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Social Determinants of Health and Glaucoma Screening and Detection in the SIGHT Studies

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Abstract

Purpose: To describe the neighborhood-level social risk factors across the three SIGHT Study sites and assess potential characteristics of these populations to help other researchers effectively design and implement targeted glaucoma community-based screening and follow-up programs in high-risk groups.

Methods/Results: In 2019, Columbia University, University of Michigan, and University of Alabama at Birmingham each received 5 years of CDC funding to test a wide spectrum of targeted telehealth delivery methods to detect glaucoma in community-based health delivery settings among high-risk populations. This collaborative initiative supported innovative strategies to better engage populations most at risk and least likely to have access to eye care to detect and manage glaucoma and other eye diseases in community-based settings. Among the initial 2,379 participants enrolled in all three site SIGHT Studies; 27% screened positive for glaucoma/glaucoma suspect. Of all SIGHT Study participants, 91% were 40 years of age and older, 64% identified as female, 60% identified as African-American, 32% identified as White, 19% identified as Hispanic/Latino, 53% had a high school education or less, 15% had no health insurance, and 38% had Medicaid insurance. Targeted glaucoma screenings in populations with high levels of poverty and high proportions of people who identify as African American, Hispanic/Latino identified a 27% rate of glaucoma and suspected glaucoma, three times the national average.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Conclusion: These findings were consistent across each of the SIGHT Studies, which are located in three geographically distinct US locations in rural Alabama, small urban locations in Michigan, and urban New York City.

Précis:

Targeted glaucoma screenings in populations with high levels of poverty and high proportions of people who identify as African American, Hispanic/Latino identified a 27% rate of glaucoma and suspected glaucoma, which is three times the national average.

Keywords

Vision screening; Telemedicine; Telehealth; CDC; Glaucoma; Social determinants of health

Introduction

The conditions into which we are born, grow, live, learn, work, and age are referred to as social determinants of health and affect a wide range of health outcomes. *Healthy People 2030*, the *American Academy of Ophthalmology Task Force on Eye Health Disparities* and the *World Health Organization (WHO)* outlines the following six key areas of social determinants of health: (i) health care system, (ii) community and social context, (iii) food, (iv) education, (v) neighborhood and physical environment, and (vi) economic stability.[1–3] The Kaiser Family Foundation details each of these concepts, for example the health care system includes insurance coverage, provider availability, provider linguistic and cultural competency, and quality of care.[4] Community and social context includes social integration, social support systems, community engagement, discrimination, and stress. Food refers to both having sufficient quantity of food and access to healthy food options. Education includes language, literacy, early childhood education, vocational training, and higher education. The neighborhood and physical, or built, environment includes housing, transportation, safety, parks, playgrounds, green space, walkability, and geography.[4] Economic stability includes employment, income, expenses, debt, medical bills, and economic support. [5] While social determinants of health can negatively and positively affect society at-large, social risk factors describe how social determinants of health negatively affect individuals.[6] Understanding how these six domains of social determinants of health confer social risk for poor health outcomes is imperative for designing appropriate research studies, community-based programs, and policies.

In 2021, the National Eye Institute released its strategic plan which emphasized the need to understand and address eye health disparities in order to eliminate vision loss and improve quality-of-life.[7] Glaucoma is one of the leading causes of vision loss and blindness in the United States. The prevalence of glaucoma is much higher among people with lower socio-economic status and in people who identify as African-American or Hispanic/Latino, who also present to the healthcare system with more severe glaucoma compared to non-Hispanic Whites.[8–10] In 2012, the United States Centers for Disease Control (CDC) Vision Health Initiative began funding research to improve glaucoma detection in high-risk populations by creating novel research interventions to reach people with extensive social risk factors for developing vision loss. This research led to innovative community-based outreach strategies,

including using mobile technologies to bring eye care to communities with high rates of poverty and deprivation, and telemedicine to provide specialty glaucoma support to optometrists working at local Walmart stores in Alabama.[11,12]

To build upon this research, in 2018 the United States' Centers for Disease Control (CDC) issued a grant opportunity entitled, *Improving Detection and Management of Glaucoma and Other Eye Diseases Among High-Risk Populations*. This initiative supported innovative strategies to better engage populations most at risk and least likely to have access to eye care to detect and manage glaucoma and other eye diseases in community-based settings. In 2019, Columbia University, University of Michigan, and University of Alabama at Birmingham each received 5 years of CDC funding to test a wide spectrum of targeted telehealth delivery methods to detect glaucoma in community-based health delivery settings among high-risk populations. Sites are using ophthalmic technicians, community health workers, patient navigators, and/or health coaches to improve follow-up eye exam adherence in those detected with glaucoma and other ocular conditions. The three universities established the *Screening and Interventions for Glaucoma and Eye Health Through Telemedicine* (SIGHT) network (SIGHTStudies.org) to describe the strategies being tested. These SIGHT Studies are being conducted in the urban Northeast (New York, NY), semi-urban Midwest (Flint and Ypsilanti, MI), and the rural South (Centreville (Bibb County), Maplesville (Chilton County), and Marion (Perry County), Alabama) and provide assessments of different engagement strategies in heterogeneous geographical locations. The three SIGHT Studies employed different strategies to detect glaucoma, yet all three sites detected similar rates of glaucoma/suspected glaucoma (24% to 33%), three times the national average of 8%.[13] Clearly, targeted screenings in high-risk populations and innovative engagement strategies used in the SIGHT Studies were effective at detecting glaucoma and other eye diseases, even during the COVID-19 pandemic.

The purpose of this paper is to describe the neighborhood-level social risk factors across the three SIGHT Studies and assess potential characteristics of these populations to help other researchers effectively design and implement targeted glaucoma community-based screening and follow-up programs in high-risk groups.

Methods

Institutional Review Board approval for these three studies was obtained at each site and all participants completed written informed consent. The studies all adhered to the principles of the Declaration of Helsinki.

In New York City (NYC-SIGHT), Columbia University Department of Ophthalmology researchers designed the *Manhattan Vision Screening and Follow-up Study* (NYC-SIGHT) and partnered with the NYC Housing Authority (NYCHA) and the NYC Department for the Aging. Community-based eye health screenings were conducted in affordable (public) housing developments and senior centers in Harlem and Washington Heights neighborhoods, as these locations serve people who have high rates of poverty and a high proportion of people who identify as African American and Hispanic/Latino.[14] The NYC-SIGHT study enrolled 708 participants from March 1, 2021 to May 31, 2022 and provided patient

navigators and free eyeglasses to participants randomized to the intervention group. This location is investigating if additional patient navigator support will improve adherence to recommended follow-up appointments for those referred to ophthalmology compared to usual care after a 1-year period.

At the University of Michigan, the *Michigan Screening and Intervention for Glaucoma and Eye Health through Telemedicine Study* (MI-SIGHT) partnered with a free clinic and a Federally Qualified Health Center (FQHC) to set up a telemedicine-based eye health screening and low-cost glasses program in these primary care clinics that each serve small urban cities with high rates of poverty and high proportions of people who identify as Black.[15] The MI-SIGHT study enrolled 1171 participants in its first year cohort between June 28, 2020 to January 26, 2022. In order to support people who screened positive for glaucoma and eye disease in obtaining the necessary follow-up eye care, MI-SIGHT also provided education and health care navigation. The study is also testing whether personalized education and coaching will improve adherence to recommended ophthalmology follow-up care compared to usual care.

At the University of Alabama at Birmingham, the *Alabama Screening and Intervention for Glaucoma and Eye Health through Telemedicine Study* (AL-SIGHT) has implemented a telemedicine-based detection and management strategy for glaucoma and other eye diseases in patients seen at FQHCs located in rural Alabama in an area with the highest concentration of people who identify as African American in the United States; this area also has very few eye care resources.[16] The AL-SIGHT study enrolled 500 participants from November 1, 2020 to June 30, 2022. The AL-SIGHT study is also evaluating whether evidence-based glaucoma education improved adherence to recommended follow-up glaucoma care. An additional intervention arm adds a financial incentive to participants who were recommended for follow-up eye care with an ophthalmologist or optometrist.

Individual level demographic characteristics and social determinants of health data, including age, gender, race, ethnicity, health insurance status, and education were collected from participants in all three sites. Glaucoma screening status (positive or negative) was collected from all three sites and has been previously described.[14–16] Participants' addresses at the time of enrollment were mapped to 12-digit Federal Information Processing Standards (FIPS) codes using ArcGIS (ArcGIS Pro version 2.8, Esri Inc., Redlands, CA). The FIPS codes contain census tract and census block group numbers which were used to link participants to neighborhood-level characteristics. The neighborhood-level characteristics were obtained from the 2015–2019 American Community Survey (ACS) 5-year estimates using PolicyMap (Philadelphia, PA), a cloud-based data analytics tool,[17] and to the US Census Data for Area Deprivation Index (ADI) national decile score.[18] The ADI is a factor-based index that uses seventeen US Census-based poverty, education, housing quality, and employment indicators to characterize and rank the socioeconomic contextual disadvantage of a particular neighborhood. The ADI national percentile score ranges from 1–100 and the state decile score ranges from 1–10, with higher values indicating more socio-economic deprivation. The ACS estimates are not published for areas in which the sample size is too small to protect individuals' privacy. In addition, persons who provided a P.O. Box number were excluded because of uncertainty on the actual census tract or block group in which

they resided. Thus, certain neighborhood-level variables were not available for all study participants.

The following neighborhood-level variables were assessed: income per capita, national ADI rank, state ADI rank, and percent of people who: identify as people of color (defined as anyone who does not identify as White), have Medicaid, have no insurance, have no car, are cost-burdened by their mortgage, and are cost-burdened by their rent. The average number of cars per household and urban vs rural designation was also assessed. Owner and renter cost burden is defined as gross rents/mortgages that are ≥ 30% of household income. Neighborhood level variables were calculated for each geographic site and compared between the program site and the program state average using descriptive statistics.

RESULTS

Social Risk Factors in the SIGHT Studies Cohorts

Baseline demographic and clinical characteristics are shown in Table 1 among the initial 2,379 participants enrolled in all three site SIGHT Studies; the average rate among the sites for screening positive for glaucoma/glaucoma suspect was 27%.[14–16] Of all SIGHT Study participants, 91% were 40 years of age and older, 64% identified as female, 60% identified as African-American, 32% identified as White, 19% identified as Hispanic/Latino, 53% had a high school education or less, 15% had no health insurance, and 38% had Medicaid insurance (Table 1). Of the study participants in NYC-SIGHT, 10 out of 10 (100%) NYCHA buildings were geocoded; in MI-SIGHT, 1142/1171 (98%) addresses were geocoded; in AL-SIGHT, 430/500 (86%) addresses were geocoded. The neighborhoods from which each program recruited all had increased levels deprivation and increased proportions of African-American individuals compared to national averages.[19]

Among NYC-SIGHT participants, the average income per capita of participants' neighborhood was lower than the state average and the percent of people of color, percent of people with Medicaid, and percent of people without insurance were higher than New York state averages (Table 2). The NYC-SIGHT participants lived in areas with less deprivation overall compared to New York state averages. In MI-SIGHT, compared to Michigan state averages, participants had lower per capita income and lower number of cars per household but higher area deprivation, greater percent of people of color, and greater percent of people with Medicaid, people without insurance, and people who were burdened by their rent or mortgage payment in their neighborhood. Compared to the Alabama state average, AL-SIGHT participants live in more rural areas, live in neighborhoods with a lower per capita income and a higher percentage of Medicaid beneficiaries. While AL-SIGHT participants' neighborhoods have a lower percentage of people of color and a lower percentage of people without insurance compared to state averages, overall Alabama has the highest levels of deprivation throughout the state compared to Michigan or New York (Table 2).

Discussion

Targeted glaucoma screenings in populations with high levels of poverty and high proportions of people who identify as African American, Hispanic/Latino identified a 27%

rate of glaucoma and suspected glaucoma, which is three times the national average.[20] These findings were consistent across each of the SIGHT Studies, which are located in three geographically distinct locations across the US: rural Alabama, small urban locations in Michigan, and urban New York City. In New York City, the neighborhoods surrounding the NYCHA affordable housing developments have become somewhat gentrified, but the people living within the housing developments are still, by definition, living with limited means at the poverty level.[21] In Michigan, screenings took place at a free clinic and at a FQHC in two communities with high poverty rates and recruited people from clinics as well from the surrounding community. In Alabama, the program took place in FQHCs in a region that is largely rural, had high levels of economic deprivation and where over 50% of the population identified as African American.

In both 2013 and 2022, the United States Preventive Services Task Force (USPSTF) concluded that insufficient evidence exists to assess the balance of benefits and harms of screening for primary open angle glaucoma in adults.[22–24] One challenge identified by the USPSTF is that even with highly accurate screening, with the relatively low prevalence of primary open angle glaucoma in the general population, screening will generate too many false positive referrals, burdening both individuals and the healthcare system. However, this challenge needs to be weighed against the reality that 50% of people with glaucoma remain undiagnosed.[25] As the SIGHT Studies investigators described in an editorial in the *Journal of Glaucoma*, when the prevalence of glaucoma in a particular community shifts from the average in the United States population of 1.4% to the 25% level initially detected in the SIGHT Studies, the false discovery rate decreases from 79% to 14%, putting many fewer people at risk for overtreatment and many more in a position to have their glaucoma treated to mitigate vision loss.[26] What is fascinating about this finding is that national policy has long been dictated by nation-wide averages. While the nation-wide rate of glaucoma is low, the SIGHT Studies results demonstrate that targeted eye health screening strategies within FQHCs, affordable housing developments, and senior centers effectively reached high-risk groups and detected substantially high glaucoma/suspect rates. Policy change should address the “how” of directing resources towards communities with high-risk populations of people who would benefit from targeted glaucoma screening.

Using census data to identify communities with high proportions of people living in poverty – which can be identified by metrics such as a high ADI, a low per capita income or a high percent of people with Medicaid compared to state averages - and high proportions of people who identify as African American, Latino or Hispanic -- will help identify communities in which glaucoma detection and treatment programs could help mitigate vision loss on a population level. A new tool that could also help identify appropriate neighborhoods is the Climate and Economic Justice Screening tool[27] that uses census tract data to identify neighborhoods with high levels of poverty, unemployment, pollution, lack of infrastructure, inadequate housing, high rates of chronic disease, and high proportions of people who do not speak English along with other economic indicators. If a state is interested in creating a glaucoma detection program, using this tool, alongside other census data, would help implement programs in areas where glaucoma may be detected at rates as high as in the SIGHT Studies. Leveraging FQHCs to offer high quality eyecare or bringing eye care to affordable housing developments and senior centers- infrastructure which already

exist in medically underserved communities – could be a way to implement glaucoma detection programs nationally. Using community-based engaged research strategies to inform community outreach will likely improve engagement of these medically underserved communities when programs are being implemented.[28] High program satisfaction and consideration of providing low-cost, affordable glasses as part of the eye disease detection programs are also important factors in sustaining community involvement.[29]

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Conflicts of Interest:

The funding organizations had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. No author has a financial or proprietary interest in any material or method mentioned.

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Table 1.

Baseline participant characteristics across three sites.

	Columbia (n=708) n (%)	UM (n=1171) n (%)	UAB (n=500) n (%)	Combined Non-missing Total (%)
Age Category (years), n (%)				
18–39	0 (0)	173 (14.8)	43 (8.6)	213 (9.0)
40–59	170 (24.0)	513 (43.8)	247 (49.4)	924 (38.8)
60–79	416 (58.8)	452 (38.6)	192 (38.4)	1066 (44.8)
≥80	122 (17.2)	33 (2.8)	18 (3.6)	176 (7.4)
Sex, n (%)				
Female	461 (65.1)	721 (62.3)	322 (64.4)	1504 (63.6)
Male	247 (34.9)	437 (37.7)	178 (35.6)	862 (36.4)
Race, n (%)				
African American	357 (50.4)	591 (54.1)	228 (45.6)	1176 (59.9)
White	4 (0.5)	371 (33.9)	258 (51.6)	633 (32.3)
Other (Asian, American Indian/Alaska Native, and multiracial)	7 (1.0)	131 (12.0)	14 (2.8)	152 (7.8)
Ethnicity, n (%)				
Hispanic	297 (41.9)	101 (10.4)	5 (1.0)	403 (18.5)
Non-Hispanic	411 (58.1)	867 (89.6)	495 (99.0)	1773 (81.5)
Education, n (%)				
Less than high school	214 (30.2)	119 (10.3)	119 (23.8)	452 (19.2)
High school degree or equivalent	232 (32.8)	373 (32.4)	187 (37.5)	792 (33.6)
Some college, college graduate, or graduate degree	262 (37.0)	659 (57.3)	193 (38.7)	1114 (47.2)
Medical Insurance, n (%)				
Yes	675 (95.3)	914 (80.0)	417 (83.4)	2006 (85.4)
No	33 (4.7)	228 (20.0)	83 (16.6)	344 (14.6)
Insurance Type, n (%)				
Medicare	405 (57.2)	325 (27.8)	160 (32.0)	890 (37.4)
Medicaid	389 (54.9)	419 (35.8)	101 (20.2)	909 (38.2)
Private, supplemental, or other	209 (29.5)	311 (26.6)	251 (50.2)	771 (32.4)
Glaucoma/glaucoma suspect status, n (%)				

	Columbia (n=708)	UM (n=1171)	UAB (n=500)	
	n (%)	n (%)	n (%)	Combined Non-missing Total (%)
Screened Positive	189 (26.7)	284 (24.3)	165 (33.0)	638 (26.9)

*Missing: UM: sex n=13; race n=78; ethnicity n=203; education n=20; medical insurance n=29, glaucoma status n=7; Columbia: race n=340; UAB: education n=1.

UM, University of Michigan. UAB, University of Alabama at Birmingham.

Table 2.

Comparison of neighborhood level variables between the program site and the program state national average.

Continuous Variable	NY State Avg	Columbia Median (IQR); Mean	MI State Avg	UM Median (IQR); Mean	AL State Avg	UAB Median (IQR); Mean
Income per capita ($USD) *	41,610.7	18,305.0 (14,713.0–36,092.0); 27678.5	32,346.8	22,226.0 (15,433.0–31300.0); 25,508.3	27,917.4	20908.0 (13550.0–26318.0); 21355.8
National ADI Rank *	33.7	19.0 (5.0–23.0); 17.7	64.9	92.0 (65.0–99.0); 79.7	71.3	86.0 (75.0–93.0); 82.6
State ADI Rank *	5.5	5.0 (2.0–6.0); 4.3	5.5	9.0 (5.0–10.0); 7.4	5.5	7.0 (5.0–9.0); 6.9
Neighborhood People of Color (%) *	42.8	96.4 (83.5–99.2); 90.9	26.0	47.6 (22.2–84.2); 51.5	37.3	30.8 (11.1–59.0); 37.9
Neighborhood Medicaid (%) †	26.1	48.3 (33.2–53.0); 44.6	26.8	41.5 (18.8–56.0); 38.9	21.0	23.0 (17.5–36.9); 27.1
People with No Insurance (%) †	5.4	7.5 (3.8–12.2); 8.2	5.6	5.2 (3.3–8.0); 5.6	9.9	7.4 (5.4–11.9); 9.2
Household with No Car (%) †	26.4	82.5 (78.3–84.9); 80.6	8.3	10.8 (4.4–18.6); 13.0	6.6	4.2 (2.1–9.6); 6.7
Average Number of Cars per Household †	1.3	0.2 (0.2–0.2); 0.2	1.8	1.5 (1.2–1.8); 1.5	1.9	1.9 (1.6–2.2); 1.9
Owner Cost Burden (%) *	29.1	80.4 (0.0–100.0); 60.1	19.7	20.7 (12.9–31.8); 23.8	18.2	13.9 (6.7–29.4); 19.7
Renter Cost Burden (%) *	46.2	54.3 (39.8–60.3); 51.9	41.1	49.0 (31.0–66.2); 48.3	36.6	36.1 (0–53.9); 33.3
Categorical Variable	**State N/Total (%)**	**n (%)**	**State N/Total (%)**	**n (%)**	**State N/Total (%)**	**n (%)**
Urban *	4179/4858 (86.0)	10 (100.0)	2007/2756 (72.8)	1019 (92.0)	2555/3925 (65.1)	43/430 (10.0)

ADI, Area Deprivation Index. SNAP, Supplemental Nutrition Assistance Program. USD, United State Dollar. IQR, Interquartile Range. Avg, Average. NY, New York. UM, University of Michigan. UAB, University of Alabama at Birmingham.

*Census block group level.

†Census tract level.