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Healthcare Access and Utilization among Glaucoma Patients in a Nationwide Cohort

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Abstract

Précis: Despite having lower socioeconomic status on several measures, glaucoma patients do not report more barriers to healthcare access and utilization than non-glaucoma patients.

Purpose: To characterize measures of socioeconomic status and barriers to healthcare access and utilization between patients with and without a diagnosis of glaucoma.

Patients and Methods: Patients aged 65 years and over enrolled in the NIH *All of Us* Research Program, a nationwide longitudinal cohort, were extracted. We analyzed demographic information as well as several measures of socioeconomic status and healthcare access and utilization. Survey responses were compared by glaucoma status (any type) with Pearson's chi-square tests, univariable logistic regression, and multivariable logistic regression adjusting for age, gender, race/ethnicity, and insurance status.

Results: Of the 49 487 patients who answered at least one question on the *All of Us* Healthcare Access and Utilization Survey, 4441 (9.0%) had a diagnosis of glaucoma. The majority of the cohort was female (28 162, 56.9%) and non-Hispanic White (42 008, 84.9%). Glaucoma patients were observed to have lower rates of education (p=0.004), employment (p<0.001), and home ownership (p<0.001) on chi-square tests. On multivariable logistic regression models, those with glaucoma were significantly more likely to speak to an eye doctor (OR: 2.46; 95% CI: 2.16–2.81) and significantly less likely to have trouble affording eyeglasses (OR: 0.85 95% CI: 0.72–0.99) in the prior year than those without a diagnosis of glaucoma. No significant association was found for other measures of healthcare access and utilization by glaucoma status.

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Conclusion: Although glaucoma patients aged 65 years and over fared worse on several measures of socioeconomic status, no significant difference was found in measures of healthcare access and utilization.

Keywords

INTRODUCTION

Glaucoma is a progressive neuropathy of the optic nerve and is the leading cause of irreversible blindness worldwide, with more than 70 million affected individuals.[1] Glaucoma prevalence is only expected to rise in the coming decades as the global population ages.[2] In the United States, current annual healthcare expenditures attributable to glaucoma are estimated to be over $9 billion in total and over $1800 per diagnosis, largely due to expenditures in prescription medications.[3] Glaucoma care is costly because proper management consists of close monitoring of optic nerve health and may include complicated and expensive medical and surgical regimens in order to manage intraocular pressure – the main modifiable risk factor for disease progression.[4]

The cost of glaucoma care may be unmanageable for lower income patients in the United States. There is evidence that lower socioeconomic status is associated with glaucoma progression,[5] which may be mediated through poor medication adherence[6,7] or less utilization of ophthalmologic care.[8] Further, glaucoma patients have been shown to have poorer medication adherence than individuals without glaucoma,[9] making them a high risk group. However, whether glaucoma patients differ from non-glaucoma patients with respect to other barriers of healthcare access and utilization, such as affordability and delays in care, is less clear.

In this study, we explored demographics, socioeconomic factors, and barriers to healthcare access and utilization in a large nationwide cohort, and compared by glaucoma status. Understanding barriers that glaucoma patients may have in accessing healthcare services is essential to designing interventions to ensure patients obtain appropriate care to protect their vision.

METHODS

Study Population

We obtained data from the National Institutes of Health (NIH) *All of Us* Research Program, a nationwide database highlighting diversity aiming to enroll at least 1 million people.[10] *All of Us* collects a wide range of data from participants, including electronic health record (EHR) data, physical measurements, wearable data, biospecimens, and survey data.[10] Participants provided written informed consent at enrollment in the study, which was approved by the NIH *All of Us* Institutional Review Board (IRB). Data are de-identified by *All of Us* prior to becoming available to researchers.[10] University of California San Diego (UCSD) IRB and Ethics Committee consultation was sought to determine whether

application for formal approval was necessary. Secondary analyses of de-identified data, such as evaluated for our study, are considered non-human subjects research by the UCSD IRB, and they did not require additional approvals. The study adhered to the tenets of the Declaration of Helsinki. Per the All of Us Research Program data sharing policies, cells with less than 20 respondents are suppressed. At the time of our analysis, 331 360 participants were contained in the latest v5 dataset.

We studied adults who participated in the Healthcare Access and Utilization Survey, a nationwide survey administered by the NIH *All of Us* Research Program which was originally derived from the National Health Interview Survey.[11] Surveys were answered from June 2016 to March 2021. A total of 124 528 individuals were identified in the *All of Us* database who answered the Healthcare Access and Utilization Survey, of whom 49 487 (39.7%) were aged 65 and over (Figure 1). We then included only those individuals aged 65 years and over to capture the experience of elderly adults and to minimize age effects when comparing the glaucoma and non-glaucoma cohort.

Variables

Results were stratified by glaucoma status, which was based on International Classification of Disease (ICD) diagnosis codes of any glaucoma type and can be found in Supplemental Digital Content 1. Information regarding demographic and socioeconomic information were extracted from survey responses in the *All of Us* Basics survey.[12] Race/ethnicity was categorized as non-Hispanic (NH) White, NH African American, NH Asian, Hispanic (any race), and other. Marital status was categorized as married, separated, divorced, widowed, living with partner, or never married. Education was categorized as no high school diploma, high school diploma/GED, some college, and college and above. Employment was categorized as employed for wages, or not employed for wages. Annual income in dollars was categorized as 0–24,999, 25k-49,999, 50k-99,999, 100k-199,999, >200k. Housing status was categorized as own home, rent, or other arrangement. Stable housing concern was categorized as yes or no. Insurance status was categorized as Medicaid, other plan (employer provided, privately purchased, Medicare, Military provided, VA provided, or other), and no insurance – prioritized in that order if participants had multiple types of insurance.

We studied several questions from the Healthcare Access and Utilization Survey relating to patients' access to seeing healthcare professionals (whether they spoke to a general doctor, medical specialist, eye doctor, and number of eye doctor visits in the past year) and their ability to afford care (whether they were worried about paying, and whether they could afford eyeglasses, follow-up care, a healthcare provider, a specialist, or emergency care in the past year). Information on causes of delayed care were also derived from the Healthcare Access and Utilization Survey. We studied seven questions as follows: delayed care due to co-pay, childcare, elderly care, out of pocket costs, not being able to get time off work, transportation issues, and living in a rural area in the past year.

Data Analysis

Survey responses were stratified by glaucoma status (i.e., diagnosed with glaucoma vs. not diagnosed with glaucoma) and analyzed using Pearson's Chi-squared tests to generate

unadjusted p-values, using the Holm-Bonferroni adjustment for multiple comparisons. We used univariable and multivariable logistic regression to generate odds ratios (ORs) and 95% confidence intervals (CIs) to characterize binary survey responses by glaucoma status; individuals without glaucoma served as the reference group. Potential covariates were identified using a directed acyclic graph[13] of known and suspected confounders for the association between glaucoma status and measures of healthcare access and utilization (Supplemental Digital Content 2). Age, gender, race/ethnicity, marital status, education, employment, income, home ownership, and insurance status were considered. Paths between the exposure and outcome were identified using the back-door criterion.[13] We found that adjusting for age (as a continuous variable), gender, race/ethnicity, and health insurance status provided the minimal sufficient adjustment for estimating the relationship between glaucoma status (primary exposure variable of interest) and healthcare access/utilization measures (outcome measures) (Supplemental Digital Content 2). Statistical tests were two-sided, and p-values were considered statistically significant at the $\alpha = 0.05$ level. Analyses were conducted on the NIH *All of Us* Researcher Workbench using R software version 4.1.0 on cloud-based Jupyter notebooks and are available in the referenced notebook.[14]

RESULTS

Of the 49 487 patients aged 65 years and over who responded to *All of Us* Healthcare Access and Utilization survey items, 4441 (9.0%) had a diagnosis of glaucoma. Most study participants were female (28 162, 56.9%), while 42 008 (84.9%) were NH White, 2896 (5.9%) were NH African American, 715 (1.4%) were NH Asian, 1897 (3.8%) were Hispanic (any race), and 611 (1.2%) were other. Glaucoma patients had a median age of 75 years, with an interquartile range (IQR) from 70–79 years, while non-glaucoma patients had a median age of 72 years (IQR: 69–77). On unadjusted chi-square tests, glaucoma patients were more likely to be NH African American (p<0.001) or Hispanic (any race) (p<0.001) than patients without glaucoma. Further, glaucoma patients were less likely to be married (p<0.001), have a college education (p=0.004), be employed (p<0.001), or own their own home (p<0.001) compared to non-glaucoma patients. No difference was observed by income category (p=0.325) (Table 1).

On unadjusted chi-square tests, glaucoma patients in this cohort were more likely to be on Medicaid insurance than non-glaucoma patients (5.7% vs 4.8%; p=0.010). Despite this, glaucoma patients were slightly more likely to speak to a general doctor (92.7% vs 90.7%; p<0.001) and medical specialist (54.3% vs 53.0%; p=0.010) in the past year than non-glaucoma patients. Further, though glaucoma patients were more likely to speak to an eye doctor (71.6% vs 60.1%; p<0.001) and have more eye doctor visits (p<0.001) than non-glaucoma patients, a substantial proportion of glaucoma patients did not speak to an eye doctor in the past year (392; 8.8%). A total of 16 687 (33.7%) patients described being very or somewhat worried about paying for care, which did not differ by glaucoma status on chi-square tests. Further, a total of 1483 (3.0%) reported that they could not afford follow-up care, 1118 (2.3%) could not afford a healthcare provider, 1923 (3.9%) could not afford a specialist, and 507 (1.0%) could not afford emergency care in the previous year – none of which differed by glaucoma status. However, glaucoma patients were slightly less likely to not be able to afford eyeglasses in the previous year (5.6% vs 6.7%; p=0.012). No

difference was observed for ability to afford other measures of care, such as follow-up care, a healthcare provider, a specialist, or emergency care (Table 2).

On measures of delaying care due to cost concerns, a total of 1484 (3.0%) patients delayed care due to not being able to afford the co-pay, 67 (0.1%) due to childcare obligations, 599 (1.2%) due to elderly care obligations, and 1652 (3.3%) due to transportation issues – none of which differed by glaucoma status on chi-square tests. However, glaucoma patients were slightly less likely to delay care due to out of pocket costs (7.4% vs 8.9%; p=0.002), because they could not get time off work (1.3% vs 1.7%; p=0.048), or because of living in a rural area (1.2% vs 1.6%; p=0.033) (Table 3).

On univariable logistic regression models, those with glaucoma were significantly more likely to speak an eye doctor (OR: 2.67; 95% CI: 2.40–2.98) in the prior year compared to those without a diagnosis of glaucoma. Further, those with glaucoma were significantly less likely to have trouble affording eyeglasses (OR: 0.84; 95% CI: 0.83–0.96) (Table 4). These associations persisted in multivariable logistic regression models adjusting for age, gender, race/ethnicity, and health insurance status, which demonstrated that individuals with glaucoma were significantly more likely to speak to an eye doctor (OR: 2.46; 95% CI: 2.16–2.81) and significantly less likely to have trouble affording eyeglasses (OR: 0.85 95% CI: 0.72–0.99) in the prior year than those without a diagnosis of glaucoma (Table 4).

Although initial univariable analyses demonstrated that glaucoma patients were more likely to speak to a to a general doctor (OR: 1.31; 95% CI: 1.14–1.52) or a medical specialist (OR: 1.11; 95% CI: 1.03–1.20), and less likely to delay care due to out of pocket costs (OR: 0.82; 95% CI: 0.73–0.93), for not being able to get time off work (OR: 0.75; 95% CI: 0.57–0.98), and for being in a rural area (OR: 0.73; 95% CI: 0.55–0.96), these associations did not persist in multivariable models after adjusting for age, gender, race/ethnicity, and health insurance status (Table 4).

We performed sub-analyses on glaucoma patients who did and did not speak to an eye doctor in the previous year. On chi-square tests, those who did not speak to an eye doctor were significantly more likely to have lower education and income than those who did. Further, they were less likely to speak to a general doctor or a medical specialist, and more likely to not be able to afford eyeglasses or follow-up care. These patients were also more likely to delay care due to co-pays. On multivariable logistic regression analysis adjusting for age, gender, race/ethnicity, and health insurance status, those who did speak to an eye doctor were more likely to speak to a general doctor or medical specialist. Further, those who did speak to an eye doctor were less likely to not be able to afford eyeglasses, follow-up care, or a specialist. Lastly, they were less likely to delay care due to co-pays (Supplemental Digital Content 3).

DISCUSSION

In this study of a large nationwide cohort of elderly adults, we found that many reported issues with paying for care. About a third of patients were very or somewhat worried about paying for care, despite the fact that nearly all had some form of health insurance. However,

this anxiety about costs less often translated into an inability to afford care or an outright delay in care. Though the most common cause reported, less than 10% of participants reported not being able to afford care or delaying care due to costs, which is in line with previous studies.[15] In the case of medication adherence for glaucoma patients, it has been reported that costs are less of a factor than other barriers such as poor self-efficacy, problems with instilling drops, forgetfulness, and difficulty with medication schedules.[16]

Compared to patients without a diagnosis of glaucoma, glaucoma patients in this cohort were more likely to be a racial or ethnic minority. Race and ethnicity are known risk factors for glaucoma development and progression among minorities compared to non-Hispanic Whites.[17] African American and Hispanic glaucoma patients have been shown to have more cost-related barriers to obtaining their medications, which may confer worse medication adherence and glaucoma outcomes.[18] In addition, anatomical differences by race, such as larger optic discs with less reserve axons and thinner corneas leading to an underestimation of intraocular pressure on applanation among those of African descent, are thought to play a role.[19,20]

Glaucoma patients in this cohort differed on several key measures of socioeconomic status, including education, employment, and home ownership. This was likely at least partially mediated through differences in race and ethnicity – which is strongly linked to socioeconomic status in the US.[21] However, we did not observe any significant income differences by glaucoma status, which has been reported in other studies,[17,22] and is associated with increasing glaucoma severity.[5] Further, we found that glaucoma patients were less likely to be married than non-glaucoma patients. Married individuals are thought to have "protection effects" from increased social support and reduction of risky behavior that is associated with having a live-in partner.[23] Following this, marriage may be protective against late-onset diagnosis and disease progression due to increased health surveillance, and may be considered a socioeconomic factor as it is associated with wealth attainment.[23] There is evidence that being unmarried is an independent risk factor for open-angle glaucoma.[24] Further research is needed to understand this relationship, including whether being unmarried is associated with faster vision loss after diagnosis.

Educational attainment was lower among glaucoma patients than non-glaucoma patients. This is an important factor as knowledge about disease has been shown to be related to treatment adherence.[25,26] However, knowledge about disease is related but not necessarily the same as educational attainment.[27] There are several studies that relate educational attainment with outcomes in other asymptomatic chronic diseases, including hypertension,[28] diabetes,[29] and chronic kidney disease.[30] This may be mediated by differences in economic resources, work conditions, participatory planning and goal setting, and medication adherence, among other mechanisms.[31,32] More research is needed to understand how educational attainment relates to glaucoma outcomes. Further, though glaucoma patients in this cohort did not differ significantly on income, they were less likely to be employed, be on insurance plans other than Medicaid, and own a home than non-glaucoma patients. This may be mediated through differences in race/ethnicity between groups, as African Americans and Hispanics are less likely to own a home than Whites.[33] This is important as home ownership is associated with many factors that indirectly influence health, including wealth

creation and social opportunities.[33] Further, financial strain from unaffordable housing has been associated with cost-related medication nonadherence generally as well as increased prevalence of some chronic conditions.[34]

A substantial proportion of glaucoma patients reported not speaking to an eye doctor in the previous year (8.8%), which is suboptimal given that clinic follow-up intervals typically range from 1 year for very mild or pre-perimetric glaucoma to 3–4 months or less for severe glaucoma.[35] Regular appointments are essential to monitor optic disc health and visual field changes, including earlier access to medication modifications or surgery if warranted.[36] In our supplemental analysis, we found that glaucoma patients who did not speak to an eye doctor in the previous year fared worse on measures of socioeconomic status and have more barriers to accessing various healthcare services compared to glaucoma patients who did speak to an eye doctor in the previous year. These patients should be the target of interventions to improve access among glaucoma patients. The extent to which modifiable factors, such as costs or transportation, contributed to these glaucoma patients not speaking to an eye doctor compared to other known factors of clinic dropout such as frustration with medication schedules, lower disease severity, or lack of family history is unclear.[16,37]

Lastly, despite faring worse on several measures of socioeconomic status on descriptive analyses, glaucoma patients in this cohort did not experience more barriers to healthcare access and utilization on multivariable logistic regression models. Further, glaucoma patients were not more likely to delay care due to out of pocket costs, living in a rural area, or because they could not get time off work – the latter of which must be interpreted with caution as glaucoma patients are less likely to be employed. A likely cause of the incongruency between poorer measures of socioeconomic status but no significant difference in measures of healthcare access and utilization is that those with chronic health conditions are known to have higher rates of healthcare utilization.[38] Further, it is possible that the relative value that individuals place on their vision, which is thought to be higher than any other health concern,[39] may be protective against access barriers and delays in care for some.

Our study has several strengths, including using a large nationwide study deriving data from multiple centers across the US, and utilizing a large number of glaucoma patients (over 4000) with controls (over 45 000), which allowed us to perform regression analysis controlling for confounding factors. Furthermore, we were able to analyze patient-reported barriers to healthcare access and utilization thanks to specific survey items related to this topic in the *All of Us* database – this represents a unique opportunity given that these data are not routinely available in electronic health records or in administrative claims databases. This is especially important given a broad shift toward patient-centered care and increasing recognition of patient perspectives.

However, our study is not without limitations. First, as with all studies that rely on patient report, responses may have been affected by social desirability and recall bias. However, we would not expect these biases to affect glaucoma patients differently than patients without glaucoma. Further, we expect any effect to be at least partially mitigated as surveys were de-identified and conducted by a third party, compared to clinic-based studies

where participants may be more concerned about how their physicians would perceive their responses. Next, there may have been some selection bias, as most of the *All of Us* participants who elected to participate in the Healthcare Access and Utilization Survey identified as White, were well-educated, and had some form of health insurance – in proportions greater than the overall US population.[40] This may affect generalizability as it likely led to an under-estimation overall of barriers to healthcare access and utilization. In addition, we did not have information on preferred language and how that may have affected outcomes. Finally, it must be noted that though some of the differences found might be statistically significant, absolute differences are small for many measures and may not necessarily be clinically significant.

In summary, we report measures of socioeconomic status and barriers to healthcare access and utilization between patients aged 65 years and over with and without a diagnosis of glaucoma. Despite having poorer measures of socioeconomic status, glaucoma patients do not report significantly greater barriers to healthcare access and utilization. Still, a substantial proportion of glaucoma patients reported difficulty with getting care. It is important for eye care providers and healthcare institutions to be aware of these modifiable barriers to care among their patients, and integrate patient social support structures into practice.[41]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Financial Support:

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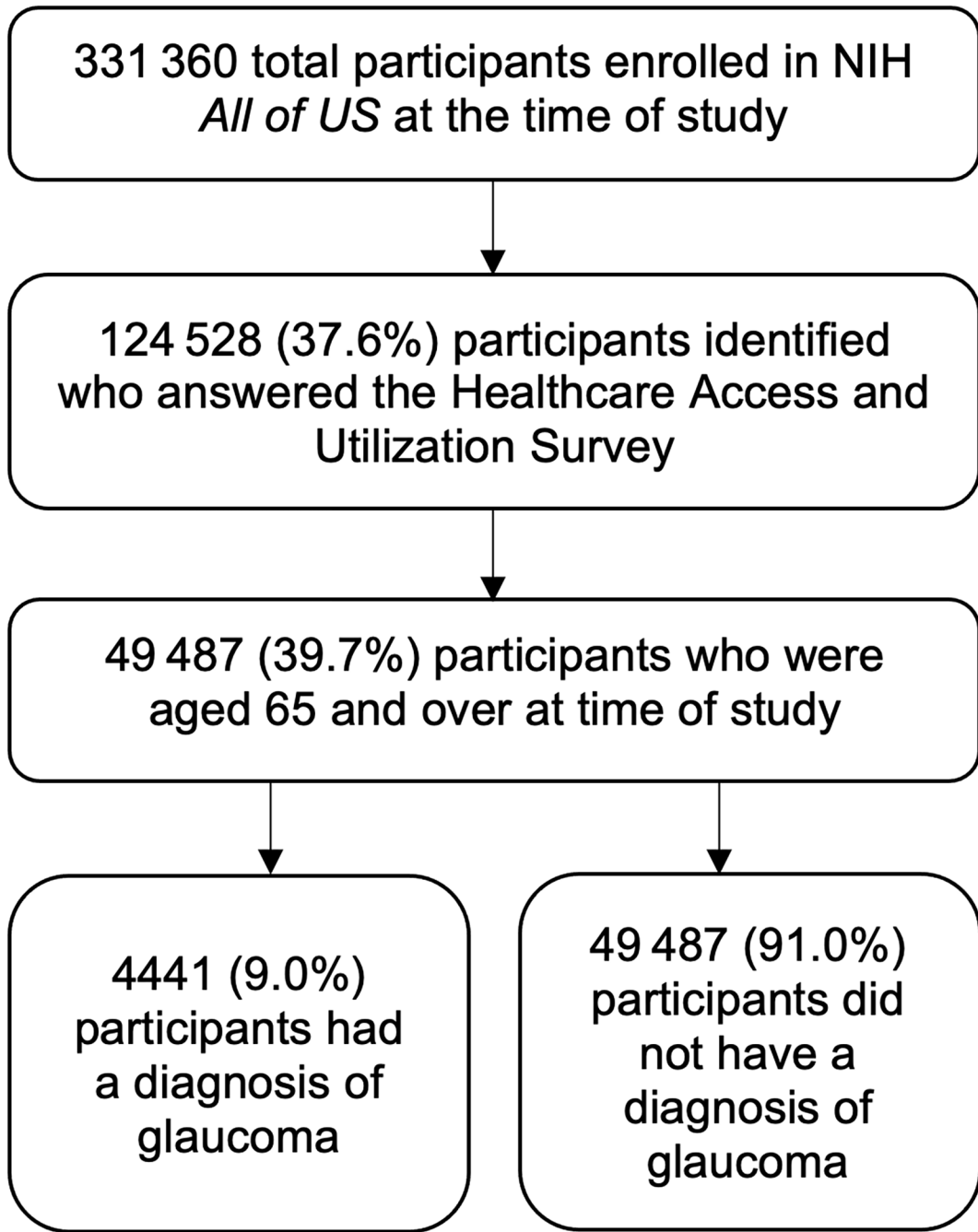
Figure 1.
Flowchart of exclusion criteria leading to a final study population of 49 487 patients aged 65 years and older enrolled in the NIH *All of Us* Research Program who responded to the Healthcare Access and Utilization Survey.

Table 1.

Demographic and socioeconomic characteristics among patients 65 years and older enrolled in the NIH *All of Us* Research Program who responded to the Healthcare Access and Utilization Survey by glaucoma status.

Characteristics[a]	Glaucoma Patients	Non-Glaucoma Patients	P Value[b]
Total, No. (%)	4441 (9.0)	45046 (91.0)	
Median age (IQR)	75 (70–79)	72 (69–77)	
Gender, No. (%)			0.373
Female	2556 (57.6)	25606 (56.8)	
Male	1834 (41.3)	18915 (42.0)	
NA	51 (1.1)	525 (1.2)	
Race/Ethnicity, No. (%)			<0.001
NH White	3516 (79.2)	38492 (85.5)	
NH African American	407 (9.2)	2489 (5.5)	
NH Asian	92 (2.1)	623 (1.4)	
Hispanic (any race)	229 (5.2)	1668 (3.7)	
Other	62 (1.4)	549 (1.2)	
NA	135 (3.0)	1228 (2.7)	
Marital status, No. (%)			<0.001
Married	2618 (59.0)	28173 (62.5)	
Separated	47 (1.1)	514 (1.1)	
Divorced	680 (15.3)	7028 (15.6)	
Widowed	484 (10.9)	4240 (9.4)	
Living with partner	112 (2.5)	1264 (2.8)	
Never married	450 (10.1)	3411 (7.6)	
NA	50 (1.1)	416 (0.9)	
Education, No. (%)			0.004
No HS diploma	85 (1.9)	714 (1.6)	
HS diploma/GED	398 (9.0)	3441 (7.6)	
Some college	997 (22.4)	10116 (22.5)	
College and above	2925 (65.9)	30386 (67.5)	
NA	36 (0.8)	389 (0.9)	
Employment, No. (%)			<0.001
Employed for wages	1150 (25.9)	13405 (29.8)	
Not employed for wages	3250 (73.2)	31279 (69.4)	
NA	41 (0.9)	362 (0.8)	
Income, No. (%)			0.325
0–25k	467 (10.5)	4399 (9.8)	
25k–50k	704 (15.9)	7259 (16.1)	
50k–100k	1287 (29.0)	13417 (29.8)	
100k–200k	1000 (22.5)	10630 (23.6)	
>200k	410 (9.2)	4338 (9.6)	
NA	573 (12.9)	5003 (11.1)	

Characteristics[a]	Glaucoma Patients	Non-Glaucoma Patients	P Value[b]
Housing, No. (%)			<0.001
Own home	3407 (76.7)	36675 (81.4)	
Rent	825 (18.6)	6383 (14.2)	
Other arrangement	143 (3.2)	1430 (3.2)	
NA	66 (1.5)	558 (1.2)	
Stable housing concern, No. (%)			0.945
Yes	192 (4.3)	1936 (4.3)	
No	4209 (94.8)	42796 (95.0)	
NA	40 (0.9)	314 (0.7)	

Abbreviations: No., number; IQR, interquartile range; NH, non-Hispanic; HS, high school; GED, general educational development.

[a]Per the *All of Us* Research Program data sharing policies, cells with less than 20 respondents are suppressed.

[b]P-values were generated from Pearson's Chi-squared tests using the Holm-Bonferroni adjustment for multiple comparisons.

Table 2.

Barriers to healthcare access and utilization among patients 65 years and older enrolled in the NIH *All of Us* Research Program who responded to the Healthcare Access and Utilization Survey by glaucoma status.

Characteristics[a]	Glaucoma Patients	Non-Glaucoma Patients	P-Value[b]
Health insurance, No. (%)			0.010
Medicaid	254 (5.7)	2145 (4.8)	
Other plan[c]	3396 (76.5)	34799 (77.3)	
None	<20	29 (0.1)	
NA	786 (17.7)	8073 (17.9)	
Spoken to general doctor, No. (%)			<0.001
Yes	4117 (92.7)	40840 (90.7)	
No	204 (4.6)	2655 (5.9)	
NA	120 (2.7)	1551 (3.4)	
Spoken to medical specialist, No. (%)			0.010
Yes	2410 (54.3)	23861 (53.0)	
No	962 (21.7)	10559 (23.4)	
NA	1069 (24.1)	10626 (23.6)	
Spoken to eye doctor, No. (%)			<0.001
Yes	3178 (71.6)	27085 (60.1)	
No	392 (8.8)	8934 (19.8)	
NA	871 (19.6)	9027 (20.0)	
Eye doctor visits, No. (%)			<0.001
1 visit	1173 (26.4)	17374 (38.6)	
2–3 visits	1264 (28.5)	6812 (15.1)	
4–5 visits	419 (9.4)	1572 (3.5)	
6–7 visits	128 (2.9)	552 (1.2)	
8–9 visits	53 (1.2)	203 (0.5)	
10–12 visits	49 (1.1)	154 (0.3)	
13–15 visits	<20	38 (0.1)	
16+ visits	<20	43 (0.1)	
NA	1319 (29.7)	18298 (40.6)	
Worried about paying			0.225
Very worried	184 (4.1)	2093 (4.6)	
Somewhat worried	1274 (28.7)	13136 (29.2)	
Not at all worried	2857 (64.3)	28600 (63.5)	
NA	126 (2.8)	1217 (2.7)	
Can afford eyeglasses, No. (%)			0.012
Yes	249 (5.6)	2997 (6.7)	
No	3426 (77.1)	34675 (77.0)	
NA	766 (17.2)	7374 (16.4)	
Can afford follow-up care, No. (%)			0.296
Yes	120 (2.7)	1363 (3.0)	

Characteristics[a]	Glaucoma Patients	Non-Glaucoma Patients	P-Value[b]
No	3507 (79.0)	35843 (79.6)	
NA	814 (18.3)	7840 (17.4)	
Can afford healthcare provider			0.058
Yes	81 (1.8)	1037 (2.3)	
No	3601 (81.1)	36731 (81.5)	
NA	759 (17.1)	7278 (16.2)	
Can afford specialist			0.224
Yes	155 (3.5)	1768 (3.9)	
No	3485 (78.5)	35697 (79.2)	
NA	801 (18.0)	7581 (16.8)	
Can afford emergency care, No. (%)			0.999
Yes	45 (1.0)	462 (1.0)	
No	4003 (90.1)	41091 (91.2)	
NA	393 (8.8)	3493 (7.8)	

Abbreviations: No., number.

[a]Per the *All of Us* Research Program data sharing policies, cells with less than 20 respondents are suppressed.

[b]P-values were generated from Pearson's Chi-squared tests using the Holm-Bonferroni adjustment for multiple comparisons.

[c]Other plans include employer provided, privately purchased, Medicare, Military provided, VA provided, and other.

Table 3.

Causes of delayed care among patients 65 years and older enrolled in the NIH *All of Us* Research Program who responded to the Healthcare Access and Utilization Survey by glaucoma status.

Characteristics[a]	Glaucoma Patients	Non-Glaucoma Patients	P Value[b]
Delayed care due to co-pay			0.358
Yes	121 (2.7)	1363 (3.0)	
No	3472 (78.2)	35631 (79.1)	
NA	848 (19.1)	8052 (17.9)	
Delayed care due to childcare			0.546
Yes	<20	63 (0.1)	
No	3579 (80.6)	37048 (82.2)	
NA	858 (19.3)	7935 (17.6)	
Delayed care due to elderly care			0.616
Yes	49 (1.1)	550 (1.2)	
No	3561 (80.2)	36676 (81.4)	
NA	831 (18.7)	7820 (17.4)	
Delayed care due to out of pocket costs			0.002
Yes	327 (7.4)	4017 (8.9)	
No	3229 (72.7)	32747 (72.7)	
NA	885 (19.9)	8282 (18.4)	
Delayed care because couldn get time off work			0.048
Yes	56 (1.3)	767 (1.7)	
No	3755 (84.6)	38737 (86.0)	
NA	630 (14.2)	5542 (12.3)	
Delayed care due to transportation			0.201
Yes	163 (3.7)	1489 (3.3)	
No	4155 (93.6)	42414 (94.2)	
NA	123 (2.8)	1143 (2.5)	
Delayed care due to being in a rural area, No. (%)			0.033
Yes	53 (1.2)	737 (1.6)	
No	4129 (93.0)	41994 (93.2)	
NA	259 (5.8)	2315 (5.1)	

Abbreviations: No., number.

[a]Per the *All of Us* Research Program data sharing policies, cells with less than 20 respondents are suppressed.

[b]P-values were generated from Pearson's Chi-squared tests using the Holm-Bonferroni adjustment for multiple comparisons.

Table 4.

Univariable and multivariable logistic regression models for the association between glaucoma status and measures of healthcare access and utilization among patients 65 years and older enrolled in the NIH *All of Us* Research Program, with those without glaucoma as the reference group.

Univariable Logistic Regression

Question [a]	No Glaucoma OR (95%CI)	Glaucoma OR (95%CI)	P-value
Spoken to a general doctor	Ref	1.31 (1.14–1.52)	<0.001
Spoken to a medical specialist	Ref	1.11 (1.03–1.20)	0.001
Spoken to an eye doctor	Ref	2.67 (2.40–2.98)	<0.001
Can't afford eyeglasses	Ref	0.84 (0.83–0.96)	0.01
Can't afford follow-up care	Ref	0.90 (0.74–1.08)	0.28
Can't afford healthcare provider	Ref	0.66 (0.20–1.59)	0.05
Can't afford specialist	Ref	0.89 (0.76–1.06)	0.21
Can't afford emergency care	Ref	1.00 (0.73–1.35)	0.99
Delayed care due to co-pay	Ref	0.91 (0.75–1.10)	0.33
Delayed care due to childcare	Ref	0.66 (0.20–1.59)	0.05
Delayed care due to elderly care	Ref	0.92 (0.68–1.22)	0.57
Delayed care due to out of pocket costs	Ref	0.82 (0.73–0.93)	0.002
Delayed care because couldn't get time off work	Ref	0.75 (0.57–0.98)	0.04
Delayed care due to transportation	Ref	1.12 (0.94–1.31)	0.19
Delayed care due to being in rural area	Ref	0.73 (0.55–0.96)	0.03

Multivariable Logistic Regression [b]

Question [a]	No Glaucoma OR (95%CI)	Glaucoma OR (95%CI)	P-value
Spoken to a general doctor	Ref	1.16 (0.99–1.37)	0.07
Spoken to a medical specialist	Ref	1.07 (0.98–1.17)	0.13
Spoken to an eye doctor	Ref	2.56 (2.27–2.90)	<0.001
Can't afford eyeglasses	Ref	0.85 (0.72–0.99)	0.04
Can't afford follow-up care	Ref	0.90 (0.71–1.11)	0.33
Can't afford healthcare provider	Ref	0.87 (0.67–1.13)	0.31
Can't afford specialist	Ref	0.90 (0.74–1.10)	0.32
Can't afford emergency care	Ref	1.05 (0.72–1.48)	0.78
Delayed care due to co-pay	Ref	1.13 (0.88–1.42)	0.86
Delayed care due to childcare	Ref	0.58 (0.14–1.59)	0.36
Delayed care due to elderly care	Ref	0.79 (0.54–1.11)	0.19
Delayed care due to out of pocket costs	Ref	0.89 (0.77–1.02)	0.10
Delayed care because couldn't get time off work	Ref	0.87 (0.61–1.20)	0.42
Delayed care due to transportation	Ref	1.08 (0.89–1.30)	0.45
Delayed care due to being in rural area	Ref	0.81 (0.58–1.10)	0.19

Abbreviations: OR, odds ratio; CI, confidence interval; Ref, reference.

[a]All questions studied have binary outcomes (yes/no).

bMultivariable models were adjusted for age (as a continuous variable), gender, race/ethnicity, and insurance status.