Race and Biology

BETH BAKER

Researchers grapple with health disparities, systemic racism.

In 2020, a confluence of events brought the ongoing legacy of structural racism front and center in the United States. As the COVID-19 pandemic spread, its lethal impact was far greater on African Americans, Latin Americans, and Native Americans than on others. At the same time, the world witnessed through mobile-phone videos the killings of George Floyd in Minneapolis and Ahmaud Arbery in Brunswick, Georgia, among other deaths. In July, science writer Christian Cooper, who was “birding while Black” in Central Park, was falsely accused of threatening a White woman. His video of the exchange went viral. Together, these events forced a national reckoning with racism and the systems that perpetuate inequities.

Across the country, millions protested peacefully under the banner of Black Lives Matter. Adding their

In 2020, as many as 26 million Americans participated in more than 4700 protests over the killing of George Floyd and other Black Americans, according to surveys, making it the largest such movement in US history. Scientific societies weighed in with strong statements against racism and systemic inequities. Photograph: Ross Wells.
voices were many scientific societies, including the American Institute of Biological Sciences (AIBS), which issued a statement in June saying that it “stands with all people and organizations working to end racism and injustice through peaceful protest, legal action, policy change, and systemic reform.”

On 10 June, thousands of academic researchers staged a 1-day strike, calling on the STEM (science, technology, engineering, and mathematics) fields to prioritize the needs of Black Americans. That was followed in July by the American Association for the Advancement of Science pledging to its 120,000 members to be more accountable in its diversity efforts.

Meanwhile, Representative Eddie Bernice Johnson (D–TX), chair of the House Committee on Science, Space, and Technology, asked the National Academies of Sciences, Engineering, and Medicine to investigate systemic racism in academic research. The House included $1.5 million for that purpose in the 2021 appropriations bill. As of this writing, the bill was pending.

Through public statements, policy initiatives, articles, and research, scientists are trying to make a difference by correcting longstanding inequities, especially those that contribute to racial health disparities, “Issues related to diversity, equity, and inclusion within the last couple of years have been on the forefront of thinking among scientific bodies, more so than at any other time,” says Michael Bamshad, division chief of genetics at University of Washington. “Issuing a statement is but a first step. It’s meaningful but it has to be followed by practical change.”

Pioneering racial “science”

From its beginning, the field of biology was enmeshed with racist ideas. In the eighteenth century, Carl Linnaeus, founder of modern taxonomy, classified humans into what became a racial hierarchy. As the Linnaean Society of London explains, in its effort “to confront the consequences of scientific racism,” in Linnaeus’s first nine editions of his famous work, Systema naturae, he described four “varieties” of humans (Europaeus albus, Americanus rubescens, Asiaticus fusus, and Africanus niger). In 1758, he went further, naming six varieties of humans and attributing each with behavior or personality traits, clothing, and type of government. For example, in the behavior category, the Americanus variety was supposedly “unyielding, cheerful, free”; the Europaeus was “light, wise, inventor”; the Asiaticus, “stern, haughty, greedy”; and Africanus, “sly, sluggish, neglectful.”

Others carried on his legacy. In the early nineteenth century, Samuel Morton amassed a collection of human skulls, whose size was correlated with intelligence, he argued, placing Whites at the top of the imagined hierarchy. The pseudoscience of craniology and phrenology, linking the size and shape of skulls to intelligence, held sway in the early to mid-nineteenth century, linking the size and shape of skulls to intelligence, held sway in the early to mid-nineteenth century, scientists were trying to make a difference by correcting longstanding inequities, especially those that contribute to racial health disparities, and a 2019 article in Advances in Physiology Education.

The ranks of White abolitionists included naturalist Henry Thoreau and British scientist William Allen, who cofounded the Pharmaceutical Society. They were among many prominent British and US scientific thinkers opposing slavery, albeit often from a paternalistic standpoint.
Fast forward to the twentieth century and the horrors of Nazi eugenics, whose roots were in both the German and the US scientific communities, the latter supported by the Carnegie Institution and the Rockefeller Foundation. After World War II, eugenics was finally condemned, and by 1950, the science of genetics was proving that humanity was not neatly divided into “races”—at least not biologically.

Modern genetics shows that roughly 94% of human genetic variation is found within populations, whereas only 6% is between populations (or “races”). Race, as it is now generally accepted by scientists, is not a biological reality but rather reflects the cultural and social underpinnings originally used to justify slavery and that live on in a myriad of ways.

Instead of race, geneticists now prefer the term genetic ancestry. Genomes from reference populations around the globe have been collected, with the most diversity found in African populations. “There is much more diversity between them than the combined African genome would have between the European genome,” says Nicolas Robine, director of computational biology at the New York Genome Center (NYGC), a nonprofit academic research institution that serves as a collaborative hub for genomic research. “The proportion that is variable is very small, compared to that which is common to everybody.”

As Angela Saini, whose parents emigrated to England from India, writes in her 2019 book Superior: The Return of Race Science, “Statistically this means that although I look nothing like the white British woman who lives next door to me... it’s perfectly possible for me to have more in common genetically with her than with my Indian-born neighbor who lives downstairs.”

No matter, White supremacists continue to misinterpret genetics to try to bolster their views. In response, the American Society of Human Genetics (ASHG) issued a strong statement in 2018 denouncing attempts to link their science to White supremacy. “Any attempt to use genetics to rank populations demonstrates a fundamental misunderstanding of genetics,” the statement read. It went on to urge scientists to “debunk genetics-based arguments promoting racial supremacy.”

“One doesn’t have to travel too deeply in the news to find notions of race conflated with ancestry in very deterministic ways,” says Bamshad. “As human geneticists, we bear responsibility in part to try and mitigate that, to educate researchers and the public at large.”
Genetics and racial health disparities

The major cause of health disparities is racism and its attendant ills, such as poverty, housing segregation, lack of quality education and health care, and chronic stress, say epidemiologists. Nevertheless, Robine says, “It’s worth studying the genetic effects as well, because we know that it plays a role and there is a path for us to identify the differences that we observe at the molecular level.”

At NYGC, researchers are identifying molecular differences in cancer profiles of populations from different ancestries that may lead to improved cancer testing and treatments for all, Robine says. In September, NYGC awarded a total $2 million to six projects through its Polyethnc-1000 initiative. The initiative was created in 2018 to help overcome inequities in the care of cancer patients.

For example, although African-American and Latin-American women have a lower lifetime risk of breast cancer, both groups have a higher mortality rate from the disease. NYGC has collaborators working with colleagues in Ghana and Ethiopia who have found that the genetic profiles of breast cancer tumors differ in those two countries. “When we study African-American women in the United States with breast cancer, if we observe similar signals in these patients to patients in Ghana, it points to an effect of genetic ancestry,” Robine says. “If there are differences, it points to potential environmental effects.” The results of these studies should be available within 2 years.

Brandon Mahal, a radiation oncologist at the University of Miami Health Center who studies prostate cancer, cautions that genetics should not be used to blame health disparities on African Americans’ being somehow innately more susceptible to ill health. “Genomics has been used the wrong way for many years,” he says. “There were a lot of efforts to ‘biologize’ race as the driver of disparities, but that’s a biased way to study genomics and is potentially a very destructive way.”

He and others say there is value in studying genomics in diverse cohorts, “but we need to be sure we’re doing it in the right way…. Studying diverse cohorts as a way to understand disease and the presentation of diseases in various populations is going to help us.” For example, relatively few Black patients have been included in research to develop prognostic models of cancer risk, and these models are less accurate in their prognostic ability outside of the White populations that the models were developed in, according to Mahal.

Black men in the United States and elsewhere have a higher risk of developing prostate cancer, are more likely to be diagnosed with an aggressive type, and have more than a twofold risk of dying from the disease in their lifetime. Randomized clinical trials have shown that across races, men have similar outcomes when given good treatment. By studying tumor genomics, researchers are seeing differences in types and frequency of mutation that may lead them to understanding African Americans’ increased risk of developing the disease. These differences are not necessarily inherited, says Mahal, and could be due to “environmental influences, other co-morbidities, diet, exercise, types of treatment, even racism that could lead to changes in the microenvironment and genome.”

He and others are comparing African-American men who have prostate cancer with patients of African descent in West Africa, the United Kingdom, and the Caribbean to identify what stressors and exposures there might be. “There could be components where there are disparities driven by ancestry, but it’s very important to study the environment in which patients live as possible drivers,” he says.

Interdisciplinary research is key

Genetic ancestry plays only a small role in explaining why most of the major causes of death and disability
in the United States (other than lung cancer and suicide) occur more frequently in Black people than in White, says cardiologist and epidemiologist Richard S. Cooper of Loyola University Chicago’s Stritch School of Medicine. Not only chronic conditions, such as diabetes and hypertension, but some infectious diseases too occur more frequently in African Americans and Native Americans, with deadly consequences, as COVID-19 grimly demonstrated. (Many nations in southwest and central Africa, the ancestral home to most African Americans, have relatively low numbers of COVID-19 as of this writing.)

In his decades of research on hypertension, Cooper has concluded that the search for some intrinsic difference, rather than external inequities, to explain why African Americans have higher rates of hypertension or other diseases is fruitless—or worse. It can perpetuate racism “by casting social reality as biological reality,” as he and Jay S. Kaufman wrote in *Hypertension* in 1998, a view that has only strengthened over time.

Researchers from many disciplines argue that science would get far more bang for its research buck by looking to solve broader societal contributors to disparities. Housing conditions, segregated neighborhoods, poverty, education, the burden of racism, environmental pollutants, and other factors are likely the main contributors to higher rates of disease and disability in marginalized groups. “We support wholeheartedly the study of health disparities from a wide range of disciplines,” says Michael Yudell, professor of community health and prevention at Drexel University. “Our issue is that race is a poor proxy to understand the biological factors underpinning health disparities.”

Yudell and colleagues initiated a public statement published in *Science* in September, urging the National Institutes of Health (NIH) to “confront the use of race in science.” The multidisciplinary list of signatories, initially at 70, has grown to 320 and counting. “There is an urgent need for NIH to provide scientists with information about what utility racial data have beyond fostering diversity in research, how such information should or should not be used in data analysis, and what identifiers of human populations might be better suited for use in biomedical research,” the statement said. The group urges the NIH to lead efforts to educate scientists and the public about human genetic diversity and “to develop a consensus statement on best practices in genetic, clinical, and social scientific studies for characterizing human genetic diversity.”

With COVID-19, for example, the increased incidence and mortality seen among Black Americans, Latin Americans, and Native Americans had little to do with genetics, says Cooper. People who had to show up for work or who live in multigenerational households were far more likely to become infected, he notes in an unpublished article, and the highest death rates in New York City could “be tracked with precision to the minority ZIP codes of the Bronx, Brooklyn, and Queens…. That story is not a mystery to anybody.”

A study published in November in *Nature* used mobile-phone data to track how COVID-19 was spread in the early months of the pandemic. It confirmed that people in low-income neighborhoods were more likely to get the disease because they were less able to work from home, and the stores where they shopped were smaller and more crowded. “As a result, a shopping trip is twice as risky as it is for someone from a wealthier area.”

Luisa Borrell, a social epidemiologist at the City University of New York Graduate School of Public Health and Health Policy, studies allostatic load among different populations. “The
Concept of allostasis refers to our ability to respond and manage stress through our physiological system changes,” she explains. “When we talk about allostatic load, we use a summary or index of multi-system risks that captures this physiological process. We use markers of heart disease, metabolic syndrome, and inflammation such as blood pressure, glycated hemoglobin level, and C-reactive protein—these that react to stress or to insults within our body.” When such stress or insults accumulate, she says, “the body loses the elasticity or its ability to respond.” A multidisciplinary research team also is investigating if there are genetic mutations related to living in a particular neighborhood and how these mutations relate to childhood asthma.

In a 2019 study in *PLOS ONE*, Borrell and colleagues looked at mortality rates, both all-cause and cardiovascular specific, among White, Black, and Mexican Americans in the United States and the allostatic load they bear. High allostatic scores were associated with older age; with being Black or Mexican American, widowed, less educated; and with having low income. Mortality rates were directly associated with allostatic load scores.

“We found that allostatic load has a stronger effect in younger African Americans and Mexican Americans,” says Borrell, with those under 65 more likely to die prematurely. “That may suggest that allostatic load is deteriorating or aging minority individuals faster than Whites.”

Studying the allostatic load of something as complex as structural racism is difficult, says Borrell. “We really need to invest and learn how to measure it, document it, monitor it, and do something to either prevent it or eliminate it. This is crucial for an equitable society as racism at all levels affects everyone.”

Nancy Krieger, Harvard professor of social epidemiology, developed the ecosocial theory of disease distribution and its analytic construct of “embodiment,” the idea that our bodies reflect the conditions in which we grow and develop, beginning in utero. Among the many factors she has identified: food insecurity and fast-food prevalence, poor sanitation and lack of potable water, discrimination, toxic exposure, ergonomic strain, and lack of good healthcare, with the distributions of these exposures structurally shaped by a society’s political economy, political ecology, and social history. The reverse of these—healthful living conditions, access to good medical care—also shows up in the body. Ignoring these conditions and
focusing on a “disembodied and decontextualized” gene or lifestyle, she argues, will not lead to human health and well-being.

“She embodies the societal and ecological context in which they live,” she says. She has conducted research, for example, on the impact of growing up in the Jim Crow South and how this has affected the contemporary risk of the type of breast cancer diagnosed among African-American women in relation to estrogen receptor status. To understand big questions related to public health, Krieger says, “You need people to work in interdisciplinary teams,” with biologists having a big role to play.

**The new field of social epigenomics**

In 2017, the National Institute on Minority Health and Health Disparities (NIMHD), part of the NIH, initiated a social epigenomics research program. Along with the NIMHD, the $43.6 million program was funded by the National Cancer Institute, the National Institute on Aging, and the National Human Genome Research Institute. “Social epigenomics is the impact of social and environmental factors and how that manifests biologically through genetic changes in response to those stresses,” explains Anna Nápoles, scientific director of the Intramural Research Program at the NIMHD. These stresses “don’t change the underlying human genome, but they affect gene expression.”

As a social epidemiologist, Nápoles looks at the chronic stress of racial discrimination and the effects of social inequality, and how those influence biological pathways that in turn affect health, whether through the vascular, inflammatory, or immune system response. Longitudinal studies are examining how poverty or access to good nutrition and education in early childhood affect biology later in life.

Nápoles says that she is optimistic that the painful events of 2020 will lead to significant progress. “It’s creating many opportunities to focus on these social and environmental factors...”

According to the Centers for Disease Control and Prevention, people from some racial and ethnic groups are disproportionately represented in work settings deemed essential, putting them in contact with the public, without paid sick days, and unable to work from home. This puts them at greater risk of contracting and dying from COVID-19. Shown here are Brooklyn Hospital staff in May 2020. Photograph: Adjajo, https://creativecommons.org/licenses/by-sa/4.0/legalcode
that lead to chronic stress, including structural racism. It's opened up many opportunities to work with other investigators to draw attention at a national level and hopefully we'll see some benefits in terms of improved outcomes for populations who are really suffering these disparities."

Another interdisciplinary path for biologists is through the environmental justice movement, says plant ecologist Steward Pickett at the Cary Institute of Ecosystem Studies and AIBS Board member. His perspective stems from his "identity as an African American and the experiences growing up as Jim Crow was giving way to the civil rights movement," he says. "That was a clear point of progress and informs my views of how progress was made then and my expectations of how it could be made now."

As an urban ecologist, he works closely with social scientists. "Biology can learn a lot from the scholarship and activism of environmental justice," he says. "One of the things that a lot of people are coming to realize is that it's not just really about individual behaviors—of course individual behaviors of discrimination and bigotry are harmful and can be fatal, but what people are coming to understand is there are large networks of interaction that are involved with keeping this racial hierarchy in place and separating people by race and class. We have an opportunity to say, hey, this is not just about people's genetics or natural characteristics. It's not natural that segregation exists—it's a social product.... That means [it] can be altered if society chooses."

Working in communities that have long been neglected also gives scientists the opportunity to engage in dialogue with residents, and "you find yourself answering questions of scientific interest but also you're answering questions of interest to them, to help them be part of the larger solution."

One example is the growing understanding at the local level of the impact of global warming on urban communities. "People are looking very closely at how the thermal environment plays out where Black and Brown and Indigenous people are often segregated in urban environments," says Pickett. "It's now becoming obvious at local and state scales, they can do things to improve the built environment. There's a lot of possibility for greening." He and many others stress the importance of having a more diverse community of scientists to tackle urgent questions.

In another step, the ASHG recently began publishing *Human Genetics and Genomics Advances*, a new open-access online journal that seeks to create more opportunities for researchers to address issues of diversity, equity, and inclusion. They have assembled a diverse roster of associate editors. Bamshad, as editor in chief, says that they intend "to think hard about ways we can improve equity in the publishing of scientific content."

One creative biologist who gave voice to racial justice is Scott Edwards, Harvard professor of organismic and evolutionary biology. During the early days of the pandemic, Edwards, who is African American, bicycled across the country, birdwatching along the way and sharing his journey on Twitter. After George Floyd was killed, Edwards hung a Black Lives Matter sign on his bike and started a GoFundMe campaign, raising $57,000 to support economically disadvantaged students from diverse backgrounds in their studies of evolutionary biology and biodiversity.

And David Linden, a neuroscientist with Johns Hopkins School of Medicine and author of *Unique: The New Science of Human Individuality*, offers a webinar entitled "The Scientific Case against Racism." He urges biologists to more intentionally share with the public the science that undercuts racism. "The scientific case is not the be all and end all about consideration of racism," he says. "Racism is also morally wrong and an affront to human dignity. It's best understood by the lived experience of people who endure it. Scientists are one seat of many at the antiracist table."

Beth Baker (bbaker@aibs.org) is a freelance journalist and Features editor of BioScience.