

# Racial Disparities in Ischemic Heart Disease

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## Abstract

Ischemic heart disease is a leading cause of death for most racial and ethnic minorities and is estimated to be responsible for one in seven deaths in the United States. Black adults have the highest burden of cardiovascular disease. Despite significant advances in treatment of ischemic heart disease and an increased awareness of racial disparities, racial and ethnic minority groups remained disproportionately burdened with ischemic heart disease and experience higher mortality and rehospitalization rates compared to Whites. This review details racial disparities in different syndromes, treatments, and outcomes of ischemic heart disease and suggests strategies for reducing or eliminating these disparities.

**Key words:** racial disparity; ischemic heart disease

## Introduction

Ischemic heart disease is a leading cause of death for most racial and ethnic minorities and is estimated to be responsible for one in seven deaths in the US overall [1]. Black adults are known to have the highest burden overall of cardiovascular disease[2]. Numerous developments over recent decades have improved treatment options and led to improved medical outcomes. However, centuries of racism in this country have had a deep and profound impact on communities of color, creating inequity in housing, education, wealth, and employment, all of which are considered social determinants of health[3]. Despite significant advances in treatment of ischemic heart disease and an increased awareness of these racial disparities, decades of research have shown that several racial and ethnic minority groups are disproportionately burdened and experience higher mortality and rehospitalization rates compared with the White population[4]. This continues to remain an area of interest in the United States for medical, ethical, and economic reasons.

## History

Long before COVID-19, the field of medicine has had a complex relationship with black patients. As noted by the medical historian Todd Savvitt, in the past “white medical educators and researchers relied greatly on the availability of African American patients...for dissection, surgery and bedside demonstrations.” [5] He also notes a pervasive historic belief that “blacks were medically different than whites and so in need if special treatment.” Some of the myths regarding these differences included that blacks were impervious to pain, had weak lungs that strengthened with work, a high heat tolerance, immunity to illness and large sex organs with small brains that led to promiscuity and low intelligence. These sorts of beliefs laid the foundation for the justification

of slavery as well as provided support for discriminatory public policies. Within the medical field, they also provided the backbone for unethical experimentation.

Much is known about large-scale experiments such as the Tuskegee Syphilis Study[6], where 600 Black sharecroppers were unknowingly enrolled in a syphilis study, where they were not made aware of their diagnosis and monitored for as long as 40 years, even after a treatment was available. However, many smaller scale experiments were also performed. Prior to these events, in his 1855 autobiography[7], a former slave named John Brown wrote about being loaned to a local Georgia physician who was trying to prove that black skin was thicker than white skin. Mr. Brown described the physicians use of “blisters to my hands, legs and feet which bear scars to this day. He continued until he drew up the dark skin from the upper and the under one. He used to blister me at intervals of about two weeks.” In 1945, as part of the larger Manhattan Project investigating radiation in humans, a Black male named Ebb Cade, who was involved a motor vehicle accident, ended up receiving 5 injections of plutonium and had 15 teeth removed without his knowledge or consent[8]. With this history in mind, social inequity and mistrust of the medical community from the black community would seem inevitable.

In recent decades, disparities in health outcomes have been noted among various racial groups[9]. The 1985 publication of *Black and Minority Health*[10] by the US Government, which was the first comprehensive federal report on the relationship between race and health revealed a lower disease burden and longer life expectancy among white populations, stated that “Blacks, Hispanics, Native Americans, and those of

Asian/Pacific Islander heritage have not benefited fully or equitably from the fruits of science or from those systems responsible for translating and using health sciences technology.” Since that time, extensive research has been targeted towards intervening on these inequalities.

As part of the Affordable Care Act (ACA) in the United States, a new office was established dedicated to address this inequity. Within current medical literature, much of contemporary ischemic heart disease research has been dedicated to broadening our understanding of the structural causes of racial and ethnic disparities in ischemic heart disease [11]. These factors may be amenable to intervention and provide targets for initiatives and policies to reduce disparities and enact change. In this article, we review the recently published research related to the distribution and determinants of racial and ethnic differences in ischemic heart disease outcomes in the USA.

### Genetic and Biological Differences

The problematic history of race in the US, which historically justified mistreatment and inequity by attributing it to genetic differences, has complicated discussions about clinically relevant differences among races that effect clinical outcomes. Similar to other groups (e.g., women) it is important to quantify and understand how much patients’ innate biology affects their susceptibility and treatment response for ischemic heart disease.

Perhaps one of the best described examples of biological differences in ischemic heart disease is in the realm of antiplatelet therapy. Batchelor et al previously analyzed [12] a Black population and observed higher antiplatelet compliance than Whites, but despite that fact Blacks still had higher 5-year rates of myocardial infarction (MI) and stent thrombosis.

In addition, both loss-of-function and gain-of-function CYP polymorphisms affect clopidogrel metabolism, which may affect mortality among clopidogrel-treated patients after acute MI [13]. These polymorphisms can vary according to race.

Lev et al [14] showed that sex and race independently influenced platelet-fibrin clot strength. Black women observed in this study had the highest thrombogenicity profile, which was hypothesized to confer a high-risk phenotype for the occurrence of thrombotic events. Pendyala et al [15] evaluated genetic mutations conferring reduced platelet reactivity and found a higher prevalence among Blacks compared to Whites undergoing percutaneous coronary intervention (PCI). This might confer a higher risk for ischemic complications, although the relation between genetic mutations (i.e. loss of function alleles) and clinic events is unclear and the overall effect has been called into question by subsequent review[16].

In addition, pathophysiological differences have been noted among races. For example, Edelstein et al [17] observed that compared to Whites, Blacks exhibited enhanced platelet activation through the PAR4 thrombin receptor. Similar analysis has also shown differences in platelet activation between Asian Indians and Caucasians[18]. Infeld et al [19] indicated that between African-American and European-American subjects, platelet reactivity varies both at baseline, and with the administration of aspirin and ticagrelor. Whether these affect clinical outcomes is unknown. Regardless, some experts[19] have suggested that racial differences in anti-platelet therapy should be included in personalized dual-antiplatelet therapy (DAPT) recommendations. For instance, East Asian patients have more bleeding and fewer ischemic complications after PCI compared to Caucasians[20, 21], which might favor a shorter duration of DAPT.

Some metrics of cardiac disease show a sustained racial gap even after statistical adjustment, raising a question as to how great a role underlying

biological difference plays. For example, Okin et al [22] showed that black patients with hypertension are at increased risk of sudden cardiac death compared to other races even after correcting for known risk factors.

Other investigators have reported increased rates of post-MI vasospasm in Japanese patients[23]. Telomere length, known to decrease with oxidative exposure and aging, has also been shown [24] to vary based on race. Blacks have [25] increased oxidative stress and inflammatory markers in cell cultures, and even among Black and Hispanic children low-grade inflammation have been noted[26]. The continued analysis of these inherent differences will continue to prove critical in providing effective, individualized care in the realm of IHD.

### Socioeconomic Determinants of Racial Differences

In the United States, Blacks face a disproportionately high burden of poverty and low socioeconomic status (SES). Black race has long been associated with poorer healthcare outcomes in the setting of low socioeconomic status. Interestingly, Bucholz et al [27] evaluated outcomes in acute MI by local socioeconomic status and showed that among patients living in low SES areas, the life expectancy was similar among blacks and whites. However, high SES areas saw the highest disparity in life expectancy among races.

Other studies have noted a large contribution of socioeconomic factors to cardiac outcomes. The Atherosclerosis Risk in Communities Study (ARIC) by Zhao et al [28] found that Blacks had a much higher risk of sudden cardiac death (SCD) than Whites. However, 65% of the differences between races were attributable to income, education, and traditional risk factors, with only a third attributable to race.

Blacks have been reported to be less likely to undergo cardiac catheterization than Whites, but this may be due to social contextual variables [29]. Ayotte et al [30] found that patients who knew someone that had undergone the procedure, had social support, and were encouraged by family were far more likely to undergo cardiac catheterization; these factors were less prevalent among Blacks.

Some authors have pointed out the significant impact that socioeconomic factors have with IHD outcomes and in some instances, this have been observed in the absence of racial disparity. Ng et al [31] evaluated patients in Maryland admitted for MI to determine the relative risk of mortality based on insurance status and race. Increased risk of death was not associated with race, but lack of insurance correlated with a higher risk of death. These findings remained even after adjustment for disease severity, location, neighborhood household income and other confounding factors. Gaglia et al [32] showed that one year after PCI, patients with government-sponsored insurance and no insurance had worse outcomes than those with private insurance. Similarly, Koch et al [33] assessed the impact of sex, race and socioeconomic status on outcomes on patients that underwent coronary artery bypass grafting and surgical valve procedures. This showed a significantly higher risk-adjusted mortality among those with a lower socioeconomic position, which was defined by regional averages in home value, income, education level and employment; however race did not correlate with mortality in this study.

### Ischemic Heart Disease Risk Factors and Comorbidities

Numerous publications have outlined the racial disparity in cardiovascular disease comorbidities and risk factors, including obesity, hypertension, hyperlipidemia, diabetes, and smoking prevalence [34, 35]. This can be directly linked to differences in the incidence of ischemic heart disease.

Racial difference in the number and severity of co-morbidities have been identified in patients diagnosed with coronary disease [36] and undergoing PCI [37]. Blacks have a higher prevalence of the comorbidities that correlate with coronary artery disease. Likewise, Mexican Americans and Native Americans have a higher prevalence of the co-morbidities associated with coronary artery disease, [38] and that disparity has increased over time [39].

The clinical implication of these differences is immense. In the REGARDS (Reasons for Geographic and Racial Differences in Stroke) study[40], 1122 patients were found to have a MI, with Blacks at a significantly higher risk of having a cardiac event, and higher post-MI mortality than Whites participants. On further analysis these differences remained after adjusting for sociodemographic demographics but when adjusted for pre-MI comorbidities, these differences were markedly attenuated. This suggests that targeting risk factors and comorbidities before IHD develops might alleviate a significant portion of racial disparities.

### Disparities in Health Knowledge

In addition to risk factors, heart disease awareness is lower among minority populations. One large survey by Mochari-Greenberger et al showed that Black and Hispanic women were 66% less likely than white women to be aware that heart disease was the leading cause of death in women[41]. Among males in the US, African-American Race, low income, and lower education correlated with less knowledge of MI symptoms [42]. A similar analysis performed with African American women by Lutifiyya et al [43] showed a similarly low rate of symptom knowledge among those with lower income and uninsured. Whites have previously shown substantially more knowledge of MI risk factors and warning signs compared to African Americans [44]. These findings were further supported in a large 2001 National Health Interview Survey[45] that African Americans and Hispanics were less likely to recognize MI symptoms and the need to call 911. All these studies point towards a significant health knowledge gap between racial groups with regards to ischemic heart disease.

Over time, several public campaigns have been launched to improve public knowledge regarding ischemic heart disease. In 1997, the American Heart Association initiated a national campaign for women for this purpose. Analysis performed nine years after showed an increased awareness among women, however the difference between the white population and blacks and Hispanics remained unchanged[46].

### Disparities in Access

Compared to other developed countries, the United States has a tiered healthcare system that often fails to offer adequate healthcare coverage to the disadvantaged. In 2014 Jonathan Chait noted [47]that “few industrialized countries provide as stingy aid to the poor as the United States...In none of them is the principal of universal health insurance even contested by a major conservative party.”

In the US a disproportionately low rate of health insurance has been observed in Blacks and can be directly linked to IHD outcomes. Since the passage of the Affordable Care Act in 2014, blacks have made larger gains in healthcare insurance through the Health Insurance Marketplace and Medicaid expansion than the Whites [48]. Similar legislation in the future may be critical in expanding access to healthcare to minority populations.

Longitudinal analysis of 18 years of Medicare data (1992-2010) [49]showed that Blacks are less likely to be hospitalized for acute MI and are also less likely to receive PCI than Whites. From 1994-1995, similar data [50]showed that for patients diagnosed with acute MI, Black patients

were less likely to undergo coronary catheterization. This was observed regardless of the race of the treating physician. A review of 1997 Medicare claims by Cromwell et al [51] showed that Whites were more likely to be admitted for ischemic heart disease, but even once admitted Blacks and Native Americans were less likely to undergo invasive diagnostic and surgical revascularization.

In addition, Blacks have also been shown to be less likely to receive guideline-based therapies [52]. Longitudinal analysis published by Arora et al [53] showed that Blacks admitted to the hospital for NSTEMI over a 15-year span not only had lower rates of reperfusion, but they were less likely to receive aspirin, other anti-platelet therapy, beta-blockers, or lipid lowering medications.

One proposed intervention on these disparities has been an emphasis on a more protocol driven management of CHD. In fact, a 2016 analysis of NCDR by Edmund Anstey et al [54]showed similar utilization of interventional procedures between black and white patients in the setting of STEMI, which was largely protocol driven. In comparison, in NSTEMI with its more variable management, black patients had both lower rates of interventional procedures and longer delays to therapy.

Rather than discrimination or bias by individual physicians, systematic differences in the hospitals may account for much of the current disparity. Because Blacks and Whites tend to live in different areas and utilize different hospitals [55], national database reports, which are often based on pooled data[56], may not adequately account for differences in hospital quality, practice patterns and resources. This concept has been referred to as the “hospital effect”. Barnato et al [57]examined this effect by focusing analysis on management of acute MI within individual hospitals. They found in their group that outcome differences between blacks and whites were narrowed or completely erased, and that utilization of different hospitals led to the overall disparity.

These gaps also apply to cardiac arrest. Multivariate analysis has shown [58] that in hospitals with higher proportions of black patients, the probability of survival was lower for Black patients and White patients compared to their survival in predominantly White hospitals.

Improving access to healthcare coverage, as well as continue guideline and protocol driven care that reduces variability among different hospitals, has to potential to provide more equal access to care among all races.

### Disparities in PCI

Significant advances have been made in the prevention, management, and outcomes of patients with acute MI, specifically with percutaneous coronary intervention (PCI). With these advancements, as well as efforts described above aimed at reducing inequality in care, evidence suggests that although improvement has been made, significant disparities remain[59]. For example, an analysis of Kaiser Permanente data by Chi et al [60] showed steady declines in hospitalization rates for acute MI, non-ST segment elevation MI and ST segment MI since 2000. However, after experiencing an initial steep decline from 2000-2009, decreases in rates of these diseases in Blacks reached a plateau in 2010 that was not observed in Whites or Hispanics.

A review of Get with the Guidelines data by Cavender et al [61] for patient with ST-elevation MI showed that after adjusting for confounding factors Blacks had lower odds of achieving a door-to-balloon time of less than 90 minutes compared to Whites.

Thomas et al looked at 22,618 patients [36]that were found to have significant coronary artery disease. They found that Black patients with

were less likely to receive PCI as their initial therapy as compared to White counterparts. Even after adjustment for clinical and baseline characteristics, they were found to have a subsequent lower long-term survival than whites.

Wilde et al looked at [62] cardiac arrest patients and found lower rates of timely coronary angiography and drug eluting stents for Black patients. However, analysis of the Pragmatic Airway Resuscitation Trial[63] showed no difference in overall survival among races in 3002 patients with out of hospital cardiac arrest.

With the advent of the drug-eluting stent and their associated improvement in outcomes, several groups[64] sought to analyze what patients were most like to receive a drug eluting stent (DES) as opposed to a bare metal stent. On one study African Americans and Hispanics were shown to be the least likely to receive DES in the setting of PCI, and patients with private insurance were found to be the most likely. Another similar analysis by Gaglie et al [65] showed that Blacks were associated with less utilization of drug-eluting stents.

### Disparities in Post-MI Course

Previous analysis by Kumar et al [66] of the NCDR database has shown worse long-term outcomes after PCI among Black and Hispanic patients relative to White and Asian patients. Iantorno et al also [67] showed that among patients who underwent PCI, after 1-year adverse major cardiovascular events were up to 1.5 times more likely to occur in Blacks compared to whites.

A meta-analysis [37] of ten randomized PCI trials by Golomb et al showed rate of major adverse cardiac events post PCI was significantly higher among Blacks. Mohamad et al retrospectively evaluated[68] patients with unprotected left main coronary artery (LMCA) that underwent revascularization, and found that that only age and African American race were independent risk factors of adverse cardiac outcomes within one year.

Black race is an independent risk predictor of acute kidney injury (AKI) after PCI [69]. This remains even after adjustment for demographics, socioeconomic status, comorbidities, predisposing medications, PCI indication, peri-procedural AKI prophylaxis, PCI procedural characteristics, and baseline eGFR. It is worth noting that with regards to this complication, even GFR has been found to be an imperfect method of assessing renal function in Blacks due to potential differences in muscle mass, and there has been a national movement recently to address this potential bias [70].

Cai et al [71] found that the incidence of major adverse cardiac events and major hemorrhage after PCI was higher in Black patients compared to Whites.

In a study by Bucholz et al [72] of life expectancy and the years of potential life lost using Medicare data, Blacks had a shorter post-MI life expectancy, and also lost more of their expected life than white patients. After adjustment for differences in disease burden, the racial gap was attenuated, with race remaining an independent predictor but highlighting the higher burden of chronic medical comorbidities accounting for much of the outcome difference between races.

In one trial mentioned previously [62], despite lower rates of timely angiography and lower use of drug-eluting stents, Black patients actually had the lowest in-hospital mortality rates. In comparison, Asian patients at the same center had the worst in-hospital mortality despite much higher use of early invasive treatments.

Following hospitalization, Blacks are less likely to be enrolled in cardiac rehab [73]. Among 822 patients referred, minorities initiated cardiac rehabilitation less often than did White patients, even after adjustment for gender, referral patterns, and the presence of copayment. For those that did participate, cardiac rehabilitation participation was associated with decreased mortality regardless of race.

These disparities are also not unique to Blacks, although data for other racial and ethnic groups is sparse. For example, readmission rates following acute MI are higher among Hispanic patients than Whites [74], and higher in Hispanic-serving hospitals as compared to non-Hispanic-serving hospitals.

### Quality of Life with Ischemic Heart Disease

For those who carry the diagnosis of IHD, racial differences occur in overall quality of life. Non-Hispanic Blacks and Native Americans have a greater number of unhealthy days compared to Whites[75]. For Native Americans particularly, these differences remained even after multivariable adjustment for age, sex, education, income, household size and healthcare coverage. Hispanics were also noted in the same analysis to report a poor health status overall.

An analysis of 24 years of data from the National Health and Nutrition Examination Survey Data [76] showed that from 1988-2012 anginal symptoms decreased among adults aged 65 or older among all races except Blacks. In patients diagnosed with stable coronary artery disease in a primary care setting [77] and assessed with the Seattle Angina Questionnaire-7, Blacks had more frequent anginal symptoms than other racial groups.

In TRANSLATE-ACS (Treatment with Adenosine Diphosphate Receptor Inhibitors: Longitudinal Assessment of Treatment Patterns and Events after Acute Coronary Syndrome), which followed patients symptoms following a MI, Blacks were more likely to have a statistically significant increase in reported anginal symptoms at both 6 weeks and 1 year when compared to other races.

### Conclusion

Extensive literature has shown that there are significant racial disparities in the prevention, recognition, management, and outcomes from ischemic heart disease. The solution to this complex issue will require a multifaceted approach. Ongoing research directed at improving access to medical care, eliminating bias in healthcare, improved preventative care and health literacy regarding coronary artery disease prevention will be needed to help eliminate disparities completely. The majority of the studies cited in this review reflect disparities between Blacks and Whites. This is in large part due to a significant discrepancy in the literature that exists for Blacks compared to other minorities, and further research and analysis is similarly needed in groups such as Hispanics, Asian Americans, Native Americans, and others.

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The authors have no relationship with industry and no potential conflicts of interest.

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