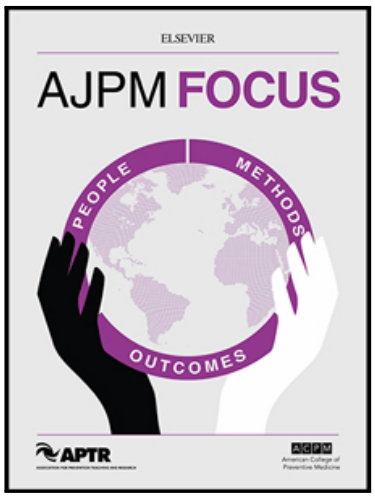

Prevalence of Comprehensive Eye Exam in Preschool Children with Eye Conditions

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Highlights

- Prevalence of complete eye exams was low among preschool children in California
- Complete eye exams were also uncommon in children with treatable vision disorders
- Parent education and vision insurance increase complete eye exams in preschoolers
- Complete eye exam correlates with better detection of eye condition in preschoolers

Prevalence of Comprehensive Eye Exam in Preschool Children with Eye Conditions

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Abstract

Introduction: The study's purpose is to assess the prevalence of comprehensive eye examinations (CEE) in multi-ethnic preschool children, including children with visually significant eye conditions, and identify factors associated with CEE.

Methods: A sample of 9,197 African American (AA), Hispanic (HS), Asian American (AS), and non-Hispanic White (NHW) 6- to 72-month-old children was recruited for the Multi-Ethnic Pediatric Eye Disease Study from 2003-2011. Logistic regression performed in 2022 identified

independent factors associated with parent-reported history of CEE. The proportion of children with previous CEE and the proportion with undetected amblyopia or strabismus were measured. **Results:** CEE prevalence was 6.3% overall, and 38.3%, 24.8%, 19.1%, 15.1%, and 9.8% among children with strabismus, amblyopia, significant anisometropia, hyperopia, and astigmatism, respectively. Children without prior CEE were more likely to have undetected amblyopia or strabismus than those with CEE history (Ps<0.001). CEE prevalence was higher among older children. Prevalence varied by race/ethnicity, with 8.1%, 7.9%, 6.3%, and 4.9% of NHW, AS, AA, and HS children having had prior CEE, respectively; however, the differences did not remain after adjusting for other associated factors. Older age, a primary caregiver with a college/university degree or higher, having vision insurance, gestational age <33 weeks, neurodevelopmental disorder diagnosis, strabismus, and ocular disease history were all associated with a relatively higher CEE prevalence in multivariable analyses (P≤0.003 for all). **Conclusions:** CEE was uncommon among preschool children, including those with treatable vision disorders. Interventions, like parent education and vision insurance, are needed to improve CEE access and utilization for at-risk preschool children.

Keywords: amblyopia; strabismus; refractive error; comprehensive eye examination; preschool vision screening

Introduction

Amblyopia, strabismus, and significant refractive error are the most common visual abnormalities in preschool children.[1] Amblyopia affects about 1.5-2.6% and strabismus affects 2.4-3.6% of preschool children.[2,3] If left untreated, these childhood vision disorders can result in irreversible vision loss,[4] interfere with a child's academic performance,[5–8] and impair development.[9–11] Treatment of amblyopia is most successful if initiated before age 7.[12] Accordingly, early detection and treatment of these vision disorders among preschool children is critical.[13] However, it is unclear whether preschool children with these conditions are receiving vision care.

The US Preventive Services Task Force (USPSTF) 2017 report recommends vision screening at least once for children ages 3-5 years old.[14] In current practice, many primary care settings offer vision screenings, with handheld autorefraction and photoscreening increasingly being deployed.[14] Children who fail the screenings are typically referred for a comprehensive eye exam (CEE) necessary for accurate diagnosis and appropriate treatment.[13,14] Performed by an ophthalmologist or optometrist, CEEs typically involve use of cycloplegic eye drops that prevent the child from over-focusing and enables more accurate refractive error measurement.[13,15] A CEE for children also includes an assessment of visual acuity, ocular alignment, and binocular function.[13,15]

Unfortunately, despite recent policy changes and advances in vision screening tools,[13,16] pediatric vision screenings and follow-through on referral recommendations remain inadequate in the US. 24 states, including California, still do not mandate vision screening for preschool children.[18]

The prevalence of vision screening among children aged 5 years and younger in the US remained around 40% during 2016-2020,[17] similar to those reported for 2008 and 2011.[18] One study in Baltimore, Maryland found that less than 53% of pre-K children who failed vision screenings received follow-up eye care afterward.[13,19]

Given the consistently low rates of vision screening and poor follow-through on referral, it is intuitively apparent that a large proportion of preschool children with visually-significant eye conditions have not had a CEE. However, it is essential to quantify the actual proportion and assess the distribution among preschool children with different vision conditions, but data is limited. To address this need, the present study used data from the Multi-Ethnic Pediatric Eye Disease Study (MEPEDS), a cohort of multi-ethnic preschool children in Southern California and the largest and most recent population-based pediatric eye study in the US. This study investigates the prevalence of CEE among preschool children with amblyopia, strabismus, and significant refractive errors. It also provides a reference point for changes in eye care utilization among preschool children that may be produced by recent/future public health interventions and advances in clinical practices. Additionally, this study evaluates potential factors associated with a history of CEE among these preschool children.

Material and Methods

The data reported herein were collected from 2003-2011 from participants in MEPEDS, a population-based cohort study of 9,197 California preschool children residing in Los Angeles and Riverside counties. The protocol and informed consent forms were reviewed and approved by the IRB/Ethics Committee of the Los Angeles County/University of Southern California

Medical Center and the Battelle Centers for Public Health Research and Evaluation IRB, and they complied with the current Health Insurance Portability and Accountability Act regulations. A parent/guardian of each study participant gave written informed consent. An independent data monitoring and oversight committee provided study oversight.

Study Population

The study population of African American (AA) (n= 3,047), Hispanic (HS) (3,097), Asian American (AS) (1,525), non-Hispanic White (NHW) (1,510), and other racial/ethnic (N=18) children aged 6 to 72 months was identified by door-to-door screening of families within 74 census tracts in Los Angeles and Riverside counties.[20] Overall participation rate was 80%. The details of the screening process have been reported previously.[20]

Measures

During the study, CEEs were performed by optometrists/ophthalmologists, who were trained and certified using standardized protocols.[20] The details of the ocular examination have been reported previously.[20]

Undetected eye disease was defined if amblyopia/strabismus was diagnosed at the examination with parent-report of no such prior diagnosis made by a physician. Unilateral amblyopia was defined as a 2-line interocular difference in best-corrected VA with 20/32 or worse in the worse eye and a corresponding unilateral amblyopia risk factor. Bilateral amblyopia was defined as bilaterally decreased best-corrected VA (worse than 20/50 for ≥30-to 47-month-olds or worse than 20/40 for ≥48-months-olds) in the presence of bilateral isometropia (≥4.00 D SE hyperopia,

≥6.00 D SE myopia, ≥2.50 D of astigmatism) or with evidence of visual axis obstruction of both eyes. Strabismus was defined as constant or intermittent heterotropia of any magnitude at distance or near fixation, or both. Participants tested at only 1 fixation distance and found to be without strabismus were considered non-strabismic.

The interview consisted of a standardized parental questionnaire administered by trained interviewers.[20] Parent(s) were asked "when was the child's last complete eye examination—one that included dilating of pupils where the doctor used bright lights to look in the back of his/her eyes?" with the options of “within the past 12 months,” “1-3 years ago,” “more than 3 years ago,” “never,” or “don’t know.” A dichotomous parent-reported measure of eye care use was analyzed: ever having had a dilated eye examination (yes/no).

Health service use is a function of a person's need for such service, predisposition to use the service, and enabling factors that facilitate access to the service.[21,22] This study defined 3 categories of independent variables: predisposing (demographic/social), enabling, and need (self-reported/evaluated).

- *Predisposing demographic variables* were age, gender (parent-reported), race/ethnicity (parent-reported), and primary language spoken at home.
- *Predisposing social variables* were the primary caregiver’s highest level of education, maternal age at child’s birth, family history of strabismus/amblyopia in first-degree relatives, preschool/daycare attendance.
- *Enabling variables* were annual household income, medical/vision insurance, regular primary care.

- *Evaluated need variables* were amblyopia, strabismus, and significant refractive error from examination.
- *Self-reported need variables* were gestational age, low birth weight for gestational age, neurodevelopmental disorders, and parent-reported history of amblyopia/strabismus, myopia, and other ocular disease.

Statistical Analysis

The analysis cohort consisted of all children from whom a reliable cycloplegic refraction was obtained. Cycloplegic SE refractive error for the worse eye was used for analyses. Significant refractive error was defined as hyperopia ≥+4.00 D SE, astigmatism ≥2.00 D, or anisometropia ≥2.00 D SE. Logistic regression was used to calculate ORs and 95% CIs to evaluate potential associations between the five conceptual model categories and having had a prior CEE. Multivariable regression was first completed for all variables in each behavioral model category. Factors associated with a history of CEE with a P-value ≤0.10 in the category-specific analyses were used for inclusion in the final multivariable analysis, which included variables from all five categories. Variables with a P-value <0.05 in the final multivariable analysis were retained. For comparison, forward stepwise regression was completed as a secondary analysis to select independent variables from all model categories at the 0.05 level. Bonferroni correction was applied to adjust for multiple comparisons in the multivariable analysis. All statistical tests were two-sided. All analyses were conducted using SAS software 9.4 (SAS, Inc., Cary, North Carolina, USA).

Results

Among the 9,197 participants, 669 (7.3%) did not complete the interview, 15 (0.2%) participated in the interview but did not answer the question about the child's past CEE, 1 (0.01%) refused to answer, and 30 (0.3%) responded “unknown.” Among the remaining 8,482 participants, the prevalence of prior CEE was 6.3% (Table 1): 284 (3.3%) reported that it had taken place in the prior 12 months, 213 (2.5%) in the prior 1-3 years, and 33 (0.4%) more than 3 years prior.

The prevalence of CEE was greater among older participants, with the highest prevalence in those 61-72 months of age. Overall, the proportion of participants with reported prior CEE varied by race/ethnicity, with the parents of 89 (8.1%) NHW, 106 (7.9%) AS, 187 (6.3%) AA, and 148 (4.9%) HS participants reporting a previous CEE (P<0.001; Table 1). However, after adjusting for other covariates identified in the multivariable analysis, the difference was no longer statistically significant.

Overall, 38.3% (n=90) and 24.8% (29) of participants with strabismus and amblyopia, respectively, were reported to have had a prior CEE. These proportions shifted to 41.8% (69) and 22.3% (23) when limited to participants 36-72 months old. Similarly, 15.1% (53), 9.8% (56), and 19.1% (12) of participants with significant hyperopia, significant astigmatism, and significant anisometropia, respectively, were reported to have had a prior CEE. These proportions increased to 19.2% (42), 16.6% (44), and 22.7% (10) when limited to participants 36-72 months old. The prevalence of CEE varied by subtype of strabismus (Figure 1; P<0.001), with a higher prevalence among participants with esotropia or constant strabismus, and a lower prevalence among those with exotropia or intermittent strabismus. The prevalence of CEE also varied by

subtype of amblyopia (P=0.026), with a higher prevalence reported among those with strabismic amblyopia versus those with anisometropic or bilateral ametropic amblyopia.

Among the participants with strabismus, the prevalence of CEE differed by race/ethnicity (Table 1; 73.5%, 36%, 25.3%, and 37.3% for NHW, HS, AA, and AS children, respectively). This difference remained in the multivariable analyses adjusted for other factors (see below for detailed list of factors) (P<0.001, data not shown). A race/ethnicity difference was also observed among those with esotropia (P=0.018), with a prior CEE reported for 78.3% (18), 44.8% (13), 48.5% (16), and 50.0% (10) of NHW, HS, AA, and AS children, respectively. A similar pattern among those with exotropia (P=0.016) was observed, with a previous CEE reported for 50.0% (4), 31.1% (14), 4.9% (2), and 26.7% (8) of NHW, HS, AA, and AS children, respectively. Race/ethnicity differences among participants with amblyopia or significant refractive error did not remain after adjusting for other covariates.

A history of CEE was associated with lower prevalences of undetected amblyopia and undetected strabismus (Table 2; P<0.001 for both). Similar trends were found when analyses were limited to the oldest group of participants (61-72 months old) (Appendix Table 1).

The independent associations identified between variables based on Andersen's Behavioral Model[21] and prior CEE are shown in Table 3. Hyperopia was associated with CEE, but the association did not remain significant after Bonferroni correction for multiple comparisons. Older age remained associated with a higher prevalence of CEE (P<0.001). Participants 61-72 months old were 3.43 (95% CI, 2.18-5.41) times as likely as those 6-12 months old to have had a

previous CEE. Strabismus, gestational age <33 weeks, neurodevelopmental disorder, parent-reported history of strabismus/amblyopia, parent-reported history of myopia, and parent-reported history of other ocular disease were associated with a higher prevalence of CEE (P≤0.001 for all). Participants whose primary caregiver reported having attained at least a college/university degree were 1.62 (95% CI, 1.18-2.23) times as likely to have had a previous CEE compared to those whose primary caregiver's highest education level was less than a high school graduate level (P=0.003). Participants with vision insurance were 3.23 (95% CI, 1.59-6.55) times as likely to have undergone a previous CEE as those without insurance (P=0.001). The primary language spoken at home was not associated with a history of CEE in the multivariable model.

Discussion

This study reports the prevalence of and factors associated with having had a prior CEE for a large population-based sample of multi-ethnic preschool children in Southern California. Only 6.3% of the parents reported that their child had had a prior CEE. This finding is somewhat consistent with the CDC's report that states that <15% of all preschool children received a CEE, but the data's time frame and population sample is unclear.[13] Similarly, a retrospective cohort study in San Francisco, California, reported that among 4,953 preschool children screened, 379 (7.7%) were referred for further follow-up, with only 216 children (4.4%) receiving a CEE.[23] Consistent with existing clinical practice guidelines,[13,15] children born premature and with neurodevelopmental disorders were more likely to have a history of CEE. Because these children are at higher risk for vision disorders, it is recommended that they bypass vision screening and be referred directly to a vision specialist.[1]

The present study found that a history of CEE was uncommon even among children with amblyopia, strabismus, or significant refractive error. The 2017 USPSTF report recommends vision screening at least once for children ages 3-5 years, and that children who fail be referred for a CEE.[14] In 2004 during the MEPEDS timeframe, the USPSTF also recommended screening in children younger than age 5.[24] However, in our MEPEDS cohort, only 38.3%, 24.8%, 15.1%, 9.8%, and 19.1% of children with strabismus, amblyopia, significant hyperopia, significant astigmatism, and significant anisometropia, respectively, reported having had a prior CEE. Even among the older children in the 3-to 5-year-old age range, who are more likely to have had vision screening and have high vision testability, only 41.8%, 22.3%, 19.2%, 16.6%, and 22.7% of older children with strabismus, amblyopia, significant hyperopia, significant astigmatism, and significant anisometropia, respectively, were reported to have had a prior CEE. These findings suggest that some combination of insufficient/ineffective screening and/or poor follow-through on referral recommendations after screening is limiting the appropriate eye care utilization for preschool children in Southern California.

In this study, prior CEE was associated with better detection of amblyopia and strabismus among preschool children. However, these disorders remained undetected in a large proportion of these children even after reportedly having had a previous CEE. A potential limitation may be the testability of young children.[14] However, in the present study, even the 5-year-old children had high rates of undetected eye conditions.

The study findings indicate that older age was associated with a higher prevalence of CEE, with the highest prevalence among preschool children occurring around age 5. This trend aligns with

the California Public School guidelines in place at the time of MEPEDS.[25] These guidelines required vision screening for children upon school entry;[25] thus, the state's policy may have led to a higher prevalence of CEE resulting from failed vision screenings, specifically among children close to school entry. However, the overall prevalence of CEE remained low even among the oldest children, and most children with strabismus or amblyopia had never undergone a CEE.

CEE was more common among children with a primary caregiver with at least a college/university degree. This finding is consistent with the findings of the National Survey of Children's Health (NSCH), which found that children in homes with adults with a college education were more likely to have received vision testing compared with children in families with adults who did not complete high school or only had some college education.[18] These findings highlight how social determinants of health, such as parental education, can affect vision care utilization. Higher parental education may reflect easier communication with physicians, more health knowledge, and different attitudes and beliefs about the importance of eye care. The effect of parental education is unlikely to be a marker for factors such as high income, which was not associated with CEE in the present study, or more insurance, which was adjusted in the study model as an independent factor.

Having vision insurance was associated with a higher prevalence of CEE among preschool children, highlighting a key enabling factor that can be modified to support and encourage parents to take their children to a vision specialist for a CEE. This finding is consistent with past studies, which have identified that lack of insurance is associated with lower utilization of vision

care.[26,27] Specifically for vision care, past studies like the Chinese American Eye Study and the Los Angeles Latino Eye Study found that those with additional vision coverage had even greater eye care use than just medically insured individuals.[28,29] Under the Affordable Care Act (ACA), all new individual and small group health insurance plans are required to cover pediatric vision care;[18] however, plans that were in place before the ACA or group plans for large employers with 50 or more employees are not required to cover pediatric vision care.

Limitations

The present study's strengths include its population-based design, large sample size, high participation rate, rigorous protocols, and quality control procedures.[30–32] However, several limitations still need to be acknowledged. One limitation is that the data was collected between 2003-2011, and vision screening tools and policies (i.e., commercially available instrument-based screening, increased reimbursement) have changed over time, possibly influencing the prevalence of CEEs among children. For example, at the time of MEPEDS, the USPSTF 2004 report recommended screening in children younger than age 5 years old, [24] not just among 3-5 years old children. However, based on NSCH data, the prevalence for vision screening among children aged 5 years and younger remained around 40% during 2016-2020,[17] similar to the prevalence reported for 2008 and 2011.[18] Therefore, the present study's findings can still facilitate the understanding of vision care usage among preschool children today. Another limitation is the potential for recall bias because history of CEE and other factors were reported by the parent and not verified by medical records. History of CEE may also be misclassified because the present study defined CEE based on parental reports of CEEs that included dilating pupils, and it is unclear whether the drops were cycloplegic or mydriatic drops. Despite these

potential misclassifications, the current study's data on CEE prevalence is consistent with findings from other studies and the CDC's data that CEEs are relatively rare among preschoolers.[13,23] Further, because optotype visual acuity was not assessed in children younger than 30 months, the diagnosis of amblyopia in children in this age range was based on fixation preference testing, which has been shown in older children to be a poor surrogate for amblyopia diagnosis based on optotype testing.[30,33,34] Lastly, although MEPEDS is a population-based study of urban preschool children in Southern California, the generalizability of the study findings to other preschool populations (such as rural areas) is uncertain and the prevalence of CEE may be even lower.

Conclusions

In conclusion, a history of CEE was relatively rare among preschool children, even among children with ocular disorders, such as amblyopia and strabismus. Interventions targeting individual/families, such as programs that increase parental health education about the importance of eye care, and interventions targeting health care delivery systems, such as increasing vision insurance coverage and access, are both needed to improve vision health in preschool children.

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LIST OF FIGURES

Figure Title:

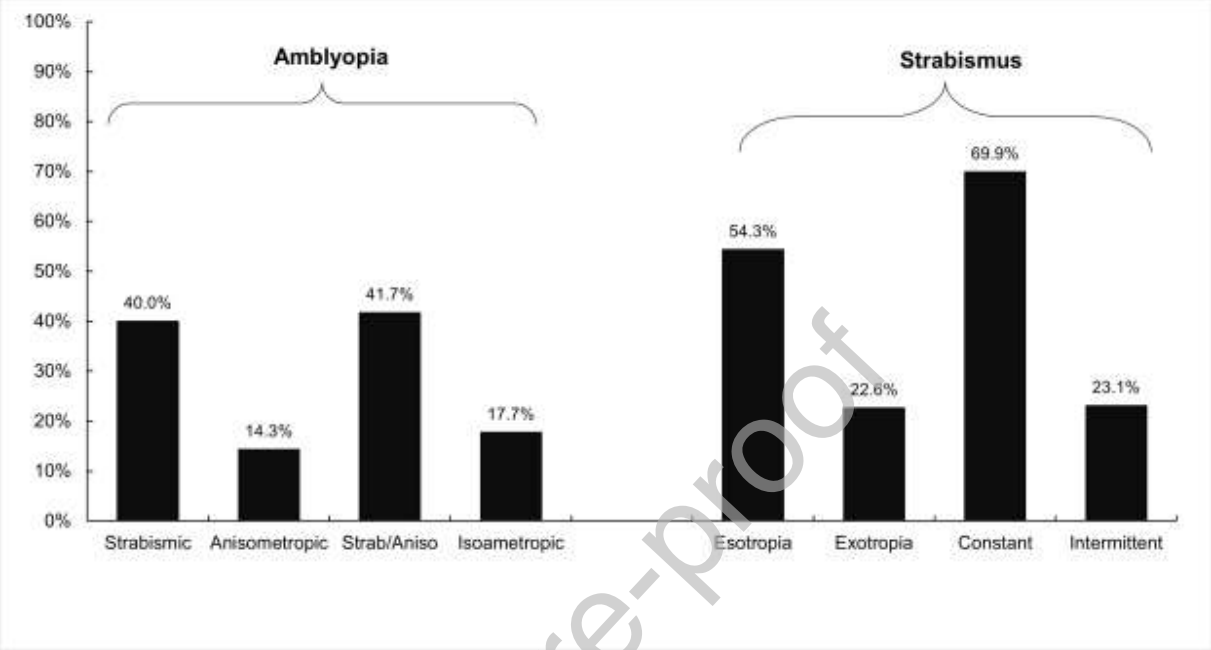

Figure 1. Prevalence of Comprehensive Eye Exam by Amblyopia and Strabismus Type

Table 1. Prevalence of Comprehensive Eye Exam in Children by Age, Gender, Race/Ethnicity, and Vision Disorder

N (%)	All Children (N=8482)	Children with Strabismus (N=235)	Children with Amblyopia (N=117)	Children with ≥+4.00D Spherical Equivalent Hyperopia (N=352)	Children with ≥2.0D Astigmatism (N=1104)	Children with ≥2.00D Spherical Equivalent Anisometropia (N=63)
Overall	530 (6.3%)	90 (38.3%)	29 (24.8%)	53 (15.1%)	56 (9.8%)	12 (19.1%)
Age (months)						
6-12	25 (2.8%)	2 (16.7%)	-	1 (3.3%)	4 (3.2%)	0 (0%)
13-24	64 (4.3%)	8 (34.8%)	2 (66.7%)	4 (9.1%)	5 (5.2%)	2 (22.2%)
25-36	67 (4.3%)	11 (31.4%)	4 (36.4%)	6 (10.2%)	3 (3.5%)	0 (0%)
37-48	94 (6.1%)	12 (27.9%)	3 (9.1%)	10 (13.2%)	9 (10.6%)	1 (7.1%)
49-60	111 (7.3%)	30 (45.5%)	10 (27.8%)	17 (21.5%)	17 (20.2%)	5 (33.3%)
61-72	169 (11.6%)	27 (48.2%)	10 (29.4%)	15 (23.4%)	18 (18.8%)	4 (26.7%)
P for age trend [a]	***<0.001***	***0.012***	*0.93*	***<0.001***	***<0.001***	*0.16*
Gender						
Male	275 (6.3%)	40 (37.7%)	14 (23.7%)	29 (16.2%)	24 (8.4%)	6 (18.8%)
Female	255 (6.2%)	50 (38.8%)	15 (25.9%)	24 (13.9%)	32 (11.2%)	6 (19.4%)
P for gender difference [b]	*0.82*	*0.89*	*0.83*	*0.56*	*0.26*	*0.99*
Race/Ethnicity						
Non-Hispanic	89 (8.1%)	25	8 (42.1%)	14	4 (13.8%)	3 (50%)

White		(73.5%)		(30.4%)		
Hispanic	148 (4.9%)	27 (36.0%)	9 (18.4%)	21 (13.2%)	19 (6.3%)	2 (12.5%)
African American	187 (6.3%)	19 (25.3%)	5 (17.2%)	10 (8.8%)	23 (13.0%)	4 (14.8%)
Asian American	106 (7.9%)	19 (37.3%)	7 (36.8%)	8 (24.2%)	10 (16.7%)	3 (23.1%)
P for race difference [c]	***<0.001***	***<0.001***	*0.093*	***0.003***	***0.012***	*0.22*

Note: Boldface indicates statistical significance (P<0.05)
[a]Mantel-Haenszel Chi-Square test.
[b]Fisher's exact test.
[c]Fisher's exact test. Children of other races/ethnicities were too few and therefore not included in this analysis.
[d]Abbreviation: CEE=comprehensive eye exam.

Table 2. Children with Undetected/Detected Amblyopia and Strabismus Stratified by History of Comprehensive Eye Exam

Children with Eye Conditions	Never had a CEE	Having had a CEE	P[a]
All children with amblyopia	88 (100%)	29 (100%)	
Previously detected amblyopia	0 (0%)	7 (24.1%)	**<0.001**
Undetected amblyopia	88 (100%)	22 (75.9%)	
All children with strabismus	145 (100%)	90 (100%)	
Previously detected strabismus	34 (23.5%)	52 (57.8%)	**<0.001**
Undetected strabismus	111 (76.5%)	38 (42.2%)	

Note: Boldface indicates statistical significance (P<0.05)
[a] Fisher's exact test.
[b]Abbreviation: CEE=comprehensive eye exam

Table 3. Multivariable Associations of Predisposing, Enabling, and Need Variables with History of Comprehensive Eye Exam

Factors		Ever had a CEE		
	N[e]	Prevalence[e]	Adjusted OR (95% CI)[e]	P value[e]
Predisposing demographic factors				
Age (months)				
6-12	859	2.8%	1.00 (reference)	-
13-24	1382	4.3%	1.37 (0.83-2.25)	0.22
25-36	1425	4.1%	1.24 (0.75-2.03)	0.41
37-48	1410	6.0%	1.78 (1.1-2.87)	**0.018**
49-60	1380	7.2%	1.75 (1.09-2.83)	**0.022**
61-72	1319	12.0%	3.43 (2.18-5.41)	**<.0001**[a]
Predisposing social factors				
Education level of the primary caregiver				
< High school graduate	2196	4.4%	1.00 (reference)	-
High school graduate	4152	6.4%	1.2 (0.92-1.56)	0.19
College/university graduate or more	1427	8.4%	1.62 (1.18-2.23)	**0.003**[a]
Enabling factors				
Medical and vision insurance within last 12 months				
Not insured	324	3.4%	1.00 (reference)	-
Medical Insurance only	4205	4.2%	1.56 (0.77-3.18)	0.22
Both medical and vision insurance	3246	9.2%	3.23 (1.59-6.55)	**0.001**[a]
Evaluated need factors				
Strabismus				
No	7567	5.3%	1.00 (reference)	-
Yes	208	39.9%	4.38 (2.9-6.63)	**<.0001**[a]
Hyperopia ≥+4.0D SE				
No	7451	5.8%	1.00 (reference)	-
Yes	324	15.4%	1.67 (1.11-2.49)	**0.013**
Self-reported need factors				
Gestational age				
≥33 weeks	7558	5.4%	1.00 (reference)	-
<33 weeks	217	34.1%	8.34 (5.92-11.73)	**<.0001**[a]
Neurodevelopmental disorders [c]				
No	7493	5.7%	1.00 (reference)	-
Yes	282	19.5%	2.32 (1.58-3.39)	**<.0001**[a]
Parent-reported history of strabismus or amblyopia				
No	7654	5.5%	1.00 (reference)	-
Yes	121	55.4%	6.31 (3.81-10.44)	**<.0001**[a]
Parent-reported history of myopia				

No	7735	5.9%	1.00 (reference)	-
Yes	40	72.5%	18.94 (8.49-42.26)	**<.0001**[a]
Parent-reported history of ocular diseases [d]				
No	7763	6.1%	1.00 (reference)	-
Yes	12	75.0%	16.11 (3.36-77.35)	**<0.001**[a]

Note: Boldface indicates statistical significance (P<0.05)

[a] Significant after Bonferroni correction.

[b] Abbreviations: CEE=comprehensive eye exam.

[c] Neurodevelopmental disorders included developmental delay, speech or hearing problems, motor delay, attention or learning problems, fetal alcohol syndrome, mental retardation, Down syndrome, and cerebral palsy.

[d] History of ocular diseases included cataracts, glaucoma, retinopathy of prematurity, eye tumor or retinoblastoma, optic nerve hypoplasia, and cortical visual impairment.

[e] Estimated from multivariable logistic regression with all factors listed in the table. The analysis was limited to participants with data on all these factors (N=7775).

Credit Author Statement

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Susan A. Cotter: Methodology, Writing – Review & Editing, Funding Acquisition
Mina Torres: Project administration, Data Acquisition, Methodology, Investigation
Xuejuan Jiang: Supervision, Conceptualization, Methodology, Formal Analysis, Writing – Original Draft, Writing – Review & Editing, Funding Acquisition.
Rohit Varma: Conceptualization, Methodology, Funding Acquisition

Declaration of Interests

☒The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: