Prevalence of Vision Disorders by Racial and Ethnic Group among Children Participating in Head Start

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Objective: To compare the prevalence of amblyopia, strabismus, and significant refractive error among African-American, American Indian, Asian, Hispanic, and non-Hispanic white preschoolers in the Vision In Preschoolers study.

Design: Multicenter, cross-sectional study.

Participants: Three- to 5-year old preschoolers (n = 4040) in Head Start from 5 geographically disparate areas of the United States.

Methods: All children who failed the mandatory Head Start screening and a sample of those who passed were enrolled. Study-certified pediatric optometrists and ophthalmologists performed comprehensive eye examinations including monocular distance visual acuity (VA), cover testing, and cycloplegic retinoscopy. Examination results were used to classify vision disorders, including amblyopia, strabismus, significant refractive errors, and unexplained reduced VA. Sampling weights were used to calculate prevalence rates, confidence intervals, and statistical tests for differences.

Main Outcome Measures: Prevalence rates in each racial/ethnic group.

Results: Overall, 86.5% of children invited to participate were examined, including 2072 African-American, 343 American Indian (323 from Oklahoma), 145 Asian, 796 Hispanic, and 481 non-Hispanic white children. The prevalence of any vision disorder was 21.4% and was similar across groups ($P = 0.40$), ranging from 17.9% (American Indian) to 23.3% (Hispanic). Prevalence of amblyopia was similar among all groups ($P = 0.07$), ranging from 3.0% (Asian) to 5.4% (non-Hispanic white). Prevalence of strabismus also was similar ($P = 0.12$), ranging from 1.0% (Asian) to 4.6% (non-Hispanic white). Prevalence of hyperopia >3.25 diopter (D) varied ($P = 0.007$), with the lowest rate in Asians (5.5%) and highest in non-Hispanic whites (11.9%). Prevalence of anisometropia varied ($P = 0.009$), with the lowest rate in Asians (2.7%) and highest in Hispanics (7.1%). Myopia >2.00 D was relatively uncommon (<2.0%) in all groups with the lowest rate in American Indians (0.2%) and highest rate in Asians (1.9%). Prevalence of astigmatism >1.50 D varied ($P = 0.01$), with the lowest rate among American Indians (4.3%) and highest among Hispanics (11.1%).

Conclusions: Among Head Start preschool children, the prevalence of amblyopia and strabismus was similar among 5 racial/ethnic groups. Prevalence of significant refractive errors, specifically hyperopia, astigmatism, and anisometropia, varied by group, with the highest rate of hyperopia in non-Hispanic whites, and the highest rates of astigmatism and anisometropia in Hispanics. *Ophthalmology 2014;121:630-636 © 2014 by the American Academy of Ophthalmology.*

*Supplemental material is available at www.aaojournal.org.

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Pediatric eye disorders affect all racial and ethnic groups. Recently, the National Eye Institute sponsored 2 population-based studies of the prevalence of eye disorders among children ages 6 to 72 months in the United States, the Baltimore Pediatric Eye Disease Study (BPEDS) and the Multi-ethnic Pediatric Eye Disease Study (MEPEDS) based in the Los Angeles area. These studies yielded similar prevalence rates of amblyopia (1%–4%) and strabismus (2%–5%) among African-American, Asian, Hispanic, and non-Hispanic white children.[1–5] Differences among racial and ethnic groups were greater for specific aspects of refractive error with non-Hispanic white children having a mean of +0.78 diopters (D) more hyperopia than African-American children in BPEDS, and Hispanic children having a greater prevalence of hyperopia than African-American children (26.9% vs 20.8%) and a lesser prevalence of myopia (3.7% vs 6.6%) in MEPEDS.[1,2] Neither of these studies included American Indians and only children from 2 areas of the United States were included.

The Vision In Preschoolers (VIP) study was a multicenter study of preschool children in Head Start, representing a large

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sample of children residing in low-income households and representing a variety of racial/ethnic groups (African American, American Indian, Asian, Hispanic, and non-Hispanic white).[6,7] All children underwent comprehensive eye examinations performed by VIP Study-certified pediatric optometrists and ophthalmologists. The standardized eye examination results from the VIP Study provide an additional source to compare prevalence rates of vision disorders among 5 racial/ethnic groups, including Native American Indians, a group not represented in BPEDS and MEPEDS. Results from the VIP Study complement findings from the BPEDS and the MEPEDS in providing necessary information to form rational public health care policy. The purpose of this paper is to compare the prevalence of amblyopia, strabismus, and significant refractive error among African-American, American Indian, Asian, Hispanic, and non-Hispanic white preschoolers in the VIP Study.

Methods

This is a post hoc secondary analysis of the VIP Study data. The VIP Study was a multicenter, cross-sectional, 2-phased study conducted from 2001 to 2004 and sponsored by the National Eye Institute, to evaluate the effectiveness of vision screening tests in identifying preschool children who would benefit from a comprehensive eye examination. The details of the VIP Study design have been published elsewhere[6,7]; only details of the comprehensive eye examination to identify vision disorders are described herein.

Subjects

Participants in the VIP Study were preschool children (3−5 years old) enrolled in Head Start programs collaborating with 1 of the 5 VIP Study clinical centers (Berkeley, California; Boston, Massachusetts; Columbus, Ohio; Philadelphia, Pennsylvania; Tahlequah, Oklahoma). Head Start is a federal program that promotes the school readiness of children ages birth to 5 years from low-income families by enhancing their cognitive, social, and emotional development.[8] Head Start requires all children to complete vision screening carried out by Head Start personnel or other organizations within 45 days of school entry. The VIP Study used results from these initial screenings to select an enriched sample of 3- to 5-year-olds from the 5 VIP Study clinical centers. All Head Start children who failed the local Head Start screening and a random sample (~20%) of those who did not fail the screening were targeted for enrollment into the study. Children with physical or mental disability were excluded from the VIP Study. During the VIP Study sample selection process, a list was created for each Head Start classroom of the children who passed or failed the Head Start screening. The total number of children who could be accommodated for a VIP Study screening was determined by the coordinator based on scheduling constraints. The number of children who failed the Head Start screening was subtracted from the number who could be accommodated to determine the number of children to be randomly selected from among the children who passed the Head Start screening. The number of targeted and consented children was recorded for Head Start passes and failures for each Head Start classroom.

The local institutional review boards associated with each center approved the study protocol. Written, informed consent was obtained from parents. Parents reported the race and ethnicity of their child.

Comprehensive Standardized Eye Examination

The enrolled children underwent comprehensive eye examinations performed according to VIP Study protocol by study-certified optometrists and ophthalmologists who were experienced in providing eye care to children. Each comprehensive eye examination included monocular threshold visual acuity (VA), cover testing, and cycloplegic retinoscopy. Anterior segment evaluation and dilated fundus examination were also performed to detect possible causes of reduced VA.

Monocular threshold VA testing was conducted with crowded, single H, O, T, and V optotypes using the Electronic Vision Assessment system at 10 feet, according to the protocol established by the Amblyopia Treatment Study.[9] Children who wore spectacles were tested while wearing their spectacles. Both eyes of a child were retested with full cycloplegic correction if (1) VA <20/50 for 3-year-olds, VA <20/40 for 4- to 5-year-olds, or an intereye acuity difference ≥2 lines *and* (2) hyperopia ≥2.0 D, myopia ≥0.5 D, or astigmatism ≥1.0 D was present in either eye. The final VA score of an eye was based on the best score from the initial test or retest for eyes that were retested, and based on the initial test for eyes that were not retested.

Both a cover−uncover test and an alternating cover test were performed at distance (10 feet) and near (16 inches) to evaluate ocular alignment. Cycloplegic retinoscopy was performed 30 to 40 minutes after instillation of 1 drop of 0.5% proparacaine, followed by 1 drop each of 1% cyclopentolate and 0.5% tropicamide. Retinoscopy was performed with the child wearing retinoscopy spectacles corresponding with the examiner's working distance, while the child watched a children's video presented at 10 feet.

Definitions of Vision Disorders

Results from the comprehensive vision examinations were used to classify children with respect to the 4 VIP Study−targeted vision disorders: amblyopia, strabismus, significant refractive error, and unexplained reduced VA (Table 1).

Statistical Analysis

For each of 5 racial/ethnic groups (African American, American Indian, Asian, Hispanic and non-Hispanic white), the prevalence rate of vision disorders was calculated, overall and by type of vision disorders (amblyopia, strabismus, significant refractive error, and unexplained reduced VA), by age (3, 4, and 5 years) and by gender. Spherical equivalent (SE) for each eye was calculated as SE = sphere + (1/2) × cylinder, and the average of SE from the child's 2 eyes was used in statistical comparisons of refractive error across 5 racial/ethnic groups using 1-way analysis of variance. For calculation of prevalence rates and refractive error, the sampling fractions for children passing the Head Start screening, specific to each center, were applied to take the unequal sampling weights into consideration.[10] Comparisons of prevalence rates were evaluated with the Rao-Scott chi square statistic that incorporates sampling weights. When the test for any difference among the prevalence rates for the 5 racial/ethnic groups was significant ($P < 0.05$), post hoc pairwise comparisons among the racial/ethnic groups (total of 10 pairwise comparisons) were performed, and $P < 0.01$ was considered significant to account for the multiple comparisons. Statistical procedures for survey data (Proc Survreg and Proc Survfreq) in SAS v9.2 (SAS Inc, Cary, NC) were used for all statistical analyses. In the analysis of prevalence rate by racial/ethnic groups, children with other (>1 race reported) or unknown race/ethnicity were excluded.

Table 1. Standard Definitions of Vision Disorders in the VIP Study

Targeted Disorder	Definitions
Amblyopia	Definitions are applied sequentially for amblyopia and reduced VA
Presumed unilateral	≥3-line interocular difference in VA *and* a unilateral amblyogenic factor[†]
Suspected unilateral	Two-line interocular difference in VA *and* a unilateral amblyogenic factor[†]
Suspected bilateral	
3-year-olds	<20/50 in 1 eye, <20/40 in the contralateral eye, *and* a bilateral amblyogenic factor[‡]
4- and 5-year-olds	<20/40 in 1 eye, <20/30 in the contralateral eye, *and* a bilateral amblyogenic factor[‡]
Reduced VA*	
Bilateral	
3-year-olds	<20/50 in 1 eye, <20/40 in the contralateral eye; no bilateral amblyogenic factor[‡]
4- and 5-year-olds	<20/40 in 1 eye, <20/30 in the contralateral eye; no bilateral amblyogenic factor[‡]
Unilateral	
3-year-olds	<20/50 in only 1 eye *or* 2-line or greater difference between the eyes (except 20/16, 20/25); no unilateral amblyogenic factor[†]
4- and 5-year-olds	<20/40 in only 1 eye *or* 2-line or greater difference between the eyes (except 20/16, 20/25); no unilateral amblyogenic factor[†]
Strabismus	Any heterotopia in primary gaze
Significant refractive error	Cycloplegic refraction
Astigmatism	>1.50 D between principal meridians
Hyperopia	>3.25 D in any meridian
Myopia	>2.00 D in any meridian
Anisometropia	>1.00 D interocular difference in hyperopia; >3.00 D interocular difference in myopia; >1.50 D interocular difference in astigmatism; antimetropic[‖] difference >1.00 D and 1 eye > 1.00 D hyperopia; antimetropic[‖] difference >3.00 D and 1 eye >2.00 D myopia

D = diopter; VA = visual acuity; VIP = Vision In Preschoolers.
*Reduced VA owing to a cause other than amblyopia or refractive error; cause identified or not.
[†]Strabismus, anisometropia, and a difference in spherical equivalent of ≥0.50 D when ≥1 eye had >3.50 D of hyperopia were considered unilateral amblyogenic factors.
[‡]Astigmatism of >2.50 D, hyperopia of >5.00 D, or myopia of >8.00 D in each eye were considered bilateral amblyogenic factors.
[‖]Antimetropia equals 1 eye hyperopic, 1 eye myopic.

Results

The study included 4040 preschool children enrolled into Phases I and II of the VIP Study during 2001 to 2004, representing 86.5% of those invited to participate in the VIP Study. The demographic information of all study participants and by racial/ethnic group is presented in Table 2 (available at www.aaojournal.org). Approximately half (51%) were African American, 343 (8.5%) were American Indian, 145 (3.6%) were Asian, 796 (19.7%) were Hispanic, 481 (11.9%) were non-Hispanic white, and 203 (5.0%) were other or unknown race/ethnicity. The majority (94%) of American Indians were from northeast Oklahoma where members of the Cherokee, Choctaw, Seminole, Creek, Comanche, Kiowa, and Ottaway, as well as other tribes, reside. The mean ± standard deviation of age was 54±7 months, 21% were 3-year-olds, 53% were 4-year-olds, and 26% were 5-year-olds. About half of participants were female. The mean age across racial/ethnic groups was similar except the Asians were about 2 months younger than other racial/ethnic groups of children ($P = 0.03$). Gender distribution did not differ across racial/ethnic groups ($P = 0.14$).

The prevalence rate of any VIP Study–targeted vision disorders among all children with sampling weights incorporated was 21.4% (95% confidence interval, 19.9%–23.0%). The prevalence rate for each racial/ethnic group is presented in Table 3. The prevalence rate of any vision disorder was highest in Hispanic children (23.3%) and lowest in American Indian children (17.9%), although the differences across groups were not significant ($P = 0.40$). The prevalence of vision disorders did not differ across racial/ethnic groups for each age group and for each gender (all $P \geq 0.29$; Table 4, available at www.aaojournal.org)

Table 5 presents the prevalence of each of the 4 vision disorders in each racial/ethnic group. The prevalence rate of amblyopia was greatest among non-Hispanic white children (5.44%) and least among Asian children (2.98%; $P = 0.07$). The prevalence of strabismus was highest in non-Hispanic white children (4.59%) and lowest in Asian children (0.95%), but the difference among racial/ethnic groups was not significant ($P = 0.12$). The prevalence rate for any significant refractive error did not differ across racial/

Table 3. Prevalence of Any VIP Study-Targeted Vision Disorders for Each Racial/Ethnic Group in the VIP Study

Racial/Ethnic Group	n	Any Vision Disorders*	
		Cases (n)	*Prevalence %[†] (95% CI)*
All	3837	1136	21.4 (19.8-22.9)
African American	2072	631	21.6 (19.5-23.6)
American Indian	343	70	17.9 (13.3-22.6)
Asian	145	46	19.1 (12.5-25.7)
Hispanic	796	259	23.3 (19.6-27.0)
Non-Hispanic white	481	130	19.4 (15.3-23.6)
P-value[‡]			0.40

CI = confidence interval; N = number of children; VIP = Vision In Preschoolers.
*Vision disorders included amblyopia, strabismus, significant refractive error, and reduced visual acuity as defined in Table 1.
[†]The prevalence rates are computed using the sampling weights.
[‡]From Rao-Scott chi-square test that accommodates the sampling scheme.

Table 5. Prevalence of Each Type of VIP Study–Targeted Vision Disorder by Racial/Ethnic Group in the VIP Study

	Amblyopia*		Strabismus*		Significant Refractive Error*		Reduced Visual Acuity*	
Racial/Ethnic Group	Cases (n)	Prevalence % (95% CI)	Cases (n)	Prevalence % (95% CI)	Cases (n)	Prevalence % (95% CI)	Cases (n)	Prevalence % (95% CI)
African American	119	3.27 (2.50-4.04)	79	2.50 (1.79-3.23)	477	15.2 (13.4-16.9)	180	6.95 (5.62-8.29)
American Indian	17	3.48 (1.68-5.28)	12	2.90 (1.10-4.69)	49	11.8 (7.81-15.8)	23	6.01 (3.36-8.65)
Asian	8	2.98 (0.65-5.31)	3	0.95 (0.00-2.05)	34	12.8 (7.70-18.0)	14	6.95 (2.74-11.2)
Hispanic	67	5.04 (3.39-6.70)	23	2.47 (0.90-4.03)	200	17.2 (14.0-20.4)	81	7.06 (4.98-9.15)
Non-Hispanic white	39	5.44 (2.90-7.97)	36	4.59 (2.53-6.65)	103	15.9 (11.9-19.9)	31	4.17 (2.52-5.83)
P value		0.07		0.12		0.34		0.32

CI = confidence interval; VIP = Vision In Preschoolers.
*If a child had >1 type of vision disorder, the child was represented in multiple groups of vision disorders.

ethnic groups ($P = 0.34$) with the greatest prevalence rate among Hispanics (17.2%) and least among American Indians (11.8%). The prevalence rate of reduced VA did not significantly differ across racial/ethnic group with prevalence rates ranging from 4.17% in non-Hispanic whites to 7.06% in Hispanics ($P = 0.32$).

The prevalence rates of each type of significant refractive error are shown in Table 6. The highest myopia prevalence was in Asian children (1.93%) and lowest in American Indian children (0.16%); however, the difference was not significant ($P = 0.19$). The prevalence of hyperopia differed significantly among racial/ethnic groups ($P = 0.007$), with the highest rate in non-Hispanic white children (11.9%) and the lowest rate in Asian children (5.47%). Post hoc pairwise comparisons found that non-Hispanic white children had a significantly higher prevalence rate of hyperopia than African-American ($P = 0.002$), Hispanic ($P = 0.01$), and Asian children ($P = 0.01$) children. The prevalence of astigmastism also differed across racial/ethnic group ($P = 0.01$), with the highest rate in Hispanic children (11.1%) and the lowest rate in American Indian children (4.28%). American Indian children had a significantly lower prevalence rate of astigmatism than Hispanics ($P = 0.0005$) and African Americans ($P = 0.01$). However, the severity of astigmatism did not differ across racial/ethnic groups among children with astigmatism ($P = 0.77$). Anisometropia prevalence was highest in Hispanic children (7.13%) and lowest in Asian children (2.65%; $P = 0.009$). Hispanic children had a significantly higher prevalence rate of anisometropia than Asian ($P = 0.005$) and African-American ($P = 0.005$) children. When refractive error was analyzed using SE, non-Hispanic white children had a significantly higher mean SE than that of the Asian children (1.66 vs 1.16 D; $P < 0.0001$; Table 6). Post hoc pairwise comparisons found most of the comparisons significant ($P < 0.01$), except comparisons of African American with Asian ($P = 0.18$) and Hispanic ($P = 0.55$), American Indian with non-Hispanic white ($P = 0.13$), and Asian with Hispanic ($P = 0.39$). When the refractive error was compared across racial/ethnic groups for each age group, the difference in refractive error was significant in 4-year-olds ($P < 0.0001$) and 5-year-olds ($P = 0.0008$), but not in 3-year-olds ($P = 0.77$; Table 7, available at www.aaojournal.org).

Discussion

Results from the VIP Study provide a basis for comparison of prevalence rates for eye disorders in preschool children from disparate racial/ethnic groups. The fact that all of the children were participants in Head Start is both a strength and a weakness. All children were from low-income families so that variation in socioeconomic status does not contribute to variation in prevalence by racial/ethnic group, making comparisons within the VIP Study strong. However, the same restriction decreases the likelihood that the estimated prevalence rates are representative of the rates for the entire US population.

Comparison of prevalence rates from the VIP Study with those obtained from population-based studies of pediatric eye disorders in the United States[1–5] and Singapore[11,12] shows that the VIP Study data generally support the findings from these studies with respect to variation by racial/ethnic groups (Table 8). When age is restricted to the same range used in the VIP Study (36–72 months), the estimates of amblyopia vary by only 3.2%, from 0.8% to 4.0%. Similarly, in the VIP Study, the prevalence estimates of

Table 6. Mean Refractive Error and Prevalence of Each Type of Significant Error by Racial/Ethnic Group in the VIP Study

	Spherical equivalent*		Myopia		Hyperopia		Astigmatism		Anisometropia	
Racial/ethnic Group	n	Mean ± SE (D)*	Cases (n)	Prevalence % (95% CI)	Cases (n)	Prevalence % (95% CI)	Cases (n)	Prevalence % (95% CI)	Cases (n)	Prevalence % (95% CI)
African American	2072	1.28 ± 0.03	58	1.55 (0.99-2.11)	230	6.79 (5.67-7.92)	263	8.41 (7.02-9.80)	150	4.34 (3.42-5.26)
American Indian	343	1.51 ± 0.07	1	0.16 (0.00-0.47)	37	8.89 (5.26-12.5)	19	4.28 (2.11-6.44)	14	3.25 (1.39-5.10)
Asian	145	1.16 ± 0.09	4	1.93 (0.00-4.20)	16	5.47 (2.49-8.45)	21	7.62 (3.82-11.4)	9	2.65 (0.86-4.44)
Hispanic	796	1.25 ± 0.05	21	1.34 (0.71-1.97)	85	6.87 (4.79-8.95)	130	11.1 (8.41-13.8)	90	7.13 (5.20-9.07)
Non-Hispanic white	481	1.66 ± 0.07	5	0.78 (0.00-1.60)	76	11.9 (8.25-15.6)	39	6.79 (3.90-9.68)	30	5.48 (2.74-8.22)
P value		<0.0001		0.19		0.007		0.01		0.009

CI = confidence interval; N = number of children; SE = standard error; VIP = Vision In Preschoolers.
*Spherical equivalent was calculated as sphere + (1/2)*cylinder, and average of 2 eyes was used owing to high correlation (>0.90) between eyes.

Table 8. Prevalence of Amblyopia and Strabismus from Various Studies, Restricted to Children 36–72 Months Old

Vision Disorders	Racial/Ethnic Group	VIP Study (%)	BPEDS (%)	MEPEDS (%)	BPEDS/MEPEDS Combined (%)	STARS (%)
Amblyopia	African American	3.3	0.8	1.6	1.4	
	American Indian	3.5				
	Asian	3.0		1.8		0.9
	Hispanic	5.0		2.8		
	Non-Hispanic white	5.4	1.9	4.0	3.1	
Strabismus	African American	2.5	2.7	3.3	3.1	
	American Indian	2.9				
	Asian	1.0		4.6		1.0
	Hispanic	2.5		3.1		
	Non-Hispanic white	4.6	3.6	4.2	4.0	
Mean refractive error (D)	African American	1.28	0.74	1.11	0.99	
	American Indian	1.51				
	Asian	1.16				0.76
	Hispanic	1.25		1.88		
	Non-Hispanic white	1.66	1.48			

BPEDS = Baltimore Pediatric Eye Disease Study; D = diopters; MEPEDS = Multi-ethnic Pediatric Eye Disease Study; STARS = Strabismus, Amblyopia and Refractive error in Singapore Study; VIP = Vision In Preschoolers.

amblyopia vary by only 2.4%, from 3.0% to 5.4%, with no difference among the 5 racial/ethnic groups. In a pooled analysis from the BPEDS and MEPEDS of all children (6–72 months), Hispanics had a significantly greater prevalence rate of amblyopia (6.7%) than non-Hispanic whites (2.9%) and African Americans (3.3%; $P < 0.0001$) but the differences in prevalence rate were small.[13] Nearly identical definitions of amblyopia were used in all of these studies. However, the amblyopia rates in the VIP Study are greater for each racial/ethnic group than in the other studies summarized in Table 8. Low income and factors associated with low socioeconomic status have been reported to be associated with amblyopia, so that the higher rates in the VIP Study may be attributable to the low-income status of the Head Start families.[13,14] The lower VIP rates of amblyopia also may be owing to poor performance on VA testing by Head Start preschoolers.

Prevalence rates for strabismus were similar across racial/ethnic groups both within the VIP Study and across the other studies. The rates within the VIP Study varied by 3.6%, from 1.0% in Asians to 4.6% in non-Hispanic whites, the same range for estimates from BPEDS, MEPEDS, and Strabismus, Amblyopia and Refractive error in Singapore Study (Table 8). Pooled analysis of BPEDS and MEPEDS identified a small but statistically significantly higher prevalence of strabismus (specifically esotropia) in non-Hispanic whites than African Americans and Hispanics.[15] Although low income and factors associated with low income such as premature birth have been associated with greater risk of strabismus,[14,15] VIP Study prevalence rates are not noticeably higher than those from the population-based studies.

Within the VIP Study, the prevalence of significant refractive errors as defined by the VIP Study Group (Table 1) varied significantly among racial/ethnic groups, specifically for hyperopia, astigmatism, and anisometropia. Asians had the lowest prevalence rates of hyperopia and anisometropia, whereas American Indians had the lowest prevalence of astigmatism. Non-Hispanic whites had the highest prevalence rate in hyperopia, and Hispanics had the highest rates of anisometropia and astigmatism. These results are consistent with findings from pooled analysis of BPEDS and MEPEDS, which reported that non-Hispanic whites and Hispanics had significantly higher prevalence of hyperopia than African Americans,[16] whereas Hispanic whites and African Americans had significantly higher prevalence of astigmatism and myopia than non-Hispanic white children.[16,17]

One of strengths of this study is the inclusion of a large number of children in the majority of racial/ethnic groups, including 340 American Indian preschoolers, a population not studied in other population-based studies. The large sample size in each racial/ethnic group provides good statistical power to detect small to moderate ethnic differences in prevalence rates. For example, for vision disorders with a prevalence of <12.5%, the study provides ≥85% power to detect a prevalence rate difference of 4% between the 2 racial/ethnic groups with the largest sample size (i.e., 2072 African American and 796 Hispanic children), and ≥75% power to detect a prevalence rate difference of 8% between the 2 racial/ethnic groups with the smallest sample size (i.e., 343 American Indian and 145 Asian children). Among all 5 racial/ethnic groups, we found that American Indian children had the lowest overall prevalence rate of vision disorders (17.9%; 95% confidence interval, 13.3%–22.6%) and significant refractive error (11.8%; 95% confidence interval, 7.81%–15.8%), although the differences did not attain significance. American Indian children also had the lowest prevalence rate of astigmatism (4.28%; 95% confidence interval, 2.11%–6.44%), which was significantly lower than that of African-American and Hispanic children. In contrast with the high prevalence rate of high astigmatism among preschoolers reported in several American Indian tribes in Arizona,[18] the prevalence rate of astigmatism is lower in our population of American Indians, the majority of whom live in northeastern Oklahoma, representing many tribes. The prevalence rate of astigmatism (≥1.75 D) in American Indians in this study is only 4.3%; Harvey et al[18] reported a 22% prevalence rate of high astigmatism (≥2 D) in 3- to 5-year-old

Tohono O'odham children of southwest of Arizona. This suggests that both the prevalence and magnitude of astigmatism may vary among tribes of American Indians. However, the rates of anisometropia and strabismus among American Indian children in this study seem comparable with those previously reported for the Tohono O'odham children.[19,20]

In conclusion, the VIP Study provided prevalence estimates of preschool vision disorders in each of 5 racial/ethnic groups, representing children enrolled in Head Start programs from 5 geographic areas in the United States. The prevalence of amblyopia and strabismus was similar among racial/ethnic groups. Prevalence of significant refractive errors, specifically hyperopia, astigmatism, and anisometropia, varied by group with the highest rate of hyperopia in non-Hispanic white children, and the highest rates of astigmatism and anisometropia in Hispanic children. This study, along with other population-based studies, suggest that, although there are some variations in the prevalence of vision disorders across racial/ethnic groups, providing vision screening and vision care to preschool children irrespective of their race and ethnicity is important.

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