

Uncovering Glaucoma's Vascular Link in People of African Descent

Alon Harris, MS, PhD, FARVO, has committed 30 years of research to chipping away at the notion that intraocular pressure (IOP) is the predominant risk factor for open-angle glaucoma (OAG), particularly in people of African descent. Through his internationally acclaimed work, the Professor of Ophthalmology and Vice Chair of International Research at the Icahn School of Medicine at Mount Sinai has demonstrated that vascular abnormalities can result in reduced blood flow through the retrobulbar vessels and within the retina, which, in turn, are predictive of worse glaucoma progression in people of African descent.

With the help of funding from the National Institutes of Health (NIH) and the National Science Foundation, Dr. Harris and his team are taking that research to the next level by integrating artificial intelligence (AI) and mathematical modeling with clinical and research data to better understand the role that race—as well as other risk factors, such as structural properties of the eye, ocular blood flow, and systemic conditions—plays as a risk modifier and contributor to OAG pathophysiology. For this purpose, Dr. Harris has assembled a multidisciplinary research team comprising glaucoma specialists, physiologists, mathematicians, and bioengineers.

“The only risk factor that has been approved by regulatory authorities for treating glaucoma is high intraocular pressure,” says Dr. Harris. “But our research over the years has shown that maintaining normal blood supply to the eye can help to prevent or curb steep glaucoma progression and ensure better visual outcomes by preserving the optic nerve structures. These include the ganglion cells, nerve fibers, and optic nerve. Future treatments may target vascular tissues if these findings are confirmed in larger longitudinal studies.”

Glaucoma is the leading cause of irreversible blindness in people of African descent. Specifically, this population experiences a threefold greater OAG burden compared to people of European descent, with earlier onset and faster disease progression. Not coincidentally, Dr. Harris points out that people of African descent tend to have more systemic vascular disease, including considerably higher rates of cardiovascular disease, diabetes, obesity, smoking, and sedentary lifestyle.

Dr. Harris presented some of the first findings on vascular health differences in African Americans in the 1990s. That research helped to spin off other studies that showed these disparities may include lower vascularity and perfusion of the retina, as well as lower blood flow supplying ocular tissues, and disturbances in retinal oxygen metabolism. And in a landmark population-based study conducted in Thessaloniki, Greece, Dr. Harris, as Co-Principal Investigator, found that low diastolic ocular perfusion pressure—calculated as systemic blood pressure minus intraocular pressure—may be associated with increased risk for glaucoma, particularly in patients treated with antihypertensive medications.

Dr. Harris sees mathematical modeling and AI as essential strategies to build on these earlier results. “To understand the pathophysiology of glaucoma and identify modifiable risk factors beyond IOP, we need to develop a new generation of models that are able to describe the coupling of systems like the biomechanics of ocular tissues, the hemodynamics of ocular blood flow, and the functionality of retinal ganglion cells,” he explains. Modeling and AI in conjunction with clinical and research data can serve as a “virtual lab,” he adds, where risk factors can be isolated and assessed independently of each other, leading to the design of further clinical studies towards individualized medicine.

To that end, Dr. Harris cites the considerable resources he has been able to tap into since moving his lab to the Department of Ophthalmology at New York Eye and Ear Infirmary of Mount Sinai two years ago from Indiana University School of Medicine. As he puts it, “The access to advanced imaging like OCTA coupled with incredibly skilled glaucoma specialists and a wide variety of patients and ethnicities have provided a unique platform to unravel the many questions around glaucoma that remain unanswered.”

With Dr. Harris's findings published in more than 380 peer-reviewed manuscripts and 22 books, it has been gratifying to see recognition for his work not only from his peers but also from the NIH. To date, his study of glaucoma disparity among people of African descent, stemming from retinal and retrobulbar vascular impairments, has received \$3,242,699 in federal support, with a new NIH RO1 grant of \$1.2 million awarded in 2022.



Alon Harris, MS, PhD, FARVO, at the World Trade Center Oculus