Access to eye care and prevalence of refractive error and eye conditions at a high school–based eye clinic in southeastern Michigan

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PURPOSE To analyze clinical and demographic data from a twice monthly optometrist-run comprehensive eye program at a high school in a community with high rates of poverty.

METHODS Students received comprehensive eye examinations. We collected demographic and ocular data on 429 initial visits from February 2015 to July 2019. Follow-up visits were excluded.

RESULTS The average student age was 14.2 ± 2.7 years. Of the total, 55.7% were female, 59.7% were Black, and 61.7% had Medicaid. Of the total, 70.2% had a previous eye examination, 60.8% had worn glasses previously, and 24.1% still wore glasses. Hispanic students were less likely than non-Hispanic students to have had a prior eye examination (59.1% vs 75.3% [$P = 0.022$]) or worn glasses (47.8% vs 63.8% [$P = 0.035$]). Black students had significantly worse presenting visual acuity in the better seeing eye than White students (logMAR 0.22 vs 0.13 [$P = 0.0004$]). Of the 256 Black students, 62.7% had improvement of two or more lines, compared with 42.9% of White students ($P = 0.01$). Of the students who participated, 74.0% received glasses following their examination, and 21 required referrals to ophthalmologists, of whom 13 attended the appointment.

CONCLUSIONS The high school–based clinic identified high rates of uncorrected refractive error, highlighting the benefit of a school-based eye clinic in a population with high rates of poverty. There were concerning racial and ethnic disparities in prior eye care. (J AAPOS 2022; 26:185.e1-6)

Vision problems are one of the most common disabling conditions in school-age children, and 6% of children in the United States are estimated to have a diagnosed eye condition.[1] Uncorrected refractive error is the main cause of visual impairment and blindness in children. In the long term, unaddressed vision problems have been associated with deficits in childhood literacy,[2] lower academic performance,[3] and decreased health, quality of life, and well-being.[4] In the United States, there are socioeconomic, racial and ethnic disparities in pediatric utilization of eye care.[5,6] Visual impairment in US preschoolers is expected to increase by 26% between 2015 and 2060 because of shifts in racial and ethnic demographics,[7] and the prevalence of myopia, commonly of school-age onset, is expected to increase from 28.3% to 49.8% worldwide between 2016 and 2050.[8]

To improve access to eye care, some schools have integrated eye care into the school setting.[9] In-school comprehensive eye examination programs[10-12] and mobile eye clinics[13-18] for preschool through middle school populations have been described in the literature; however, only one of those programs is a permanent, recurring clinic,[11] and none serve high school students.

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Thus, there is a gap in the literature regarding both permanent clinics and high school–based eye clinics.

The University of Michigan (UM) conducts a biweekly comprehensive eye clinic at the Michigan Medicine Regional Alliance for Healthy Schools (RAHS) School-based Health Center located at the Ypsilanti Community High School (YCHS), which serves grades 9-12 and has approximately 870 students. The demographics of YCHS are as follows: 70.3% Black, 13.8% White, 11.0% Hispanic, 4.5% two or more races, and 0.4% Asian. Nearly two-thirds (63%) of students are eligible for free lunch, reflecting the high rate of poverty in Ypsilanti. The patients' clinical and demographic data were analyzed to describe the population and understand the role of the high school–based clinic in addressing uncorrected refractive error and ophthalmic disease. We assessed the relationships between previous access to eye care, race, ethnicity, and socioeconomic status (as assessed by insurance status as Medicaid or no insurance vs private insurance) to investigate eye care disparities.

Subjects and Methods

The UM Institutional Review Board approved this study, which adhered to the tenets of the Declaration of Helsinki. An optometrist (CD) from the UM Kellogg Eye Center (KEC) pediatric section has held an eye clinic 2 days per month since 2014 at the RAHS school-based health center at YCHS. There are 10-12 appointment slots per clinic day, and both new and return patients can be seen in any slot. Eye clinic services are available to youth ≤21 years of age from the high school, other local schools, and the community-at-large. A RAHS ancillary care coordinator arranges transportation of students from other schools in the district by van for visits at YCHS. Parents can bring students directly to YCHS for eye examinations. Both insured and uninsured students are seen with no out-of-pocket charges. Students often present to the eye clinic after failing a screening at their school-based health center or primary care office or as part of the Michigan Department of Health and Human Services Vision Screening program. However, students do not require a referral to be seen at the eye clinic, and any student or parent can request an eye examination. Comprehensive eye examinations, including dilation and cycloplegic refraction, are performed in the fully equipped, permanent examination room. Eyeglasses are provided at no cost. Students select a frame at the eye clinic and a KEC optician makes the glasses, which are delivered to the school within 2 weeks for dispensing and adjustments. Students with eye diseases are referred to the KEC. Optometrist time is donated by the KEC to the RAHS eye clinic at YCHS. Students' health insurance is billed for the examination, and RAHS covers any expenses not covered by insurance. The cost of eyeglasses is covered by the RAHS.

Demographic and ocular data from initial visits to the YCHS RAHS eye clinic were collected for February 2015 through July 2019. Follow-up visits were excluded. Data collected included students' sex, age, race, ethnicity, and insurance status from the student's UM electronic health record (EHR). Race and ethnicity were self-reported. Options for racial identification included White, Black, Asian, American Indian or Alaskan Native, Native Hawaiian or Pacific Islander and Other; patients or caregivers could select more than one option. Options for ethnicity included Hispanic and non-Hispanic. Clinical data included ocular history, presenting visual acuity, best-corrected visual acuity, refraction, examination findings, ocular diagnoses, if glasses were ordered, and whether a referral was provided to KEC. Myopia was defined as requiring −0.25 D or more negative to achieve best corrected visual acuity. Hyperopia was defined as requiring at least +0.25 D or more plus to achieve best-corrected visual acuity. Elevated intraocular pressure (IOP) was defined as >21 mm Hg. Ocular history was obtained by patient self-report plus review of the EHR if the patient had been seen at KEC in the past. Visual acuity was measured using the Snellen eye chart. Presenting visual acuity was measured with a current pair of glasses, if available. Cycloplegic refraction was performed to determine best-corrected visual acuity. For students referred to KEC for additional care, the medical record was reviewed to assess whether the referral was completed. Statistical analysis was performed using SAS version 9.4 (SAS Institute, Cary, NC).

Results

In total, 429 students had an initial visit to the RAHS eye clinic during the study period. Average age was 14.2 ± 2.7 (mean ± standard deviation) years. Slightly over half were female (239 [55.7%]). In terms of race, over half (256 [59.7%]) identified as Black, 80 (18.6%) as other, 77 (17.9%) as White, 11 (2.6%) as Asian, and 2 (0.5%) as more than one race. For ethnicity, 46 (10.9%) identified as Hispanic. Most Hispanic students (44 [96%]) selected "other" for race, and 2 selected White. Given the small sample of students who identified their race as Asian or more than one race and the lack of information on the 80 students who identified their race as "other," we report subsequent results by the most common self-identified racial categories (Black and White) and ethnicity categories of Hispanic and non-Hispanic.

In terms of health insurance, 259 (61.7%) had Medicaid, 99 (23.6%) had private health insurance, and 62 (14.8%) were uninsured. There were statistically significant differences in insurance type based on race ($P < 0.0001$) and ethnicity ($P = 0.011$). See Table 1.

Of all students, 70.2% reported having had a previous eye examination, including 188 Black students and 50 White students (76.4% vs 68.5% [$P = 0.17$]). Of the Hispanic students, 26 had prior examinations; of the non-Hispanic students, 271 (59.1% vs 75.3% [$P = 0.02$]). There were 46 students (78.0%) without insurance, 187 (73.9%) with Medicaid, and 63 (68.5%) with private insurance who had had prior examinations ($P = 0.41$). See Figure 1. Of the total number of students, 261 (60.8%) wore glasses previously, of whom 61 (24.1%) were still wearing glasses. This includes 166 Black students and 41 White students who had previously worn glasses (65.1%

Table 1. Sociodemographic data

Study parameter	No. (%)[a]	*P* value
Participants	429	
Sex		
Female	239 (55.7)	
Male	190 (44.3)	
Age, years, mean ± SD (range)	14.2 ± 2.7 (4-20)	
Race		
Black	256 (59.7)	
Other	80 (18.6)	
White	77 (17.9)	
Asian	11 (2.6)	
Biracial	2 (0.5)	
Ethnicity		
Non-Hispanic	376 (89.1)	
Hispanic	46 (10.9)	
Type of health insurance		
Medicaid	259 (61.7)	
Private	99 (23.6)	
None	62 (14.8)	
Health insurance by race		<0.0001
Black		
Medicaid	175 (68.9)	
Private	53 (20.9)	
None	26 (10.2)	
White		
Medicaid	44 (57.1)	
Private	23 (29.9)	
None	10 (13.0)	
Health insurance by ethnicity		0.011
Hispanic		
Medicaid	19 (42.2)	
Private	14 (31.3)	
None	12 (26.7)	
Non-Hispanic		
Medicaid	236 (63.8)	
Private	85 (23.0)	
None	49 (13.2)	

SD, standard deviation.
[a]Unless otherwise indicated.

vs 53.9% [$P = 0.10$]). Twenty-two Hispanic students and 238 non-Hispanic students had worn glasses (47.8 vs 63.8% [$P = 0.04$]). With respect to insurance status, 43 students without insurance (69.4%), 163 students with Medicaid (62.9%), and 51 students with private insurance (52.6%) had worn glasses ($P = 0.08$). See Figure 2. Of former glasses wearers, 144 (56.9%) reported glasses lost or broken, and there was no significant difference by race, ethnicity, or insurance status ($P = 0.14$, $P = 0.48$, and $P = 0.42$, resp.).

Of the total number of examined students, 94 (21.9%) had presenting visual acuity worse than 20/40 in both eyes, and 8 (1.9%) had presenting visual acuity of 20/200 or worse in both eyes. Black students had significantly worse presenting visual acuity in the better-seeing eye than White students (0.22 ± 0.26 vs 0.13 ± 0.24 logMAR [$P = 0.0004$]), but there was no difference based on ethnicity ($P = 0.46$) or insurance status ($P = 0.26$). (Table 2) Refractive error was measured in 375 students (87.9%). The prevalence of myopia was 56.0% and the prevalence of hyperopia was 31.9% (eSupplement 1, available at jaapos.org). Most of the refractive error was clinically significant: 179 (41.7%) had myopia of −0.75 D or more, and 116 (27.0%) had hyperopia of +0.75 D or more. There was improvement of at least two lines on correction in 230 students (58.7%) in at least one eye and 169 students (43.3%) in both eyes; 146 Black students were improved in at least one eye compared with 30 White students (62.7% vs 42.9% [$P = 0.01$]), and 114 and 21, respectively, improved in both eyes on correction (49.4% vs 30.0% [$P = 0.008$]). There was no difference in visual acuity improvement by ethnicity for at least one ($P = 0.98$) or both eyes ($P = 0.26$) or by insurance status for at least one ($P = 0.22$) or both eyes ($P = 0.12$). Following examination, 316 students (74.0%) received glasses. Black students were significantly more likely to receive glasses compared to White students (78.1% vs 63.6% resp. [$P = 0.01$]), but there was no difference based on ethnicity ($P = 0.65$) or insurance status ($P = 0.06$). See Table 2.

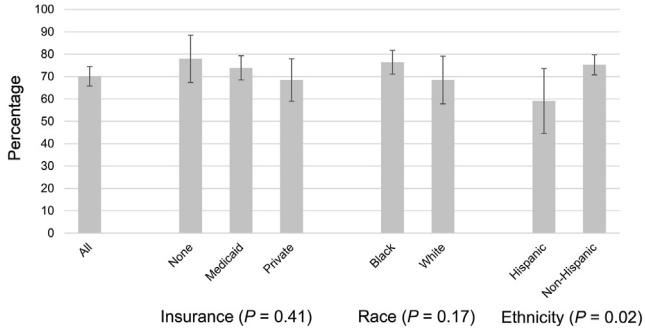

FIG 1. Prior examination by race, ethnicity, and insurance.

Medical eye problems were identified at the school-based eye clinic, including 18 students (4.2%) with suspicion for glaucoma based on an elevated IOP, 37 (8.7%) with amblyopia, and 1 (0.2%) with a cataract (eSupplement 1). Ultimately, 21 students (4.9%) were referred to the KEC for further care; 13 (61.9%) attended the appointment, 3 (14.3%) scheduled an appointment but did not attend, and five (23.8%) never scheduled an appointment. Of the 13 students who attended their follow up appointments at the KEC, 4 had strabismus (of whom 2 ultimately underwent surgery), 1 had a corneal abrasion, 2 had refractive error, 1 had keratoconus, 1 had ocular hypertension, 1 had Goldenhar syndrome with eyelid coloboma, 1 had choroidal nevus, 1 had acute zonal occult outer retinopathy, and 1 had retinopathy of prematurity with history of enucleation.

Discussion

We analyzed demographic and clinical data from a high school–based eye clinic located in an urban area of southeast Michigan with a high rate of poverty. We found that students generally had high rates of prior examinations but low rates of current glasses wear and correct glasses

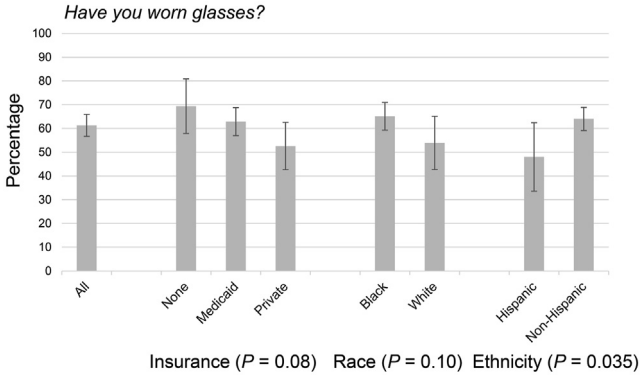

FIG 2. Prior glasses wear by race, ethnicity, and insurance.

prescription. Hispanic students were significantly less likely than non-Hispanic students to have had a prior eye examination or to have worn glasses. Black students had worse presenting visual acuity and were more likely to have two or more-line improvement in best-corrected visual acuity following refraction. Nearly three-quarters of students required new glasses. Some students referred to KEC for evaluation of potentially serious pathology did not attend the follow-up appointment.

Over two-thirds of our participants had a prior examination, higher than the rate in the Baltimore Reading and Eye Disease Study, where 46.1% of second and third graders reported a prior examination.[12] Our relatively higher rate is likely due to a number of factors. Michigan law requires robust childhood vision screening; local health departments must offer vision screening in preschool, 1st, 3rd, 5th, 7th, and 9th grades at no cost to families. Furthermore, pediatric eye examinations and glasses are both covered under Michigan Medicaid,[19] and our study cohort had high rates of Medicaid coverage. The KEC accepts Medicaid and has a clinic in Ypsilanti, providing full adult and pediatric optometric and ophthalmic care. Thus, children in the Ypsilanti community theoretically have high access to eye care.

Yet despite good access, less than one-quarter of patients who were previously prescribed glasses were still wearing them, over half reported their glasses were lost or broken and had not been replaced, and nearly three-quarters required new glasses. Similarly, studies of preschool through middle school children receiving eye care at school-based vision programs across the country reported glasses prescription rates of 67%-84%.[15,20-22] Poor presenting visual acuity despite access to eye care in our study supports the existing literature on underutilization of pediatric vision care in communities with high poverty[5,23] and suggests that having vision coverage through Medicaid does not solve access issues. A prior study found that children with Medicaid have more difficulty getting appointments with eye care providers than children with private insurance.[24] A qualitative study found a perception among parents that examination quality and eyeglasses through Medicaid would be substandard,

Table 2. Refractive data on 429 participants by race, ethnicity, and insurance status

Study parameter	Race			Ethnicity			Insurance			
	Black	White	*P* value	Hispanic	Non-Hispanic	*P* value	None	Medicaid	Private	*P* value
LogMAR PVA[a], mean ± SD	0.22 ± 0.26	0.13 ± 0.24	0.0004	0.16 ± 0.20	0.20 ± 0.26	0.46	0.18 ± 0.21	0.21 ± 0.27	0.17 ± 0.22	0.26
LogMAR BCVA,[a] mean ± SD	0.01 ± 0.06	0.00 ± 0.00	0.21	0.00 ± 0.01	0.01 ± 0.05	0.61	0.00 ± 0.02	0.01 ± 0.06	0.00 ± 0.03	0.67
BCVA improved ≥2 lines, no. (%)										
At least one eye	146 (62.7)	30 (42.9)	0.01	25 (58.1)	200 (58.3)	0.98	37 (67.3)	138 (58.5)	49 (52.7)	0.22
Both eyes	114 (49.4)	21 (30)	0.008	15 (34.9)	151 (44.3)	0.26	27 (49.1)	107 (45.7)	32 (34.4)	0.12
Glasses dispensed, no. (%)	200 (78.1)	49 (63.6)	0.01	33 (71.7)	280 (74.9)	0.65	47 (75.8)	198 (76.4)	63 (64.3)	0.06

BCVA, best-corrected visual acuity; *LogMAR*, logarithm of the minimum angle of resolution; *PVA*, presenting visual acuity.
[a]Better-seeing eye.

leading them to defer examinations.[25] The large number of students who benefited from the high school–based eye clinic in our study highlights the value of incorporating comprehensive eye care into the school setting in a community with high rates of poverty.

This study reveals racial and ethnic disparities in eye care in our population. Hispanic students had significantly lower rates of prior examinations and prior glasses than non-Hispanic students. This may reflect limited access to prior eye care, because over one-quarter of Hispanic students were uninsured. However, there was no difference in presenting visual acuity or rates of glasses prescription between Hispanic and non-Hispanic students. This was unexpected, given the low rate of prior eye examinations among Hispanic students, and may reflect low power to detect differences based on ethnicity due to low numbers of Hispanic students in our population. Black students had significantly worse presenting visual acuity than White students, and they had greater improvement in best-corrected visual acuity following refraction. Although we did not adjust for insurance status when assessing the association between race and presenting visual acuity, we did not see any association between insurance status and presenting visual acuity or prior glasses wear, so we do not believe that the racial disparity in presenting visual acuity can be explained solely by insurance status. There was no difference in rates of prior eye examinations, prior glasses wear, or lost/broken glasses between Black and White students. It is possible that Black students' prior eye examinations had taken place farther in the past and that their glasses prescriptions were more out of date.

Our study contributes to a growing body of literature on racial and ethnic disparities in pediatric access to eye care. A school-based vision program in Baltimore found that Black and Hispanic pre-Kindergarten through 8th grade students were more likely than non-Hispanic White students to improve two lines in the worse eye following refraction.[18] Similarly, an analysis of data from the National Health and Nutrition Examination Survey found that the odds of inadequate refractive correction were significantly greater in Mexican American and non-Hispanic Black participants compared to non-Hispanic White participants, with the greatest disparity among 12- to 19-year-olds.[26] Such disparities across US settings highlight the need for improved delivery of eye care and refractive correction to racial and ethnic minority children. Our findings suggest that school-based eye clinics, including at the high school level, may be an important tool for expanding access to eye care for these populations.

Nearly 40% of students referred for advanced care in our study did not receive it, either because they did not attend a scheduled appointment or because they did not schedule the appointment. This is consistent with reported referral adherence rates of 20%-50% for advanced care from other school-based eye care programs.[8-9] Barriers to follow-up for advanced care may be similar to barriers to follow-up after failed vision screenings, which include cost, difficulty scheduling follow-up appointments, and difficulty planning ahead.[25] Drawing on the fields of behavioral economics and implementation science, school-based eye clinics should continue to explore a wide array of methods for ensuring advanced follow-up when necessary,[27] including enhanced communication with parents and guardians,[28] motivational interviewing-based health coaching and providing vouchers for transportation to appointments.[29]

Having both demographic and clinical examination data on participants in a high school–based eye clinic allowed us to better characterize the effects of the program. Our program was designed to overcome many transportation and logistical barriers to eye care access. Glasses were dispensed at the school and were free of charge, a practice that a Cochrane review found to result in more students wearing glasses than if they had only been provided with a prescription.[30]

This study also has limitations. By not providing a mutually exclusive race/ethnicity category, Hispanic students may have been forced to choose a race with which they did not identify. This likely contributed to the large proportion of students who chose "other" for race, potentially biasing our analysis of racial and ethnic disparities.[31] There was limited data on past eye and refractive history. Because many prior examinations took place at non-UM settings that do not share the UM EHR, we were not able to determine when prior examinations had taken place.

Future research should focus on identifying the root causes of racial and ethnic disparities in pediatric eye care, including the impact of structural racism in creating barriers to care for racial and ethnic minority children. Qualitative methodologies may provide a deeper understanding of patients' and families' experiences, beliefs, and attitudes around eye care and identify key determinants of care.

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