HHS Public Access

Author manuscript

J Glaucoma. Author manuscript; available in PMC 2026 January 01.

Published in final edited form as:

J Glaucoma. 2025 January 01; 34(1): 30–38. doi:10.1097/IJG.0000000000002463.

Neighborhood poverty and clinic attendance in the Michigan Screening and Intervention for Glaucoma and Eye Health through Telemedicine Program

Rithambara Ramachandran, MD[1], **Patrice M. Hicks, PhD MPH**[1], **Ming-Chen Lu, MS**[1], **Leslie M. Niziol, MS**[1], **Maria A. Woodward, MD MS**[1,2], **Angela R. Elam, MD**[1,2], **Leroy Johnson, MD**[3], **Martha Kershaw, MD**[4], **David C. Musch, PhD MPH**[1,2,5], **Amanda Bicket, MD MS**[1], **Denise John, MD**[1], **Olivia J. Killeen, MD, MS**[6], **Paula Anne Newman-Casey, MD MS**[1,2]

[1]Department of Ophthalmology and Visual Sciences, University of Michigan, Ann Arbor, MI

[2]Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, MI

[3]Hamilton Community Health Network, Flint, MI

[4]Hope Clinic, Ypsilanti, MI

[5]Department of Epidemiology, University of Michigan, Ann Arbor, MI

[6]Department of Ophthalmology, Duke University, Durham, NC

Abstract

Purpose: To investigate the association between neighborhood-level characteristics and attendance for a free eye disease screening

Patients and Methods: The MI-SIGHT program is conducted in two community clinics in Southeastern Michigan. Participant-level demographics were extracted from electronic health records. Neighborhood level-characteristics including Area Deprivation Index (ADI), median household income (HHI), percent of households with >30% rent burden, percent of households without vehicles, percent of households in subsidized housing, and energy burden were obtained from the Wisconsin Neighborhood Atlas and the United States census. Logistic regression was used to model the probability of clinic visit attendance, which was the main outcome measure.

Results: 1431 participants were scheduled for screening appointments between July 2020 to November 2021, with a no-show rate of 23%. Individuals lived an average of 7.7 miles from each clinic (SD=8.1) and in neighborhoods with a mean ADI of 6.8 (SD=3.2, 1–10 scale where 10 is the most deprived). After adjusting for age, sex, race, and ethnicity, participants from neighborhoods with higher deprivation were more likely to have missed clinic visits. For example, there was an 8% higher odds of missed clinic visits for every 1-point increase in ADI (odds

Corresponding Author and Requests for Reprints: Paula Anne Newman-Casey, MD, Department of Ophthalmology and Visual Sciences, University of Michigan Medicine, W.K Kellogg Eye Center, 1000 Wall Street, Ann Arbor, Michigan 48105, Fax: 734-232-1957, panewman@med.umich.edu.

Disclaimer: 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.

Conflict of Interest: No conflicting relationships exist for any authors.

ratio, OR=1.08, p=0.020) and an 18% higher odds of a missed visit with every 10% increase in households without a vehicle (OR=1.18, p=0.013).

Conclusion: Higher neighborhood-level poverty was associated with greater odds of missing a free eye disease screening appointment after adjusting for individual characteristics. Increased neighborhood-level resources are likely needed to bolster engagement in preventive eye care.

Precis: Higher neighborhood-level poverty is associated with greater odds of missing a free eye disease screening appointment, underscoring the importance of community-based interventions to address upstream social determinants of health.

Keywords

No-show; clinic absenteeism; glaucoma; screening; social risk factors

Introduction

Missed medical appointments have repercussions for both individual-level and community-level health. The frequency of missed clinic visits, also known as clinic absenteeism, falls within the wide range of 12–80%, and varies with medical specialty, location, time of year, clinic setting, patient volumes, and clinic wait times.[1–8] Missed appointments not only impact individual patient health, but also affect the health of others who may have able to access care sooner during the unused time slot. In addition, the economic burden of absenteeism on the healthcare system is profound; it is estimated that $50 billion is lost in the United States (US) on missed clinic appointments annually.[9] Unfilled appointment times are a substantial problem for maintaining the economic viability of outpatient clinics in communities with scarcity of healthcare resources.[9]

Rates of vision impairment and blindness are increasing, and yet rates of missed clinic visits to prevent and treat eye disease remain high.[10] In 2020, 160.7 million people in the working age population, or 3.3% of the total workforce, were either blind or had severe visual impairment, leading to a $410.7 billion loss in societal productivity and purchasing power.[11] Beyond a person's work-life, vision impairment impacts a person's independence and ability to drive, read and perform activities of daily living.[11–14]

Published rates for missed eye clinic visits fall between 15–30%,[15–19] and are even higher (up to 46%) among people with glaucoma, for whom there is a need to chronically monitor and adjust treatments to preserve vision.[20–22] Previous studies have found that demographic factors, including younger age, lack of insurance, and identifying as Black or Hispanic are risk factors for missing clinic visits.[16,22–26] In a five-year retrospective analysis of an eye clinic population in Detroit, MI, Khambati et al. found that older age, male sex, non-January appointment month, longer physician-patient history, Caucasian race, retina specialty, and clinic location were all significantly associated with appointment attendance.[22] Additional qualitative and quantitative studies have noted poor health, poor communication between offices and patients, lack of transportation, large lead times before appointments, low health literacy, forgetfulness, fear of medical professionals, lack of support, and childcare-related

issues as barriers to attending clinic visits. These barriers are not social risk factors that are routinely recorded on clinic intake forms.[15,16,19,24,27–29]

The purpose of this study was to determine if neighborhood-level social risk factors, independent of individual demographic factors, were associated with missed clinic visits in a free glaucoma and eye disease screening program. Understanding whether and which neighborhood-level social risk factors are related to missed clinic visits could help inform policy on how to improve eye care utilization specifically and health care utilization more broadly.

Methods

Data Collection

The Michigan Screening and Intervention for Glaucoma and Eye Health through Telemedicine (MI-SIGHT) Program is a demonstration project funded by the Centers for Disease Control and Prevention (U01 DP006442) to use telemedicine and community-engaged research methods to detect and treat glaucoma and eye disease in communities with high proportions of people at high risk for eye disease. High risk populations include people living with low income and people who identify as Black or African American or Hispanic or Latino.[30–32] Participants were recruited from two community-based health care facilities, a free clinic in Ypsilanti, Michigan (Hope Clinic), and a federally qualified health center (FQHC) in Flint, Michigan (Hamilton Community Health Network). Both clinics have a 40-year history of providing services to surrounding communities with high levels of poverty and large minority populations. In Flint, 57% of residents identify as Black and 5% identify as Hispanic or Latino and in Ypsilanti 27% of the residents identify as Black and 6% identify as Hispanic or Latino.[33] Moreover, the median household incomes in Ypsilanti and Flint, MI are $40,256 and $32,358, respectively, compared to the national median household income of $69,021.[33]

The MI-SIGHT program participants included community residents 18 years or older who were interested in undergoing a free eye health exam. Study coordinators contacted patients referred for eye care by their primary care providers at the community clinics, with additional outreach to the wider community, guided by the MI-SIGHT Community Advisory Board.[34] Community outreach strategies included placing 11,000 flyers in the community clinics, neighborhood food banks, low-income senior housing buildings, barbershops, and churches. Participants were given extra flyers to share with friends and family. Advertising was done on local buses, local radio, local health fairs, and community access television. Exclusion criteria, as determined by an initial screening intake, included: 1) significant eye pain; 2) sudden decrease in vision in the past week; 3) binocular diplopia (double vision in both eyes); 4) cognitive impairment; 5) pregnancy; 6) current incarceration; or 7) planning to move outside of driving distance to the clinic within the next 6 months. Exclusion criteria was chosen to exclude individuals thought to be better served by a visit to an eye doctor rather than an eye disease screening program. Verbal consent to attend an in-person free eye screening visit through the MI-SIGHT program and participate in the study was obtained prior to scheduling the study visit.

Specifics of the telemedicine based glaucoma screening program have been previously described[34]. In brief, each participant underwent a complete ophthalmic examination by a trained ophthalmic technician including refraction and visual acuity testing, intraocular pressure measurement, fundus photography, and optical coherence tomography images. Results are subsequently reviewed remotely by a trained University of Michigan (UM) ophthalmologist for management and follow up recommendations. The MI-SIGHT program also offers low-cost glasses starting at $12 from an on-line retailer alongside health care navigation support to obtain recommended follow-up care with an appropriate eye care provider. This study was reviewed and approved by the UM Institutional Review Board (HUM00169371) and adheres to the tenets of the Declaration of Helsinki. The clinical trial portion of this study, not discussed herein, is registered at Clinicaltrials.gov (NCT04274764),

Participants in this cohort were enrolled between July 28, 2020 and November 11, 2021. When participants accepted an in-person eye screening appointment through the MI-SIGHT program after discussion with the study coordinator, they were registered as patients at the UM so that the university's electronic health record (EHR) and picture archiving and communication system (PACS) could be used for data and image storage and transmission. Participants received reminders a few days prior to the scheduled appointment via text or phone call which was repeated until the participant confirmed his or her upcoming appointment. Reminder strategies using a combination of phone calls and texts were the same between the FQHC and free clinic. Attendance data for the scheduled appointment was collected.

Study Measures

Individual Variables—When participants were registered, age, self-identified sex at birth, self-identified race and ethnicity, and home address were collected in addition to information regarding exclusion criteria. For each participant, public transit data from Ann Arbor Area Transportation Authority and Mass Transportation Authority in Flint, MI were obtained.[35,36] Road distances between participant residence, closest bus stop from the residence, and clinic site were calculated using a network analysis in a geographical information system (GIS), ArcGIS Pro version 2.8 (Esri Inc., Redlands, CA). ArcGIS was also used to map the participants' addresses at the time of the appointment to the appropriate 12-digit Federal Information Processing Standards (FIPS) codes.

Neighborhood Variables—The main outcome measure was attendance at the scheduled MI-SIGHT screening appointment. We investigated the impact of several neighborhood-level deprivation indices on the probability of attending the screening appointment. The FIPS codes contain census tract and census block group numbers which were used to link participants to neighborhood-level characteristics. We used the 2019 census scores based on 2010 census block group-level to obtain the neighborhood-level deprivation measures. 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 that contains thousands of community-level measures,[37] and from the Department of Energy's Low-Income Energy Affordability Data Tool (LEAD) tool.[38]

The 5-year ACS Survey offers the highest accuracy for tract and block level estimates in the periods under consideration, and are well validated, commonly used measures. However, if the sample size was too small to protect individuals' privacy, ACS estimates are not published. Thus, certain neighborhood-level variables were not available for all study participants.

All studied measures were chosen a priori as proxy measures for assessing a neighborhood's socioeconomic disadvantage as they have all shown to impact health outcomes. State Area Deprivation Index (ADI) rank was obtained from Neighborhood Atlas, which is an open-source online tool provided by the University of Wisconsin Madison.[39] ADI is a aggregate of 17 indicators of neighborhood level poverty, including income, education, housing security, and household characteristics.[40,41] The state ADI metric ranges from 1 to 10 and the national ADI metric ranges from 1 to 100, where a higher number identifies more deprivation. The additional variables examined by census block group-level from PolicyMap using ACS data for this analysis included: median household income (HHI, in thousands of United States Dollars [USD]); median percentage renter cost burden (gross rent plus the estimated average monthly cost of utilities and fuel as a percentage of total household income);[42] percentage of renters burdened by cost (gross rents that are 30% or more of household income);[42] percentage of households with no vehicles;[42] and average number of vehicles per household.[42] The percentage of households in subsidized housing measured at the census tract level was also extracted from PolicyMap.[37] Finally, the LEAD tool was used to obtain energy burden (the percentage of average annual household income spent on housing energy costs) at the census tract level.[38]

Statistical Methods

Participant demographics and neighborhood-level characteristics were summarized with descriptive statistics (mean, standard deviation [SD], median, interquartile range [IQR], frequency, and percentage) for the overall sample and stratified by the two clinic sites (FQHC and free clinic). Differences in participant characteristics between those who attended their scheduled in-person MI-SIGHT screening visits (attended) and those who did not (missed) were tested with 2-sample t-tests for continuous measures and Chi-square tests or Fisher exact tests for categorical measures. Significant Chi-square or Fisher exact tests were followed by post-hoc Holm-adjusted pairwise comparisons. Logistic regression was used to test the independent associations of individual-level and neighborhood-level characteristics with the probability of missing the clinic appointment. Model estimates are reported with odds ratios (ORs) and 95% confidence intervals (CIs) and presented in a forest plot. Holm's procedure was performed to adjust for multiple comparisons.[43,44] Statistical analysis was performed using R version 4.1.1 (R Foundation for Statistical Computing, Vienna, Austria).

Results

A total of 1,431 participants scheduled their screening visits in the MI-SIGHT program, including 57% from the FQHC and 43% from the free clinic between July 28, 2020 and November 11, 2021. Participants were on average 54.1 (SD=14.5) years old at the time

of scheduling their visit and 60.4% self-identified as female. Participants self-identified race and ethnicity were as follows: 51.4% identified as Black or African American, 36.6% identified as White, 8.9% identified as Hispanic or Latino, 5.1% identified as Asian, and 6.8% identified as Other race. Participants lived on average 7.7 (SD=8.1, range=0.1 to 83.5) miles from the clinic they were scheduled to attend. Both clinics were accessible through public transport. Among participants who attended the screening visits, 4.5% (49/1101) took public transport. The median home to bus stop distance for these participants was 0.1 miles and the median home to clinic distance was 3.2 miles (Table 2).

Participant characteristics were significantly different between the two clinics (Table 1). Participants scheduled at the FQHC were younger than those at the free clinic (53.3 vs. 55.2 years, p=0.012), a larger percentage were male (41.9% vs 36.6%, p=0.047), a larger percentage identified as Black or African American (64.2% vs 34.3%, p<0.000), and a smaller percentage identified as Hispanic or Latino (6.8% vs 11.9%, p=0.004). Participants at the FQHC lived closer to the bus stop (1.7 miles vs 6.1, p<0.0001) and traveled a shorter distance to the clinic than participants at the free clinic (5.5 miles vs 10.7, p<0.0001, Table 2).

Of the 1,431 participants, 1,423 (99.4%) had address information that could be mapped to a FIPS code for access to neighborhood-level measures (Table 2). Of these 1,423 participants, 0.2% to 12.7% of participants were missing some neighborhood-level measures because of suppressed data in ACS due to low population size. Participants lived in neighborhoods where the median HHI was $40,500 USD (IQR=$29,300-$63,200) and median renter cost burden was 31.6% of income (IQR=24.6%−43.1%). An average of 46.8% of renters (SD=23.8%) were cost burdened such that they paid ≥ 30% of their gross household income to rent their homes. In these neighborhoods, an average of 13.7% of households reported that they did not own a car (SD=13.4%). The average number of cars per household was 1.5 (SD=0.5). The state ADI rank was on average 6.8 (SD=3.2) and the national ADI was on average 76.1 (SD=26.5). Participants lived in neighborhoods where, on average, 5% (SD=2.7%) of households were considered energy burdened such that they spent approximately 5% of their gross household income on energy costs.[38] An average of 7.9% of households (SD=10.8%) lived in subsidized housing.

Characteristics Predicting Missed Screening Visit Appointments

23.1% (n=330 of 1,431) of all study participants missed their screening visits. Many individual-level and neighborhood-level characteristics were significantly associated with missed appointments (Table 3). Specifically, individual-level characteristics associated with a missed visit included identifying as male (p=0.003), identifying as non-Hispanic or Latino ethnicity (p=0.005), identifying as Black or African American (p=0.001), and living closer to the clinic (6.5 miles vs 8.0 miles, p=0.006). Distances between home to bus stop (missed vs attended: 2.4 vs 3.9 miles, p=0.1) and between home to clinic (6.5 vs 8.0 miles, p=0.2) were not associated with a missed visit (Table 3). Neighborhood-level measures associated with a missed visit included living in a neighborhood with a lower median HHI ($43,000 USD vs $51,000 USD, p<0.001), worse ADI (7.4 vs 6.7, p=0.001), having a higher percentage of households reporting that they did not own a car (16.0% vs 13.0%, p=0.012),

and having a higher percentage of household gross income spent on energy costs (5.5% vs 4.9%, p=0.006).

The rates of missed screening appointments were significantly higher at the FQHC compared to the free clinic (29.4% vs. 14.6%, p<0.001). On average, participants scheduled at the FQHC were from neighborhoods with higher levels of deprivation compared to those scheduled at the free clinic. Participants at the FQHC lived in neighborhoods with a higher state ADI rank (FQHC: 8.6 vs free clinic: 4.5, p<0.001) and a higher national ADI rank (FQHC: 90.7 vs free clinic: 56.8, p<0.001). These participants were also from neighborhoods with a lower median HHI ($37,500 USD vs $63,800 USD, p<0.001), higher median renter cost burden (FQHC: 35.6% vs free clinic: 30.2%, p<0.001), a higher percentage of renters who were cost burdened (50.0% vs 42.7%, p<0.001), a higher percentage of households that reported that they did not own a car (16.9% vs 9.4%, p<0.001), a lower average number of cars per household (1.4 cars vs 1.6, p<0.001), and a higher percentage of households that were energy burdened (6.4% vs 3.2%, p<0.001).

Overall, after adjusting for individual-level factors (age, sex, ethnicity, and race), higher neighborhood-level deprivation was associated with greater probability of a missed appointment. Lower median HHI (p=0.005), higher ADI (p=0.020), higher energy burden (p=0.021), and a higher percentage of households in a neighborhood with no vehicles (p=0.013) were all significantly associated with a higher probability of a missed screening visit (Figure 1). Specifically, a $10,000 decrease in median household income was associated with a 10% increased odds of a missed screening visit (OR=0.90, 95% CI=0.85–0.95, p=0.005). A one-unit increase in ADI (worse deprivation) was associated with an 8% increased odds of a missed screening visit (OR=1.08, 95% CI=1.03–1.14, p=0.020). A 10-percentage point increase in the percent of households with no cars was associated with an 18% increased odds of a missed screening visit (OR=1.18, 95% CI=1.06–1.30, p=0.013). Finally, for every 1-percentage point increase in households that were considered energy burdened, there was an 8% increased odds of a missed screening visit (OR=1.08, 95% CI=1.03–1.14, p=0.021).

Discussion

Of the first 1,431 participants recruited to participate in the ongoing MI-SIGHT program that provides free glaucoma and eye disease screening and helps participants access treatment and low-cost glasses, 23.1% of scheduled participants missed their appointments. The program purposefully was held in clinics embedded in neighborhoods with high levels of poverty because of the increased risks of eye disease and difficulties accessing high-quality eye care in this population. The median household income in our sample was $40,500 compared to the 2017 ACS national median income of $69,000.[33] In this study, we found that neighborhood-level measures of deprivation including ADI, median HHI, percentage of households with no vehicles, and energy cost burden were significantly associated with an increased probability of missing the scheduled screening appointment, even after controlling for individual-level characteristics including age, sex, race, and ethnicity.

Many previous studies have focused on individual-level characteristics that are associated with a higher probability of missing a clinic visit,[16,22] but here we specifically focused on the added effect of neighborhood-level characteristics on the probability of missing a clinic appointment.[41,45] In 2019, Chiam et al. conducted a study reviewing all new patient appointments scheduled in a suburban Pennsylvania clinic, and found that individuals living in zip codes with lower median household incomes had a higher likelihood of missed appointments (OR for <$35,667 USD vs. >$59,445 USD: 1.59, 95% CI 1.08, 2.34, p<0.001).[16] Similarly, a retrospective chart review of 4,598 adult patients ≥18 years with a diagnosis of glaucoma, diabetic retinopathy (DR), or age-related macular degeneration (AMD) seen at Yale University identified a significant association of residing in a zip code with reduced median household income with a decreased probability of clinic attendance (OR 1.68, p < 0.0001).[26] In our current study, we found that other neighborhood-level metrics beyond HHI, including higher energy burden and ADI, were independently associated with an increased odds of missed clinic appointments. Like others, we found that, on average, lesser commute distance was related to higher rates of missed clinic visits.[16] Possible explanations for this finding may include that those who lived farther away had higher disease acuity, fewer eye care providers, had greater access to transportation, or had higher incomes compared to those who lived closer to the clinics, which were situated in urban downtown areas. Of note, the strongest neighborhood-level predictor was percentage of households with no vehicles; participants in our sample resided in neighborhoods where an average of 13.7% (SD=13.4) of households did not own a car, compared to a national average of 9.0%.[46] Even still, only 4.5% of our participants used public transportation to attend their free eye screening visit and distance from home to bus stop or bus stop to clinic did not predict clinic attendance. Bus prices, convenient routes, frequency of buses, and safety of buses and stop locations all need to be considered beyond just availability of bus stops in assessing reasons for low public transport utilization.

The rate of missed clinic visits in our study, 23.0%, is higher than those reported by other studies investigating clinic absenteeism in ophthalmology.[15–19,22] Several studies have shown that people requiring glaucoma care have a higher likelihood of missing a clinic visit compared to people requiring care for other ophthalmologic conditions.[16,22] This may be due to the largely asymptomatic nature of early glaucoma where the focus is on prevention of future vision loss. Moreover, participants in the MI-SIGHT program predominantly came from socioeconomically deprived neighborhoods, which as we have shown here, affects the overall missed appointment rate. For comparison, Khambati et al. found that missed clinic visit rates were much lower in a satellite clinic that served a suburb with high socioeconomic status (Novi, Michigan, ADI = 1) compared to the missed clinic visit rate at the academic medical center's main location in an urban area with high rates of poverty (Detroit, MI, ADI =4).[22] In our cohort of participants presenting for screening appointments in Ypsilanti and Flint, MI, the overall mean ADI was 6.8 (SD=3.2), meaning that the neighborhoods in which MI-SIGHT participants lived were more deprived than 68% of neighborhoods in Michigan. Therefore, it is likely that the participants in this study come from more socioeconomically disadvantaged neighborhoods than those studied previously.

Despite the same appointment reminder strategies utilizing phone calls and text messages, there were significantly more missed clinic visits at the FQHC than at the free clinic (29.4%

vs 14.6%, p<0.001), underscoring our findings that neighborhood factors matter. Participants at the FQHC came from neighborhoods with lower deprivation indices. For example, the average state ADI rank for FQHC participants was 8.6, meaning that the neighborhoods in which FQHC participants lived were more deprived than 86% of other neighborhoods in Michigan. In comparison, the mean ADI among free clinic participants was much better, at 4.5 (p<0.001). Using national ADI rank, FQHC participants lived in areas with an average ADI of 90.3 on a 100-point percentile scale, meaning that the neighborhoods in which FQHC participants lived were worse than 90% of other neighborhoods nationwide.

Our results contribute to the growing body of evidence that neighborhood characteristics affect health and health behaviors. Living in a neighborhood with a worse ADI has been associated with increased prevalence of adverse health and health care outcomes, including increased risk of hospital readmissions, poorer cognitive function in older adults, and worse survival with nonmetastatic cancers even after adjusting for patient income.[45,47,48] Social cognitive theory posits that neighborhood characteristics may influence health-related behaviors through exemplifying positive social norms such as seeing people walking and running outside.[49] Likewise, walkable, social, and safe neighborhoods provide opportunities for physical activity and increased health-related quality of life, as well as decreased levels of stress.[49] Another way to understand how physical neighborhoods impact missed clinic visits is through Maslow's hierarchy of needs. Maslow's hierarchy of needs is a motivational theory which centers around the fact that individuals are motivated to first achieve basic physiological needs that necessitate survival (such as food, shelter, security, and stability) before pursuing psychological needs (such as feelings of belonging or love, self-esteem, and self-actualization).[50] Preventive healthcare activities, like participating in screening for silent eye diseases, is a less pressing need than adequate food and shelter. People who live in neighborhoods with high deprivation measures such as high ADI, high rent burden, or high energy burden may have little reserve for pursuing higher needs of wellness such as preventive eye disease screening. Through this lens, it is not hard to imagine why residents of neighborhoods with fewer resources obtain less ophthalmic care and are at the highest risk for missing clinic appointments.[24,30,51,52]

As part of the MI-SIGHT protocol, multiple phone calls were made to all participants who missed their clinic visits in order to reschedule appointments. While theoretically some individuals may have chosen to seek care elsewhere, we found this to rarely be the case. More often, based on documentation in our cancel logs, individuals missed appointments because they were ill, forgot their appointment due to other concerns, had transportation issues, or had difficulty taking time away from work. Understanding risk factors associated with missing clinic visits is crucial to developing strategies to address this issue. Strategies that have been previously utilized include reminder phone calls, automated emails/SMS/or phone calls or mailed reminder cards, and penalty fees.[1,53,54] These strategies, however, are likely to have only limited success as they place all the responsibility on the individual. Though forgetting to attend clinic appointments is a common occurrence, in neighborhoods with high levels of deprivation, the barriers to attending the clinic visit go well beyond forgetting, thereby making reminder messages a strategy unlikely to completely solve the problem. Additionally, penalty fees for missed visits, which we did not utilize, can deter people, especially those with more limited financial means, from seeking healthcare.

Furthermore, one-way automated reminders do not facilitate re-scheduling appointments if participants are unable to make it to appointments due to last minute hurdles. In the MI-SIGHT program, we used a series of reminder methods, starting with a phone call two days prior to the appointment to give patients an opportunity to re-schedule the visit, and another phone call the day before the visit if the participant did not confirm the visit the day before. Only after the patient confirmed that they can attend the appointment do we send a text message reminder the day before the appointment. Using two-way communication – a phone call - allows participants the flexibility to reschedule the appointment if needed. The fact that we still had a 23% rate of missed appointments demonstrates that reminders are helpful, but address only one reason why people miss clinic visits for preventive healthcare.

We need to move beyond strategies to bolster clinic attendance that focus only on the individual and ignore upstream deterrents not under an individual's control. Addressing the root of the issue through policy initiatives, such as tackling income inequality and its downstream effects and tackling unequal access to transportation, may help address clinic absenteeism. Specifically, providing more affordable, safe housing units, expanding clean outdoor green spaces within neighborhoods, ensuring access to healthy food, and improving public transportation could all aid people in coming to clinic visits for preventive eye care.[55–58] As part of a multi-method interventional strategy, DuMontier and colleagues identified and interviewed a cohort of patients who had missed six or more appointments in an 18-month period from May 2007 to June 2008 to better understand *why* they missed the appointments. Patients cited reasons ranging from managing family obligations to financial struggles to emotional and physical health concerns.[54] The authors then distributed a scripted discourse to be communicated by the receptionist to this cohort that made patients aware of their frequent missed appointments, described the effects on the clinic and the patient's health, and negotiated a commitment from the patient to improve appointment adherence. They also implemented a double-booking strategy, whereby members of this cohort were first scheduled into a virtual visit on the same day as their clinical appointment to confirm their attendance. After these targeted strategies, the clinic's rate of missed visits in the same cohort of patients fell from 33.3% to 17.7%. The authors posited that simply asking patients about their barriers to care in a respectful and empathetic manner improved health care providers' understanding of their patients' individual and collective issues, and subsequently decreased patient anxieties towards attending their appointments. This individual level intervention was highly successful, but still resulted in a 17.7% rate of missed clinic visits, which we hypothesize may be due to systemic barriers that were difficult for a person to overcome. To help address more upstream barriers, a community hospital-based family practice employed two social workers to connect patients to transportation and childcare services prior to their scheduled appointment and helped decrease their missed appointment rate from 25% to 7%.[59] More general area-based strategies have been limited by inconclusive results, difficulties with sustained funding, and general scalability.[55,60,61]

Limitations of this study include its lack of generalizability as the analysis was limited to people who signed up for MI-SIGHT program appointments at two sites, an FQHC and a free clinic in southeastern Michigan. Further, we could not assess how individual-level economic indicators impacted participants because these variables were not collected for

individuals who did not come to their MI-SIGHT program visit. An area of future study could involve following up with individuals who fail to attend a free clinic appointment to elicit individual level risk factors and specific barriers to seeking care. We do not have specific reasons for missed clinic visits for our cohort of patients. In addition, neighborhood-level data were extracted from national surveys based on the participants' addresses. ACS data relies on self-reported outcome measures, which can lead to social desirability bias, and restricts data from geographic locations with smaller populations, potentially lowering generalizability. Lastly, the enrollment period for this study began after the lockdown period for the COVID pandemic ended, but was still during the height of the pandemic. While the effects of the pandemic on preventive care-seeking behavior would theoretically affect both those who came and did not come to their appointment equally as all had made the appointment, the impact of the pandemic on appointment attendance is not fully clear.

Conclusion

Missing clinic visits for screening for glaucoma and other eye diseases can lead to missed early detection of disease and downstream vision loss. In the MI-SIGHT program, a free eye disease detection and treatment program, missing clinic visits was associated with living in a neighborhood with higher levels of poverty, worse neighborhood level deprivation, and more people living in circumstances where it is difficult to meet basic needs including paying rent and having access to a car. In designing interventions to address missed clinic visits, most approaches include reminder systems with the underlying thought process being that if individuals prioritized their vision, they would come to the appointment. However, individual-level strategies are not enough as they fundamentally lay blame on the individual, rather than acknowledging the larger social barriers to healthcare utilization. Our findings indicate that broad, community-based interventions are needed, especially in communities with high rates of poverty, to address upstream social factors that impact people's ability to attend clinic visits, including issues such as income inequality, access to transportation, childcare, eldercare, safe housing, employment and job flexibility.

Financial Support:

This work was supported by the Center for Disease Control and Prevention (Atlanta, GA; U01DP0064420100, PANC, ARE, MAW, LMN, AKB, DCM). National Institute for Minority Health and Health Disparities (Bethesda, MD; K23MD016430, ARE), the National Institutes of Health (GM111725, PMH), and Research to Prevent Blindness (Physician Scientist Award, PANC, Career Advancement Award, MAW). 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.

Works Cited

1. Berg BP, Murr M, Chermak D, et al. Estimating the Cost of No-Shows and Evaluating the Effects of Mitigation Strategies. Med Decis Making. 2013;33(8):976–985. doi:10.1177/0272989X13478194 [PubMed: 23515215]
2. Lehmann TNO, Aebi A, Lehmann D, Balandraux Olivet M, Stalder H. Missed appointments at a Swiss university outpatient clinic. Public Health. 2007;121(10):790–799. doi:10.1016/j.puhe.2007.01.007 [PubMed: 17555782]
3. Samuels RC, Ward VL, Melvin P, et al. Missed Appointments: Factors Contributing to High No-Show Rates in an Urban Pediatrics Primary Care Clinic. Clin Pediatr (Phila). 2015;54(10):976–982. doi:10.1177/0009922815570613 [PubMed: 25676833]

4. Sharp DJ, Hamilton W. Non-attendance at general practices and outpatient clinics. BMJ. 2001;323(7321):1081–1082. doi:10.1136/bmj.323.7321.1081 [PubMed: 11701560]
5. Cohen AD, Dreiher J, Vardy DA, Weitzman D. Nonattendance in a dermatology clinic--a large sample analysis. J Eur Acad Dermatol Venereol JEADV. 2008;22(10):1178–1183. doi:10.1111/j.1468-3083.2008.02740.x [PubMed: 18393960]
6. Kheirkhah P, Feng Q, Travis LM, Tavakoli-Tabasi S, Sharafkhaneh A. Prevalence, predictors and economic consequences of no-shows. BMC Health Serv Res. 2015;16(1):1–6. doi:10.1186/s12913-015-1243-z
7. Johnson BJ, Mold JW, Pontious JM. Reduction and management of no-shows by family medicine residency practice exemplars. Ann Fam Med. 2007;5(6):534–539. doi:10.1370/afm.752 [PubMed: 18025491]
8. Moore CG, Wilson-Witherspoon P, Probst JC. Time and Money: Effects of No-Shows at a Family Practice Residency Clinic. Fam Med.:6.
9. Adepoju OE, Chae M, Liaw W, Angelocci T, Millard P, Matuk-Villazon O. Transition to telemedicine and its impact on missed appointments in community-based clinics. Ann Med. 54(1):98–107. doi:10.1080/07853890.2021.2019826
10. Varma R, Vajaranant TS, Burkemper B, et al. Visual Impairment and Blindness in Adults in the United States: Demographic and Geographic Variations From 2015 to 2050. JAMA Ophthalmol. 2016;134(7):802–809. doi:10.1001/jamaophthalmol.2016.1284 [PubMed: 27197072]
11. Marques AP, Ramke J, Cairns J, et al. Global economic productivity losses from vision impairment and blindness. EClinicalMedicine. 2021;35:100852. doi:10.1016/j.eclinm.2021.100852
12. Dubey S, Bedi H, Bedi M, et al. Impact of Visual Impairment on the Wellbeing and Functional Disability of Patients with Glaucoma in India. J Curr Ophthalmol. 2020;32(1):14–18. doi:10.1016/j.joco.2019.09.006 [PubMed: 32510008]
13. National Academies of Sciences E, Division H and M, Practice B on PH and PH, et al. The Impact of Vision Loss. National Academies Press (US); 2016. Accessed August 12, 2022. http://www.ncbi.nlm.nih.gov/books/NBK402367/
14. Stevelink SAM, Malcolm EM, Fear NT. Visual impairment, coping strategies and impact on daily life: a qualitative study among working-age UK ex-service personnel. BMC Public Health. 2015;15(1):1118. doi:10.1186/s12889-015-2455-1 [PubMed: 26563137]
15. Nanda T, Wang A, Ducasse LM, Chen RWS, Horowitz J. No-Show Rates and Associated Patient Factors in an Ophthalmology Resident Practice. J Acad Ophthalmol. 2020;12(01):e67–e73. doi:10.1055/s-0040-1712171
16. Chiam M, Kunselman AR, Chen MC. Characteristics Associated With New Patient Appointment No-Shows at an Academic Ophthalmology Department in the United States. Am J Ophthalmol. 2021;229:210–219. doi:10.1016/j.ajo.2021.02.020 [PubMed: 33626367]
17. Goldstein I, Lin WC, Reznick LG, Chiang MF, Hribar M. Identifying Predictors of Patient no-shows in Pediatric Ophthalmology. Invest Ophthalmol Vis Sci. 2019;60(9):5444.
18. Norris AJS, Norris CE. Factors influencing non-attendance to scheduled eye surgery in rural Swaziland. Afr Vis Eye Health. 2019;78(1):10.
19. McMullen MJ, Netland PA. Lead time for appointment and the no-show rate in an ophthalmology clinic. Clin Ophthalmol Auckl NZ. 2015;9:513–516. doi:10.2147/OPTH.S82151
20. Robbins CC, Anjum S, Alwreikat AM, et al. An Initiative to Improve Follow-up of Patients with Glaucoma. Ophthalmol Sci. 2021;1(4). doi:10.1016/j.xops.2021.100059
21. Ngan R, Lam DL, Mudumbai RC, Chen PP. Risk factors for noncompliance with follow-up among normal-tension glaucoma suspects. Am J Ophthalmol. 2007;144(2):310–311. doi:10.1016/j.ajo.2007.04.005 [PubMed: 17659968]
22. Khambati A, Dowell L, Tajran J, et al. Comprehensive Analysis to Uncover Determinants of Patient Appointment Compliance in Ophthalmology at the Kresge Eye Institute, USA. Patient Prefer Adherence. 2021;15:589–600. doi:10.2147/PPA.S286486 [PubMed: 33731988]
23. Davies ML, Goffman RM, May JH, et al. Large-Scale No-Show Patterns and Distributions for Clinic Operational Research. Healthcare. 2016;4(1):15. doi:10.3390/healthcare4010015

24. Chapman KA, Machado SS, van der Merwe K, Bryson A, Smith D. Exploring Primary Care Non-Attendance: A Study of Low-Income Patients. J Prim Care Community Health. 2022;13:21501319221082352. doi:10.1177/21501319221082352
25. Boshers EB, Cooley ME, Stahnke B. Examining no-show rates in a community health centre in the United States. Health Soc Care Community. Published online November 12, 2021. doi:10.1111/hsc.13638
26. Greig EC, Gonzalez-Colaso R, Nwanyanwu K. Racial, Ethnic, and Socioeconomic Disparities Drive Appointment No-Show in Patients with Chronic Eye Disease. J Racial Ethn Health Disparities. Published online July 21, 2022. doi:10.1007/s40615-022-01363-x
27. Alkomos MF, Mendez D, Mazzei-Pifano D, et al. Patients' reasons for missing scheduled clinic appointments and their solutions at a major urban-based academic medical center. J Community Hosp Intern Med Perspect. 10(5):426–430. doi:10.1080/20009666.2020.1796903
28. Kim SD, Athukorala S, Waldron O, Bowie EM, Scott IU, Chen MC. Barriers to Attendance among Patients Scheduled for Appointments at an Academic Ophthalmology Practice. Invest Ophthalmol Vis Sci. 2021;62(8):1714.
29. Kaplan-Lewis E, Percac-Lima S. No-show to primary care appointments: why patients do not come. J Prim Care Community Health. 2013;4(4):251–255. doi:10.1177/2150131913498513 [PubMed: 24327664]
30. Zhang X, Cotch MF, Ryskulova A, et al. Vision Health Disparities in the United States by Race/Ethnicity, Education, and Economic Status: Findings from Two Nationally Representative Surveys. Am J Ophthalmol. 2012;154(6 0):S53–62.e1. doi:10.1016/j.ajo.2011.08.045
31. Allison K. Racial disparity in the prevalence of glaucoma in the United States. Eye Rep. 2019;5(1). doi:10.16964/er.v5i1.73
32. Allison K, Patel D, Besharim C. The Value of Annual Glaucoma Screening for High-Risk Adults Ages 60 to 80. Cureus. 13(10):e18710. doi:10.7759/cureus.18710
33. U.S. Census Bureau QuickFacts: Flint city, Michigan. Accessed May 3, 2023. https://www.census.gov/quickfacts/fact/table/ypsilanticitymichigan,flintcitymichigan/RHI225221
34. Newman-Casey PA, Musch DC, Niziol LM, et al. Michigan Screening and Intervention for Glaucoma and eye Health through Telemedicine (MI-SIGHT): Baseline Methodology for Implementing and Assessing a Community-Based Program. J Glaucoma. 2021;30(5):380–387. doi:10.1097/IJG.0000000000001812 [PubMed: 33596017]
35. Terms of Use | MTA Flint. Accessed April 30, 2024. https://www.mtaflint.org/terms-of-use/
36. For Software Developers | TheRide. Accessed April 30, 2024. https://www.theride.org/business/software-developers
37. About Us | PolicyMap. Accessed December 30, 2022. https://www.policymap.com/about
38. LEAD Tool | Department of Energy. Accessed December 30, 2022. https://www.energy.gov/eere/slsc/maps/lead-tool
39. Neighborhood Atlas - Home. Accessed December 30, 2022. https://www.neighborhoodatlas.medicine.wisc.edu/
40. Knighton AJ, Savitz L, Belnap T, Stephenson B, VanDerslice J. Introduction of an Area Deprivation Index Measuring Patient Socioeconomic Status in an Integrated Health System: Implications for Population Health. EGEMS Wash DC. 2016;4(3):1238. doi:10.13063/2327-9214.1238 [PubMed: 27683670]
41. Kind AJH, Jencks S, Brock J, et al. Neighborhood socioeconomic disadvantage and 30-day rehospitalization: a retrospective cohort study. Ann Intern Med. 2014;161(11):765–774. doi:10.7326/M13-2946 [PubMed: 25437404]
42. Data Dictionary | PolicyMap. Accessed May 4, 2023. https://policymap.wpengine.com/data/dictionary
43. Holm S. A Simple Sequentially Rejective Multiple Test Procedure. Scand J Stat. 1979;6(2):65–70.
44. Aickin M, Gensler H. Adjusting for multiple testing when reporting research results: the Bonferroni vs Holm methods. Am J Public Health. 1996;86(5):726–728. doi:10.2105/ajph.86.5.726 [PubMed: 8629727]

45. Zuelsdorff M, Larson JL, Hunt JFV, et al. The Area Deprivation Index: A novel tool for harmonizable risk assessment in Alzheimer's disease research. Alzheimers Dement Transl Res Clin Interv. 2020;6(1):e12039. doi:10.1002/trc2.12039
46. Number of vehicles per household in the U.S. 2017. Statista. Accessed May 4, 2023. https://www.statista.com/statistics/551403/number-of-vehicles-per-household-in-the-united-states/
47. Hu J, Kind AJH, Nerenz D. Area Deprivation Index (ADI) Predicts Readmission Risk at an Urban Teaching Hospital. Am J Med Qual Off J Am Coll Med Qual. 2018;33(5):493–501. doi:10.1177/1062860617753063
48. Cheng E, Soulos PR, Irwin ML, et al. Neighborhood and Individual Socioeconomic Disadvantage and Survival Among Patients With Nonmetastatic Common Cancers. JAMA Netw Open. 2021;4(12):e2139593. doi:10.1001/jamanetworkopen.2021.39593 [PubMed: 34919133]
49. Mohnen SM, Schneider S, Droomers M. Neighborhood characteristics as determinants of healthcare utilization – a theoretical model. Health Econ Rev. 2019;9(1):7. doi:10.1186/s13561-019-0226-x [PubMed: 30840211]
50. Maslow AH. A theory of human motivation. Psychol Rev. 1943;50:370–396. doi:10.1037/h0054346
51. Scott AW, Elam AR, Nwanyanwu K. Addressing Disparities in Eye Care—The Time Is Now. JAMA Ophthalmol. 2021;139(9):935–936. doi:10.1001/jamaophthalmol.2021.2053 [PubMed: 34351375]
52. Elam AR, Lee PP. High-Risk Populations for Vision Loss and Eye Care Underutilization: A Review of the Literature and Ideas on Moving Forward. Surv Ophthalmol. 2013;58(4):348–358. doi:10.1016/j.survophthal.2012.07.005 [PubMed: 23664105]
53. Macharia WM, Leon G, Rowe BH, Stephenson BJ, Haynes RB. An overview of interventions to improve compliance with appointment keeping for medical services. JAMA. 1992;267(13):1813–1817. [PubMed: 1532036]
54. DuMontier C, Rindfleisch K, Pruszynski J, Iii JJF. A Multi-Method Intervention to Reduce No-Shows in an Urban Residency Clinic. Fam Med.
55. Droomers M, Harting J, Jongeneel-Grimen B, Rutten L, van Kats J, Stronks K. Area-based interventions to ameliorate deprived Dutch neighborhoods in practice: Does the Dutch District Approach address the social determinants of health to such an extent that future health impacts may be expected? Prev Med. 2014;61:122–127. doi:10.1016/j.ypmed.2014.01.009 [PubMed: 24440162]
56. Social Determinants of Health and Healthy People - NACCHO. Accessed November 25, 2022. https://www.naccho.org/programs/public-health-infrastructure/performance-improvement/community-health-assessment/hp2020-and-sdoh
57. Roland KB, Milliken EL, Rohan EA, et al. Use of Community Health Workers and Patient Navigators to Improve Cancer Outcomes Among Patients Served by Federally Qualified Health Centers: A Systematic Literature Review. Health Equity. 2017;1(1):61–76. doi:10.1089/heq.2017.0001 [PubMed: 28905047]
58. Stupplebeen DA, Sentell TL, Pirkle CM, et al. Community Health Workers in Action: Community-Clinical Linkages for Diabetes Prevention and Hypertension Management at 3 Community Health Centers. Hawaii J Med Public Health J Asia Pac Med Public Health. 2019;78(6 Suppl 1):15–22.
59. Weingarten N, Meyer DL, Schneid JA. Failed appointments in residency practices: who misses them and what providers are most affected? J Am Board Fam Pract. 1997;10(6):407–411. [PubMed: 9407481]
60. Lawless P, Foden M, Wilson I, Beatty C. Understanding Area-based Regeneration: The New Deal for Communities Programme in England. Urban Stud. 2010;47(2):257–275. doi:10.1177/0042098009348324
61. Ruijsbroek A, Wong A, Kunst AE, et al. The impact of urban regeneration programmes on health and health-related behaviour: Evaluation of the Dutch District Approach 6.5 years from the start. PLOS ONE. 2017;12(5):e0177262. doi:10.1371/journal.pone.0177262

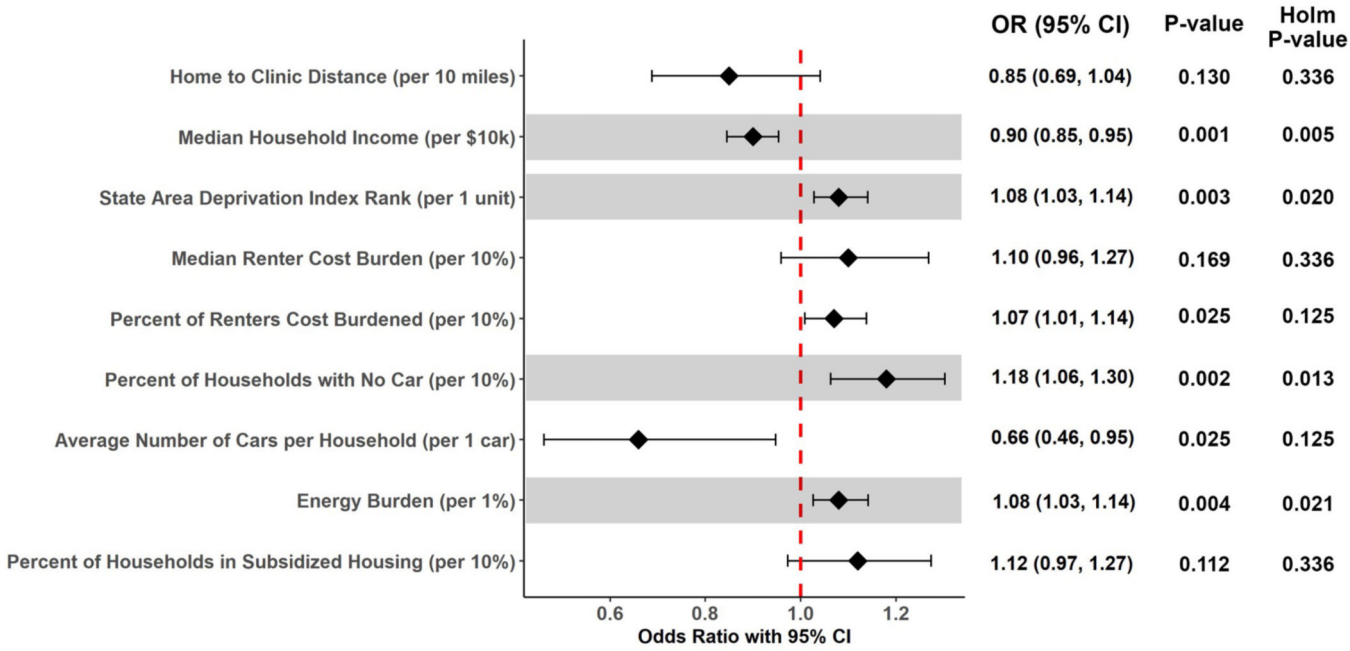

Figure 1. Logistic regression model results for the effect of individual-level and neighborhood-level variables on the probability of missed screening appointment.

Model estimates are adjusted for patient age, sex, ethnicity, and race. Each variable is included in a separate model. CI, Confidence Interval; Adj, Adjusted. *P-values were adjusted for multiple comparison with Holm's procedure.

Table 1.

Participant Demographics

	Overall (n=1431)		FQHC (n=815)		Free Clinic (n=616)		
	N	**Mean (SD)**	**N**	**Mean (SD)**	**N**	**Mean (SD)**	**P-value***
Age (years)	1431	54.1 (14.5)	815	53.3 (13.9)	616	55.2 (15.2)	0.0117
	N	**Frequency (%)**	**N**	**Frequency (%)**	**N**	**Frequency (%)**	**P-value***
Gender	1419		809		610		
Female		857 (60.4)		470 (58.1)		387 (63.4)	0.0473
Male		562 (39.6)		339 (41.9)		223 (36.6)	
Ethnicity	1152		672		480		
Hispanic/Latino		103 (8.9)		46 (6.8)		57 (11.9)	0.0044
Non-Hispanic/Non-Latino		1049 (91.1)		626 (93.2)		423 (88.1)	
Race	1314		752		562		
Black/African American		676 (51.4)		483 (64.2)		193 (34.3)	
White		481 (36.6)		222 (29.5)		259 (46.1)	
Asian		67 (5.1)		6 (0.8)		61 (10.9)	<0.0001†
Other		90 (6.8)		41 (5.5)		49 (8.7)	

SD, Standard Deviation; FQHC, Federally Qualified Health Clinic.

*Two-sample t-test, chi-square, or Fisher's exact test with Holm's procedure for multiple comparisons.

†Post-hoc pairwise comparison showed significant differences in race between two clinic sites for: Black/African American (Holm-adjusted p<0.001), White (Holm-adjusted p<0.001), Asian (Holm-adjusted p<0.001), and Other (Holm-adjusted p=0.020).

Table 2.

Individual-level and Neighborhood-level Deprivation Variables

	Overall (n=1423)			FQHC (n=815)		Free Clinic (n=608)		
Individual-level Variable	**N**	**Mean (SD)**	**IQR (Median)**	**N**	**Mean (SD)**	**N**	**Mean (SD)**	**Adj P-value***
Home to Clinic Distance (miles)	1402	7.7 (8.1)	2.8–9.6 (4.7)	808	5.5 (5.6)	594	10.7 (9.9)	<0.001
Home to Bus Stop Distance (miles)	1402	3.6 (7.2)	0.1–2.9 (0.3)	808	1.7 (4.4)	594	6.1 (9.1)	**<0.0001**
Bus Stop to Clinic Distance (miles)	1402	4.1 (2.4)	2.6–5.0 (4.0)	808	3.8 (1.9)	594	4.6 (2.8)	**<0.0001**
Neighborhood-level Variable	**N**	**Mean (SD)**	**IQR (Median)**	**N**	**Mean (SD)**	**N**	**Mean (SD)**	**Adj P-value***
By Census Block Group								
Median Household Income (thousand of dollars)	1358	49.2 (30.3)	29.3–63.2 (40.5)	755	37.5 (19.1)	603	63.8 (35.0)	<0.001
State Area Deprivation Index Rank	1410	6.8 (3.2)	4.0–10.0 (8.0)	808	8.6 (2.1)	602	4.5 (2.9)	<0.001
Median Renter Cost Burden (%)	1242	33.2 (10.9)	24.6–43.1 (31.6)	702	35.6 (10.8)	540	30.2 (10.4)	<0.001
Percent of Renters Cost Burdened	1391	46.8 (23.8)	29.6–63.8 (47.8)	793	50.0 (24.6)	598	42.7 (22.2)	<0.001
Percent of Households with No Car	1420	13.7 (13.4)	2.8–21.2 (9.1)	812	16.9 (14.5)	608	9.4 (10.3)	<0.001
Average Number of Cars per Household	1202	1.5 (0.5)	1.2–1.8 (1.4)	680	1.4 (0.5)	522	1.6 (0.4)	<0.001
By Census Tract								
Energy Burden (%)	1421	5.0 (2.7)	3.0–7.0 (4.0)	813	6.4 (2.6)	608	3.2 (1.5)	<0.001
Percent of Households in Subsidized Housing	1248	7.9 (10.8)	1.5–9.6 (3.8)	753	7.5 (10.7)	495	8.5 (11.0)	0.229

SD, Standard Deviation; IQR, Interquartile Range; FQHC, Federally Qualified Health Clinic; Adj, Adjusted.

*Two-sample t-test with Holm's procedure for multiple comparisons.

Table 3.

Comparison of individual-level and neighborhood-level deprivation variables between attended vs. missed screening appointments

	Attended (n=1101)	Missed (n=330)	
Individual-level Variable	**Mean (SD)**	**Mean (SD)**	**Adj P-value***
Home to Clinic Distance (miles)	8.0 (8.5)	6.5 (6.4)	0.006
Home to Bus Stop Distance (miles)	3.9 (7.5)	2.4 (5.6)	0.1316
Bus Stop to Clinic Distance (miles)	4.1 (2.4)	4.2 (2.2)	0.3230
Neighborhood-level Variable	**Mean (SD)**	**Mean (SD)**	**Adj P-value**
By Census Block Group			
Median Household Income (thousand of dollars)	51.0 (31.6)	43.0 (24.5)	<0.001
State Area Deprivation Index Rank	6.7 (3.3)	7.4 (3.0)	0.001
Median Renter Cost Burden (%)	33.0 (11.0)	34.1 (10.7)	0.515
Percent of Renters Cost Burdened	46.1 (23.8)	49.1 (23.9)	0.243
Percent of Households with No Car	13.0 (12.7)	16.0 (15.4)	0.012
Average Number of Cars per Household	1.5 (0.4)	1.4 (0.5)	0.183
By Census Tract			
Energy Burden (%)	4.9 (2.6)	5.5 (3.1)	0.006
Percent of Households in Subsidized Housing	7.7 (10.8)	8.4 (10.9)	1.000

SD, standard deviation; Adj, adjusted.

*Two-sample t-test with Holm's procedure for multiple comparisons.