*. 2021;70:1–27.
- Goldman N, Andrasfay T. Life expectancy loss among Native Americans during the COVID-19 pandemic. *medRxiv*. Preprint posted online June 13, 2022. doi: 10.1101/2022.03.15.22272448
- Fretts AM, Howard BV, McKnight B, Duncan GE, Beresford SA, Mete M, Zhang Y, Siscovick DS. Life's Simple 7 and incidence of diabetes among American Indians: the Strong Heart Family Study. *Diabetes Care*. 2014;37:2240–2245. doi: 10.2337/dc13-2267
- Cameron NA, Freaney PM, Wang MC, Perak AM, Dolan BM, O'Brien MJ, Tandon SD, Davis MM, Grobman WA, Allen NB, et al. Geographic differences in prepregnancy cardiometabolic health in the United

- States, 2016 through 2019. *Circulation*. 2022;145:549–551. doi: 10.1161/CIRCULATIONAHA.121.057107
19. Wang MC, Freaney PM, Perak AM, Allen NB, Greenland P, Grobman WA, Phillips SM, Lloyd-Jones DM, Khan SS. Trends in prepregnancy cardiovascular health in the United States, 2011–2019. *Am J Prev Cardiol*. 2021;7:100229. doi: 10.1016/j.ajpc.2021.100229
 20. Benschop L, Schalekamp-Timmermans S, Schelling SJC, Steegers EAP, Roeters van Lennep JE. Early pregnancy cardiovascular health and subclinical atherosclerosis. *J Am Heart Assoc*. 2019;8:e011394. doi: 10.1161/JAHA.118.011394
 21. Howard BV, Lee ET, Yeh JL, Go O, Fabsitz RR, Devereux RB, Welty TK. Hypertension in adult American Indians: the Strong Heart Study. *Hypertension*. 1996;28:256–264. doi: 10.1161/01.hyp.28.2.256
 22. Heck JL, Jones EJ, Bohn D, McCage S, Parker JG, Parker M, Pierce SL, Campbell J. Maternal mortality among American Indian/Alaska Native women: a scoping review. *J Womens Health (Larchmt)*. 2021;30:220–229. doi: 10.1089/jwh.2020.8890
 23. Zamora-Kapoor A, Nelson LA, Buchwald DS, Walker LR, Mueller BA. Pre-eclampsia in American Indians/Alaska Natives and Whites: the significance of body mass index. *Matern Child Health J*. 2016;20:2233–2238. doi: 10.1007/s10995-016-2126-6
 24. Best LG, Lunday L, Webster E, Falcon GR, Beal JR. Pre-eclampsia and risk of subsequent hypertension: in an American Indian population. *Hypertens Pregnancy*. 2017;36:131–137. doi: 10.1080/10641955.2016.1250905
 25. Lee JS, Chang PY, Zhang Y, Kizer JR, Best LG, Howard BV. Triglyceride and HDL-C dyslipidemia and risks of coronary heart disease and ischemic stroke by glycemic dysregulation status: the Strong Heart Study. *Diabetes Care*. 2017;40:529–537. doi: 10.2337/dc16-1958
 26. Howard BV, Robbins DC, Sievers ML, Lee ET, Rhoades D, Devereux RB, Cowan LD, Gray RS, Welty TK, Go OT, et al. LDL cholesterol as a strong predictor of coronary heart disease in diabetic individuals with insulin resistance and low LDL: the Strong Heart Study. *Arterioscler Thromb Vasc Biol*. 2000;20:830–835. doi: 10.1161/01.atv.20.3.830
 27. American Diabetes Association. 2: Classification and diagnosis of diabetes: Standards of Medical Care in Diabetes—2021. *Diabetes Care*. 2021;44(suppl 1):S15–S33. doi: 10.2337/dc21-S002
 28. Virani SS, Alonso A, Aparicio HJ, Benjamin EJ, Bittencourt MS, Callaway CW, Carson AP, Chamberlain AM, Cheng S, Delling FN, et al; on behalf of the American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2021 update: a report from the American Heart Association. *Circulation*. 2021;143:e254–e743. doi: 10.1161/CIR.0000000000000950
 29. Office of Minority Health. Diabetes and American Indians/Alaska Natives. Accessed April 13, 2023. <https://minorityhealth.hhs.gov/omh/browse.aspx?vl=4&vliid=33>
 30. Howard BV, Cowan LD, Go O, Welty TK, Robbins DC, Lee ET. Adverse effects of diabetes on multiple cardiovascular disease risk factors in women: the Strong Heart Study. *Diabetes Care*. 1998;21:1258–1265. doi: 10.2337/diacare.21.8.1258
 31. Liao Y, Bang D, Cosgrove S, Dulin R, Harris Z, Taylor A, White S, Yatabe G, Liburd L, Giles W, et al; Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion; Centers for Disease Control and Prevention (CDC). Surveillance of health status in minority communities: Racial and Ethnic Approaches to Community Health Across the U.S. (REACH U.S.) Risk Factor Survey, United States, 2009. *MMWR Surveill Summ*. 2011;60:1–44.
 32. Hruby A, Hu FB. The epidemiology of obesity: a big picture. *Pharmacoeconomics*. 2015;33:673–689. doi: 10.1007/s40273-014-0243-x
 33. Howard BV, Lee ET, Cowan LD, Devereux RB, Galloway JM, Go OT, Howard WJ, Rhoades ER, Robbins DC, Sievers ML, et al. Rising tide of cardiovascular disease in American Indians: the Strong Heart Study. *Circulation*. 1999;99:2389–2395. doi: 10.1161/01.cir.99.18.2389
 34. Ferranti EP, Hartman TJ, Elliott AJ, Mitchell DC, Angal J, Nickleach D, Bellissimo M, Breslow R. Diet quality of pregnant American Indian women in the Northern Plains. *Prev Chronic Dis*. 2019;16:E53. doi: 10.5888/pcd16.180536
 35. Warne D, Wescott S. Social determinants of American Indian nutritional health. *Curr Dev Nutr*. 2019;3:12–18. doi: 10.1093/cdn/nz054
 36. Eilat-Adar S, Mete M, Fretts A, Fabsitz RR, Handeland V, Lee ET, Loria C, Xu J, Yeh J, Howard BV. Dietary patterns and their association with cardiovascular risk factors in a population undergoing lifestyle changes: the Strong Heart Study. *Nutr Metab Cardiovasc Dis*. 2013;23:528–535. doi: 10.1016/j.numecd.2011.12.005
 37. Fretts AM, Howard BV, Kriska AM, Smith NL, Lumley T, Lee ET, Russell M, Siscovick D. Physical activity and incident diabetes in American Indians: the Strong Heart Study. *Am J Epidemiol*. 2009;170:632–639. doi: 10.1093/aje/kwp181
 38. Jernigan VBB, Wetherill M, Heard J, Jacob T, Salvatore AL, Cannady T, Grammar M, Standridge J, Fox J, Spiegel J, et al. Cardiovascular disease risk factors and health outcomes among American Indians in Oklahoma: the THRIVE study. *J Racial Ethn Health Disparities*. 2017;4:1061–1068. doi: 10.1007/s40615-016-0310-4
 39. Kriska AM, Hanley AJ, Harris SB, Zinman B. Physical activity, physical fitness, and insulin and glucose concentrations in an isolated Native Canadian population experiencing rapid lifestyle change. *Diabetes Care*. 2001;24:1787–1792. doi: 10.2337/diacare.24.10.1787
 40. Fretts AM, Howard BV, McKnight B, Duncan GE, Beresford SA, Calhoun D, Kriska AM, Storti KL, Siscovick DS. Modest levels of physical activity are associated with a lower incidence of diabetes in a population with a high rate of obesity: the Strong Heart Family Study. *Diabetes Care*. 2012;35:1743–1745. doi: 10.2337/dc11-2321
 41. Zhang M, An Q, Yeh F, Zhang Y, Howard BV, Lee ET, Zhao J. Smoking-attributable mortality in American Indians: findings from the Strong Heart Study. *Eur J Epidemiol*. 2015;30:553–561. doi: 10.1007/s10654-015-0031-8
 42. Nuyujukian DS, Anton-Culver H, Manson SM, Jiang L. Associations of sleep duration with cardiometabolic outcomes in American Indians and Alaska Natives and other race/ethnicities: results from the BRFSS. *Sleep Health*. 2019;5:344–351. doi: 10.1016/j.sleh.2019.02.003
 43. Tietjens JR, Claman D, Kezirian EJ, De Marco T, Mirzayan A, Sadroonri B, Goldberg AN, Long C, Gerstenfeld EP, Yeghiazarians Y. Obstructive sleep apnea in cardiovascular disease: a review of the literature and proposed multidisciplinary clinical management strategy. *J Am Heart Assoc*. 2019;8:e010440. doi: 10.1161/JAHA.118.010440
 44. Churchwell K, Elkind MSV, Benjamin RM, Carson AP, Chang EK, Lawrence W, Mills A, Odom TM, Rodriguez CJ, Rodriguez F, et al; on behalf of the American Heart Association. Call to action: structural racism as a fundamental driver of health disparities: a presidential advisory from the American Heart Association. *Circulation*. 2020;142:e454–e468. doi: 10.1161/CIR.0000000000000936
 45. Cole AB, Armstrong CM, Giano ZD, Hubach RD. An update on ACEs domain frequencies across race/ethnicity and sex in a nationally representative sample. *Child Abuse Negl*. 2022;129:105686. doi: 10.1016/j.chiabu.2022.105686
 46. Christensen L, Damon S. Social determinants of health and response to disease associated with health outcomes of American Indian and Alaska Native patients. *JAMA Netw Open*. 2022;5:e224827. doi: 10.1001/jamanetworkopen.2022.4827
 47. Serfaini K, Donovan DM, Wendt DC, Matsumiya B, McCarty CA. A comparison of early adolescent behavioral health risks among urban American Indians/Alaska Natives and their peers. *Am Indian Alsk Native Ment Health Res*. 2017;24:1–17. doi: 10.5820/aian.2402.2017.1
 48. Swaim RC, Stanley LR. Substance use among American Indian youths on reservations compared with a national sample of US adolescents. *JAMA Netw Open*. 2018;1:e180382. doi: 10.1001/jamanetworkopen.2018.0382
 49. Asher BlackDeer A, Patterson Silver Wolf DA. Evidence mapping: interventions for American Indian and Alaska Native youth mental health. *J Evid Based Soc Work (2019)*. 2020;17:49–62. doi: 10.1080/26408066.2019.1624237
 50. American Psychiatric Association. Mental health disparities: American Indian and Alaska Natives. 2014. Accessed April 13, 2023. <https://psychiatry.org/psychiatrists/cultural-competency/education/mental-health-facts>
 51. NCAI Policy Research Center. Research policy update: violence against American Indian women and girls. February 2018. Accessed April 13, 2023. https://www.ncai.org/policy-research-center/research-data/prc-publications/VAWA_Data_Brief_FINAL_2_1_2018.pdf
 52. Petrosky E, Blair JM, Betz CJ, Fowler KA, Jack SPD, Lyons BH. Racial and ethnic differences in homicides of adult women and the role of intimate partner violence: United States, 2003–2014. *MMWR Morb Mortal Wkly Rep*. 2017;66:741–746. doi: 10.15585/mmwr.mm6628a1
 53. Rosay AB. *Violence Against American Indian and Alaska Native Women and Men: 2010 Findings From the National Intimate Partner and Sexual Violence Survey*. US Department of Justice; 2016.
 54. Hoss A. Federal Indian law as a structural determinant of health. *J Law Med Ethics*. 2019;47:34–42. doi: 10.1177/1073110519898041
 55. Parker T, May PA, Maviglia MA, Petrakis S, Sunde S, Gloyd SV. PRIME-MD: its utility in detecting mental disorders in American Indians. *Int J Psychiatry Med*. 1997;27:107–128. doi: 10.2190/C6FD-7QWB-KNGR-M844

56. Duran B, Sanders M, Skipper B, Waitzkin H, Malcoe LH, Paine S, Yager J. Prevalence and correlates of mental disorders among Native American women in primary care. *Am J Public Health*. 2004;94:71–77. doi: 10.2105/ajph.94.1.71
57. Parker T, Maviglia MA, Lewis PT, Gossage JP, May PA. Psychological distress among Plains Indian mothers with children referred to screening for fetal alcohol spectrum disorders. *Subst Abuse Treat Prev Policy*. 2010;5:22. doi: 10.1186/1747-597X-5-22
58. Petersen EE, Davis NL, Goodman D, Cox S, Syverson C, Seed K, Shapiro-Mendoza C, Callaghan WM, Barfield W. Racial/ethnic disparities in pregnancy-related deaths: United States, 2007–2016. *MMWR Morb Mortal Wkly Rep*. 2019;68:762–765. doi: 10.15585/mmwr.mm6835a3
- 58a. Centers for Disease Control and Prevention. Pregnancy Mortality Surveillance System. 2023. Accessed May 5, 2023. <https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm#>
59. Trost S, Beauregard J, Chandra G, Njie F, Harvey A, Berry J, Goodman DA. *Pregnancy-Related Deaths Among American Indian or Alaska Native Persons: Data from Maternal Mortality Review Committees in 36 US States, 2017–2019*. Centers for Disease Control and Prevention, US Department of Health and Human Services; 2022.
60. Indian Health Service. Disparities: fact sheets. Accessed April 13, 2023. <https://ihs.gov/newsroom/factsheets/disparities/>
61. Cabacungan ET, Ngui EM, McGinley EL. Racial/ethnic disparities in maternal morbidities: a statewide study of labor and delivery hospitalizations in Wisconsin. *Matern Child Health J*. 2012;16:1455–1467. doi: 10.1007/s10995-011-0914-6
62. Urban Indian Health Institute, Seattle Indian Health Board. *Community Health Profile: National Aggregate of Urban Indian Health Program Service Areas*. Urban Indian Health Institute; 2016.
63. Reddy S, Patel N, Saxon M, Amin N, Biviji R. Innovations in U.S. health care delivery to reduce disparities in maternal mortality among African American and American Indian/Alaskan Native women. *J Patient Cent Res Rev*. 2021;8:140–145. doi: 10.1097/OGX.0000000000000617
64. Hanson JD. Understanding prenatal health care for American Indian women in a Northern Plains tribe. *J Transcult Nurs*. 2012;23:29–37. doi: 10.1177/1043659611423826
65. Creanga AA, Bateman BT, Kuklina EV, Callaghan WM. Racial and ethnic disparities in severe maternal morbidity: a multistate analysis, 2008–2010. *Am J Obstet Gynecol*. 2014;210:435.e1–435.e8. doi: 10.1016/j.ajog.2013.11.039
66. Harris R, Nelson LA, Muller C, Buchwald D. Stroke in American Indians and Alaska Natives: a systematic review. *Am J Public Health*. 2015;105:e16–e26. doi: 10.2105/AJPH.2015.302698
67. Centers for Disease Control and Prevention. Risk for COVID-19 infection, hospitalization, and death by race/ethnicity. 2021. Accessed April 28, 2021. <https://cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html>
68. Garovic VD, Dechend R, Easterling T, Karumanchi SA, McMurry Baird S, Magee LA, Rana S, Vermunt JV, August P; on behalf of the American Heart Association Council on Hypertension; Council on the Kidney in Cardiovascular Disease, Kidney in Heart Disease Science Committee; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Lifestyle and Cardiometabolic Health; Council on Peripheral Vascular Disease; and Stroke Council. Hypertension in pregnancy: diagnosis, blood pressure goals, and pharmacotherapy: a scientific statement from the American Heart Association [published correction appears in *Hypertension*. 2022;79:e70]. *Hypertension*. 2022;79:e21–e41. doi: 10.1161/HYP.000000000000208
69. Gambahaya ET, Minhas AS, Sharma G, Vaught AJ, Adamo L, Zakaria S, Michos ED, Hays AG. Racial differences in delivery outcomes among women with peripartum cardiomyopathy. *CJC Open*. 2022;4:373–377. doi: 10.1016/j.cjco.2021.12.004
70. Heidenreich PA, Bozkurt B, Aguilar D, Allen LA, Byun JJ, Colvin MM, Deswal A, Drazner MH, Dunlay SM, Evers LR, et al. 2022 AHA/ACC/HFSA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2022;145:e895–e1032. doi: 10.1161/CIR.0000000000001063
71. OPTN: Organ Procurement and Transplantation Network. Accessed April 13, 2023. <https://optn.transplant.hrsa.gov/>
72. Beckles GL, Truman BI; Centers for Disease Control and Prevention (CDC). Education and income: United States, 2005 and 2009. *MMWR Suppl*. 2011;60:13–17.
73. Williams DR, Mohammed SA. Discrimination and racial disparities in health: evidence and needed research. *J Behav Med*. 2009;32:20–47. doi: 10.1007/s10865-008-9185-0
74. Kozhimannil KB. Indigenous maternal health: a crisis demanding attention. *JAMA Health Forum*. 2020;1:e200517. doi: 10.1001/jamahealthforum.2020.0517
75. Warne D, Frizzell LB. American Indian health policy: historical trends and contemporary issues. *Am J Public Health*. 2014;104(suppl 3):S263–S267. doi: 10.2105/AJPH.2013.301682
76. Kozhimannil KB, Interrante JD, Tofte AN, Admon LK. Severe maternal morbidity and mortality among Indigenous women in the United States. *Obstet Gynecol*. 2020;135:294–300. doi: 10.1097/AOG.0000000000003647
77. Centers for Medicare & Medicaid Services. Improving access to maternal health care in rural communities. Accessed February 23, 2023. <https://www.cms.gov/about-cms/agency-information/omh/health-equity-programs/rural-health>
78. Barton AJ, Anderson JL. Meeting the challenge of perinatal care in rural communities. *J Perinat Neonatal Nurs*. 2021;35:150–159. doi: 10.1097/JPN.0000000000000562
79. Su S, Jimenez MP, Roberts CT, Loucks EB. The role of adverse childhood experiences in cardiovascular disease risk: a review with emphasis on plausible mechanisms. *Curr Cardiol Rep*. 2015;17:88. doi: 10.1007/s11886-015-0645-1 Accessed 06/12/2022.
80. Lujan C, DeBruyn LM, May PA, Bird ME. Profile of abused and neglected American Indian children in the Southwest. *Child Abuse Negl*. 1989;13:449–461. doi: 10.1016/0145-2134(89)90049-5
81. Selvaraj K, Ruiz MJ, Aschkenasy J, Chang JD, Heard A, Minier M, Osta AD, Pavelack M, Samelson M, Schwartz A, et al. Screening for toxic stress risk factors at well-child visits: the Addressing Social Key Questions for Health Study. *J Pediatr*. 2019;205:244–249.e4. doi: 10.1016/j.jpeds.2018.09.004
82. Rhoades DA. Racial misclassification and disparities in cardiovascular disease among American Indians and Alaska Natives. *Circulation*. 2005;111:1250–1256. doi: 10.1161/01.CIR.0000157735.25005.3F