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Prevalence of Amblyopia and Strabismus in White and African-American Children Aged 6 through 71 Months: *The Baltimore Pediatric Eye Disease Study*

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Abstract

Objective—To determine the age-specific prevalence of strabismus in White and African-American children aged 6 through 71 months and of amblyopia in White and African-American children aged 30 through 71 months.

Design—Cross-sectional population-based study.

Participants—White and African-American children aged 6 through 71 months in Baltimore, Maryland, United States. Among 4,132 children identified, 3,990 eligible children (97%) were enrolled and 2,546 children (62%) were examined.

Methods—Parents or guardians of eligible participants underwent an in-home interview and were scheduled for a detailed eye examination including optotype visual acuity and measurement of ocular deviations. Strabismus was defined as a heterotropia at near or distance fixation. Amblyopia was assessed in those children aged 30 through 71 months who were able to perform optotype testing at 3 meters.

Main Outcome Measures—The proportions of children aged 6 through 71 months with strabismus and of children aged 30 through 71 months with amblyopia.

Results—Manifest strabismus was found in 3.3% of White and 2.1% of African American children (relative prevalence (RP) 1.61, 95% confidence interval (CI): 0.97, 2.66). Esotropia and exotropia each accounted for close to half of all strabismus in both groups. Only one case of strabismus was found among 84 White children 6 through 11 months of age. Rates were higher in children 60 through 71 months of age (5.8% for Whites and 2.9% for African Americans (RP: 2.05, 95% CI: 0.79, 5.27). Amblyopia was present in 12 (1.8%) White and 7 (0.8%) African American children (RP: 2.23, 95% CI: 0.88, 5.62). Only one child had bilateral amblyopia.

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Conclusions—Manifest strabismus affected 1 in 30 White and 1 in 47 African-American preschool aged children. The prevalence of amblyopia was under 2% in both Whites and African-Americans. National population projections suggest that there are approximately 677,000 cases of manifest strabismus among children 6–71 months of age and 271,000 cases of amblyopia among children 30–71 months of age in the United States.

Keywords

strabismus; amblyopia; children; prevalence; risk factors

INTRODUCTION

The prevalences of strabismus and amblyopia have been estimated largely through school and clinic-based studies.^{1–11} The rates vary from 2 – 5% for both conditions, although strabismus is reported to be more common among Whites in Western Europe than those living in the United States. School-based studies may not include children who are developmentally delayed or those who attend private institutions and therefore may not accurately reflect the population prevalence of disease. Clinic-based research is subject to referral bias. Studies of preschool children are uncommon due to the difficulty of identifying and evaluating them.

An accurate estimate of the prevalences of strabismus and amblyopia among African-American and White preschool children using a population-based sample would guide refinement of the recommendations for screening and perhaps lead to development of targeted approaches to screening for and treatment of these conditions during the preschool period.^{12–14} Early detection of amblyopia and initiation of treatment is widely thought to improve visual acuity outcomes for children with amblyopia and younger age of initial treatment has been shown to be associated with better treatment outcomes.^{15,16} Decreasing the amblyopia rate can reduce the subsequent rate of severe bilateral vision loss because persons with amblyopia are at increased risk of injury to the healthy eye and suffer loss of function when this occurs.¹⁷

Strabismus is a common cause of amblyopia^{18,19} and can have important effects on social integration.^{20–22} Recent reports indicate that adults with strabismus are less likely to be offered jobs than those with normal ocular alignment, indicating that ongoing misalignment of the eyes can have significant social impact.^{23,24} Identifying strabismus at an earlier age may prevent the development of amblyopia and improve the chance of restoring binocularity as well as effectively treating strabismus-associated amblyopia.

The Multi-Ethnic Pediatric Eye Disease Study recently reported the results of a population-based study of Hispanic and African-American children living in Los Angeles, California.²⁵ They found the prevalence of strabismus to be about 2.5% in both groups, while amblyopia rates were 2.6% in Hispanics and 1.5% in African-Americans less than 72 months of age. The Baltimore Pediatric Eye Disease Survey (BPEDS) used the same examination protocols in order to assess the prevalence of eye diseases among a population-based sample of preschool aged children living in Baltimore City and adjacent Baltimore County. We report the prevalence of strabismus and amblyopia among African-American and White preschool children.

METHODS

BPEDS was designed to estimate and compare the prevalence of decreased visual acuity, strabismus, amblyopia, and refractive error in a population-based sample of African-American and non-Hispanic White children 6 through 71 months of age living in Baltimore. A detailed description of the BPEDS protocol has been published.²⁶ The protocol was approved by the

Committee on Human Subjects Research at the Johns Hopkins Bloomberg School of Public Health as well as the Battelle Centers for Public Health Research and Evaluation Institutional Review Board (IRB) and the IRB of the Maryland Department of Health and Mental Hygiene. Parents or legal guardians provided written, informed consent for their child's participation.

The study enrolled subjects from 54 contiguous census tracts in northeastern and eastern Baltimore City and adjacent portions of eastern Baltimore County. Parents or guardians of all enrolled subjects were invited to bring their child to the study clinic for a detailed interview and ophthalmologic examination. The comprehensive eye examination included optotype visual acuity testing using the Amblyopia Treatment Study (ATS) visual acuity protocol if possible,^{27,28} fixation preference testing at near, and testing of ocular alignment at distance and near fixation. Fixation preference was poorly correlated with single surrounded HOTV optotype visual acuity testing in children 30 to 71 months in our study.²⁹ Because no accurate assessment of visual acuity could be performed in these children we do not report amblyopia rates for children < 30 months of age.

Monocular single-surrounded HOTV visual acuity was tested using the Electronic Visual Acuity system and the ATS visual acuity protocol. In brief this visual acuity testing protocol specifies a 3 meter test distance and includes a pretest to assess testability, a rapid screening phase to obtain an approximation of the acuity threshold, threshold testing, three larger letters to re-engage the child, and a second threshold test. With the VA recorded as the lowest log of the minimum angle of resolution (logMAR) level at which 3 of 3 or 3 of 4 optotypes were correctly identified.

Ocular alignment was tested by a licensed eye care provider using unilateral cover (cover-uncover) test (UCT) and alternate cover test (ACT) while the child fixated on a cartoon video located at 6 meters. Near testing was at 40 cm using a colorful sticker as a target. Testing was performed without and with correction if such was worn. The ocular misalignment was measured by simultaneous prism and cover test (SPCT) and prism and alternate cover test (PACT). Hirschberg and Krimsky testing at near were used when UCT or SPCT, respectively, could not be performed (Krimsky-derived angle was not used if angle estimated < 10 prism diopters [PD]).

Refractive error was determined after the administration of two doses of cyclopentolate eyedrops (1% for those one year of age and older and 0.5% for those < one year of age) 5 minutes apart. Streak retinoscopy was performed a minimum of 30 minutes following instillation of the second drop of cyclopentolate. If fluctuation of the retinoscopic reflex was observed, an additional drop of cyclopentolate was administered and the refraction performed an additional 30 minutes later.

Cycloplegic autorefraction was attempted on all children using a handheld Nikon Retinomax K-Plus 2 (Nikon Corporation, Tokyo, Japan). The clinic visit included a structured interview which recorded whether the child had ever been diagnosed with and treated for strabismus or amblyopia (after defining these conditions), but these responses were not used to diagnose either condition (although one child with a history of surgery for strabismus and restricted ocular movements was included as having strabismus even though the eyes were aligned at the time of examination).

Definitions of Strabismus and Amblyopia

Manifest strabismus was defined as constant or intermittent tropia of any magnitude at distance or near fixation. Children who could be tested at only one fixation distance and without strabismus on that test were considered non-strabismic. Tropias that could not be measured by either SPCT or Krimsky testing were considered to be of unknown magnitude.

Unilateral amblyopia was defined as a 2-line interocular difference (IOD) in best-corrected visual acuity (VA), 20/32 or worse in the worse eye, and at least one of the following unilateral amblyopia risk factors: strabismus on examination; a history of strabismus surgery (from in-home interview); anisometropia consistent with the eye with worse VA (≥ 1.00 diopter [D] spherical equivalent (SE) anisohyperopia, ≥ 3.00 D SE anisomyopia, or ≥ 1.50 D anisoastigmatism); or evidence of past or present visual axis obstruction (e.g., cataract, pseudophakia, aphakia, corneal opacity, ptosis, or eyelid hemangioma).

Bilateral amblyopia was defined as bilateral subnormal best-corrected VA (worse than 20/50 in children aged 30 to 47 months, or worse than 20/40 in children ≥ 48 months) with either bilateral evidence of visual axis obstruction (see above), or bilateral ametropia (≥ 4.00 D SE hyperopia, ≥ 6.00 D SE myopia, or ≥ 2.50 D astigmatism). Children meeting both unilateral and bilateral amblyopia criteria were classified as bilateral. Children with posterior or anterior segment abnormalities precluding normal vision were not considered amblyopic.

Statistical Analysis

SAS Version 9.1.3 (SAS Institute, Cary, NC) was used for all statistical analyses. Prevalence was calculated as the ratio of the number of individuals with any type of strabismus or amblyopia to the total number evaluated. Exact Binomial confidence intervals were calculated for the prevalence estimates. A chi-square test was used to compare the proportions of children with a given diagnosis between ethnic groups and genders. Confidence intervals for relative prevalence were calculated using a Taylor series approximation. The association of strabismus prevalence with age was examined by a test for trend, stratifying by age into 6 categories. There were too few cases of amblyopia to test for a trend by age.

National projections of the number of cases of strabismus and amblyopia were made by pooling data from this study and the Multi-Ethnic Pediatric Eye Disease Study (MEPEDS)²⁵ to obtain estimates of age-specific prevalence for non-Hispanic Whites, African-Americans, and Hispanic Whites. These pooled estimates were then applied to the projected age-race-Hispanic origin population of the U.S. in 2008 to obtain an estimated number of cases nation-wide³⁰. Estimates of prevalence for Asian-Americans and for Other racial-ethnic groups were estimated as the average of the pooled prevalences for Non-Hispanic Whites, Hispanic Whites and African-Americans. We assumed prevalence was the same for boys and girls in these projections.

RESULTS

Study Cohort

Data collection was conducted between November 2003 and May 2007. A total of 63,737 occupied dwelling units were identified in 54 census tracts, of which 59,045 (93%) responded to household screening for eligible children (i.e., stated whether or not children meeting eligibility criteria lived in the house). We enrolled 3,990 (97%) of the 4,132 eligible children and examined a total of 2,546 children (151 of whom were examined in their homes) with an overall response rate of 64% (62% of all eligible subjects, Table 1 [available at <http://aaojournal.org>] and Figure 1 [available at <http://aaojournal.org>]). As previously reported,²⁶ children who underwent a clinic or home examination were similar to those who were not examined with regards to race/ethnicity, sex, parent-rated eye health of the child, proportion of parents reporting that the child had difficulty seeing in the past year, proportion of parents reporting that the child had a prior diagnosis of an eye problem, and parent-rated general health of the child. However, children 13 through 24 months of age were less likely to have a clinical examination than children in other age groups. Those with reported health problems at birth

were more likely to undergo a clinical evaluation, as were those children where the primary care giver was not working, or had a college education.

Prevalence of Strabismus

Manifest strabismus was present in 34 of 1,030 White children evaluated (3.3%, 95% confidence interval [CI] 2.3, 4.6) and 26 of 1,268 African-American children (2.1%, 95% CI, 1.3, 3.0), (Relative Prevalence (RP)=1.61, 95% CI: 0.97, 2.66) Table 2. These rates include four children who had a history of strabismus surgery, (one African-American who did not have strabismus on examination but had restricted eye movements) and 3 White children who had residual strabismus on examination). All but one case of strabismus was horizontal. Esotropia and exotropia were nearly equally prevalent (1.5% and 1.8%, respectively). Of the 48 with horizontal strabismus at distance, 7 had constant exotropia, 17 had intermittent exotropia, 4 had intermittent esotropia, and 20 had constant esotropia. Of these 48 with horizontal strabismus, 9 had coexisting vertical heterotropia (Table 2). A slightly higher prevalence of strabismus was found with testing at near. Thirty of the 41 children with measurements of the magnitude of the deviation (at distance) had 10 – 30 PD of strabismus (73.2%), and only 5 had > 30 PD of strabismus (12.2%). Findings were similar when testing the magnitude at near.

Strabismus was rare in children 6 through 11 months, with one of 167 examined children having strabismus (0.6%, Table 3). For older children the prevalence rates were higher, but there was no clear trend for increasing or decreasing prevalence after age 12 months. Strabismus rates were similar for boys and girls (2.65% and 2.57% respectively). The rate was higher among Whites, although this finding was not statistically significant (RP=1.61, 95% CI: 0.97, 2.66). A minority of children were reported to have been treated previously for strabismus (29.4% of White and 23.1% of African American children, $p = 0.58$, RP of treatment: 1.27, 95% CI: 0.53, 3.05). Using these results, together with those from the MEPEDS study, we estimate there are approximately 677,000 cases of manifest strabismus among children 6–71 months of age in the United States.

Prevalence of Amblyopia

Of the 1546 participants aged 30 through 71 months who were evaluated for amblyopia, 188 were excluded from analysis because they were unable to perform visual acuity testing in one or both eyes. Twelve of 673 Whites (1.8%, 95% Confidence Interval [CI] 0.9, 3.1) and 7 African Americans (0.8%, 95% CI, 0.3, 1.6) met the definition of amblyopia (RP: 2.23, 95% CI: 0.88, 5.62). Fifteen were considered definite and 4 were suspected. (Table 4). Of the 19 definite or suspected cases of amblyopia, anisometropia and strabismus each accounted for six cases, while an additional two children had combined strabismus and anisometropia. Therefore, 8 of the 60 children with strabismus (two of whom had anisometropia as well) had either suspect or definite amblyopia (13.3%, 95% CI, 5.9, 24.6). Three of the cases of amblyopia were due to isoametropia, one was deprivational, and the remaining was bilateral (Table 4). While not statistically significant, anisometric amblyopia was more common among Whites and accounted for the overall higher prevalence of amblyopia in this group ($p=0.09$, Fisher's Exact 2 tailed test). The prevalence of amblyopia did not appear to vary by age (within 30 to 71 months), but the numbers were too small to test for any trends (Table 5). No children were reported to have been treated for amblyopia previously. Among children 30–71 months of age in the U.S., there are approximately 271,000 cases of amblyopia.

DISCUSSION

This population-based study of preschool African-American and White children found the overall prevalence of strabismus to be 2.1% among African-Americans and 3.3% among

Whites, a difference that was not statistically significant. Esotropia and exotropia were found equally often in both racial groups. Both exotropia and esotropia were about 3 times more frequent in children after 12 months of age compared to the first year of life. The amblyopia prevalence (for those 30–71 months of age) was 1.8% for Whites and 0.8% for African Americans, not a statistically significant difference. Pooling across the two population-based studies in the U.S., there are an estimated 677,000 cases of strabismus among 6–71 month old children and 271,000 cases of amblyopia among 30–71 month old children.

Manifest strabismus prevalence among Whites has been reported in several well-designed studies.^{3–5} Graham examined the alignment and visual acuity of a birth cohort of over 4,000 children in Cardiff, Wales during their first year of school (or at home if not attending regular schools).³ He reported an overall prevalence of horizontal heterotropia of 5.3% at five to six years of age (with 4.5% esotropia and 0.8% exotropia). Kvarnstrom examined an entire birth cohort in three municipalities in Sweden during childhood finding that 2.7% had strabismus (2.1% esotropia and 0.6% exotropia).⁴ Another study from Ireland found an overall prevalence of strabismus of 2.3% among children 7 to 8 years of age.⁵ The prevalence of esotropia and exotropia has been reported using clinical data from a captive population of White children less than six years of age in Olmstead County, Minnesota.^{31,32} They found a prevalence of 2.07% for esotropia and 0.6% exotropia, but examination techniques were not standardized. A recent study from Sydney, Australia found a prevalence rate of manifest strabismus of 2.8% from a population-based sample of six-year old school children (esotropia of 1.6% and exotropia of 1.2%).¹

Our finding of nearly equal rates of esotropia and exotropia (1.5% and 1.8%, respectively) among Whites is exceptional when compared with previous reports (which found both higher rates of esotropia and much lower rates of exotropia).^{3–5,31} This seems to parallel the recent studies from Los Angeles and Sydney.^{1,25} These recent studies suggest that esotropia has become less common, while exotropia has maintained its prevalence. This could represent the effect of an unknown factor reducing the development of esotropia. One possible explanation for the lower rate of esotropia seen in the present study is that some children may have had surgery which we did not uncover during the parental interview. Another potential factor reducing the strabismic rate could be earlier detection of an intermittent esotropia with provision of hypermetropic glasses. However, the use of eye glasses by our population was very limited and likely would not have affected the prevalence.

African-Americans in the present study had a lower rate of strabismus than Whites, with lower rates for both esotropia and exotropia. The rates in Baltimore for African-Americans are similar to those reported from Los Angeles for a cohort of African-Americans (1.1% esotropia and 1.4% exotropia in Los Angeles). The methodology used in both studies was identical, and the examiners' techniques were cross-checked between the two studies with site visits. The small difference in prevalence could be due to the different origin of African-American populations in different parts of the United States, to variations in admixture, to issues with non-response in both studies, or to chance.

Amblyopia affected 0.8% of African-Americans and 1.8% of Whites and in the current study. The rate among African-Americans is lower than was reported in Los Angeles (1.5%). As with strabismus the definitions and examination techniques were identical in the Baltimore and Los Angeles studies. The largest differences between these cohorts were the prevalence of unilateral anisometropic amblyopia (0.8% in Los Angeles versus 0.1% in Baltimore) and bilateral amblyopia (0.4% in Los Angeles and 0.1% in Baltimore). Possible explanations for these differences include those for strabismus listed above related to the country of origin and racial admixture of the children, differing socioeconomic conditions, overall health, rates of prematurity,^{33–36} and neurological disorders in the examined population and relatively

unstable estimates given the small number of cases identified. While prior treatment may have influenced the overall estimate of amblyopia, no children in our study had been treated for amblyopia. Spectacle correction may have played a role in reducing amblyopia prevalence, but as noted previously glasses were prescribed very uncommonly and thus unlikely to have reduced our estimates.

Amblyopia rates for whites are consistent with previously nearly population-based published reports, although estimates of amblyopia prevalence range from under one percent to nearly 4% in those studies.^{4,16,36,37} Several authors assessed large birth cohorts in a single geographic region which should provide fairly representative estimates of amblyopia prevalence in the larger population. Williams reported a 3.6% prevalence of present or past amblyopia from a birth cohort consisting of 7,825 children seven years of age in Avon, England.¹⁶ This estimate may be high since best vision was measured with a pinhole and therefore may have been underestimated in some. Kvanstrom reporting from Sweden found a much lower prevalence of amblyopia (0.3%) which was defined as vision in one eye less than 20/60 in a birth cohort examined at 10 years of age.⁴ The Swedish health system screens vision frequently and this low rate may in part reflect frequent evaluation and early treatment of amblyopia. Thompson and colleagues used clinical records of all children up until 15 years of age in Leicestershire, England assuming that they would all attend the local clinic for eye care and reported an amblyopia prevalence of nearly 3%.³⁷ Evaluation techniques were not standardized in that study. Finally, a geographically restricted population in Israel was assessed and the amblyopia prevalence of those 3 – 6 years of age was 1.6%.³⁸ It is difficult to compare the previous reports to the present one given the lack of uniformity in examination techniques and definitions of amblyopia.

There are several limitations to our prevalence estimates that are common to this type of study. We did not attempt to classify esotropia by time of onset. As noted earlier we relied only on single-surrounded HOTV optotype testing for visual acuity and thus do not report amblyopia rates for age less than 30 months. Not all children identified and enrolled in the study presented for clinical examination. This could have biased our findings either towards detecting a higher prevalence of disease (if those with disease were more likely to come in for an examination) or lower prevalence (if they were less likely because they were already being treated). At enrollment we asked about prior diagnosis of eye disease and prior treatment, and those attending the clinical examination did not differ from those who did not attend with regards to these questions, so it is unlikely that the prevalence estimates have substantial bias in either direction. The exclusion of subjects who could not complete visual acuity testing may have led to an underestimate of the total number with amblyopia if these children were more likely to have amblyopia than those who were testable.³⁹ It is possible that a small deviation could have been missed by our examiner or a very well controlled intermittent tropia could have been misclassified as a heterophoria. Lastly, our power to detect small but potentially significant differences between ethnic groups was not sufficient with the sample size in this population-based sample.

In conclusion, strabismus affects a small proportion of White and African-American preschool-aged children, with esotropia and exotropia about equal in prevalence. The prevalence of strabismus is higher after the first year of life, with the development of refractive forms of esotropia and the appearance of exotropic deviations. Amblyopia affects a smaller percentage of the population, with anisometropic and strabismic types about equally represented. None of the children with amblyopia had been treated previously.

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Figure 1.
Recruitment of the Study Cohort.

Table 1

Demographic Characteristics of Participants

Age	White (n=1030) n (%)	African American (n=1268) n (%)	Total (n=2298) n (%)
6–11 months	84 (8.2%)	83 (6.6%)	167 (7.3%)
12–23 months	175 (17.0%)	191 (15.1%)	366 (15.9%)
24–35 months	189 (18.4%)	248 (19.6%)	437 (19.0%)
36–47 months	210 (20.4%)	240 (18.9%)	450 (19.6%)
48–59 months	201 (19.5%)	261 (20.6%)	462 (20.1%)
60–71 months	171 (16.6%)	245 (19.3%)	416 (18.1%)
Gender			
Male	467 (45.3%)	627 (49.4%)	1094 (47.6%)
Female	563 (54.7%)	641 (50.6%)	1204 (52.4%)

Table 2**Strabismus Prevalence and Subtypes by Ethnicity**

Strabismus	White (n=1030)	African American (n=1268)
	Prevalence (95% Confidence Interval) (n)	Prevalence (95% Confidence Interval) (n)
Any strabismus	3.3% (2.3, 4.6) (34)	2.1% (1.3, 3.0) (26)
Exotropia	1.8% (1.0, 2.8) (18)	1.0% (0.5, 1.8) (13)
Esotropia	1.5% (0.8, 2.4) (15)	1.0% (0.5, 1.8) (13)
Other [*]	0.1% (1)	0.0% (0)
	n (%)	n (%)
Strabismus type at distance[§]		
Intermittent exotropia	10 (31.3)	7 (29.2)
Constant exotropia	3 (9.4)	4 (34.6)
Intermittent esotropia	3 (9.4)	1 (16.7)
Constant esotropia	11 (34.4)	9 (37.5)
Strabismus identified only at near [#]	5 (15.6)	3 (12.5)
Strabismus type at near[@]		
Intermittent exotropia	4 (12.1)	5 (20.0)
Constant exotropia	3 (9.1)	5 (20.0)
Intermittent esotropia	4 (12.1)	2 (9.0)
Constant esotropia	13 (39.4)	9 (36.0)
Strabismus identified only at distance [#]	9 (27.3)	4 (12.5)
Strabismus magnitude at distance (Horizontal SPCT)		
1–9 PD	4 (11.8)	2 (8.0)
10–30 PD ^π	15 (44.1)	15 (60.0)
>30 PD ^π	2 (5.9)	3 (12.0)
Unable to measure	8 (23.5)	2 (8.0)
Strabismus identified only at near ^c	5 (14.7)	3 (12.0)
Strabismus magnitude at near (Horizontal SPCT)		
1–9 PD	7 (20.6)	3 (12.0)
10–30 PD	8 (23.5)	12 (48.0)
>30 PD	2 (5.9)	3 (12.0)
Unable to measure	8 (23.5)	3 (12.0)
Strabismus identified only at distance [#]	9 (26.5)	4 (16.0)

PD = prism diopters

SPCT = simultaneous prism cover test

^{*} Exotropia at distance fixation and esotropia at near - +3.00D cycloplegic retinoscopy[§] 1 white child was unable to do the SPCT or UCT, was constant XT at near on Hirschberg, 1 white child was XT at distance and ET at near (see a above). 1 African American child was unable to do the SPCT or UCT, was intermittent XT at near on Hirschberg, 1 had normal exam but evidence of strabismus surgery whose type at distance could not be classified[#] These strabismic children were non-strabismic at one of the fixation distances tested, or could only be evaluated at one fixation distance (usually near) due to young age and inattention.[@] 1 White child was XT at distance and ET at near (see a above). 1 African American child had normal exam but evidence of strabismus surgery whose type at near could not be classified and whose horizontal SPCT was normal at distance and near.[^] Horizontal Simultaneous Prism and Cover Test^π Prism Diopters

Table 3

Strabismus Prevalence in White and African-American Children by Age

Age	White			African American		
	Any Strabismus Prev. (n) (95% CI)	Any Exotropia Prev. (n) Any Esotropia Prev. (n)	Age	Any Strabismus Prev. (n) (95% CI)	Any Exotropia Prev. (n) Any Esotropia Prev. (n)	Age
6–11 months (n=84)	1.2% (1) (0.03, 6.5)	0% (0)	6–11 months (n=83)	0% (0) (0.0, 4.4)	0% (0)	6–11 months (n=83)
12–23 months (n=175)	2.9% (5) (0.9, 6.5)	1.1% (2)	12–23 months (n=191)	0.5% (1) (0.01, 2.9)	0% (0)	12–23 months (n=191)
24–35 months (n=189)	3.7% (7) (1.5, 7.5)	2.6% (5)	24–35 months (n=248)	2.0% (5) (0.7, 4.6)	0.4% (1)	24–35 months (n=248)
36–47 months (n=210)	1.9% (4) (0.5, 4.8)	0% (0)	36–47 months (n=240)	2.9% (7) (1.2, 5.9)	1.7% (4)	36–47 months (n=240)
48–59 months (n=201)	3.5% (7) (1.4, 7.0)	2.0% (4)	48–59 months (n=261)	2.3% (6) (0.9, 4.9)	0.8% (2)	48–59 months (n=261)
60–71 months (n=171)	5.9% (10) (2.8, 10.5)	4.1% (7)	60–71 months (n=245)	2.9% (7) (1.2, 5.8)	2.4% (6)	60–71 months (n=245)

* 95% Confidence Intervals (Poisson); reported by age and race/ethnicity for overall strabismus prevalence only.

Prev. = Prevalence

CI = Confidence Interval

Table 4**Amblyopia Prevalence by Ethnicity**

Amblyopia Type	White (n=673) Prevalence (n) (95% CI) *	African American (n=873) Prevalence (n) (95% CI) *
Any amblyopia	1.8% (12) (0.9, 3.1)	0.8% (7) (0.3, 1.7)
unilateral anisometropic amblyopia	0.7% (5)	0.1% (1)
unilateral strabismic amblyopia	0.6% (4)	0.2% (2)
unilateral combined strabismic/anisometropic amblyopia	0.3 (2)	0% (0)
unilateral deprivational amblyopia	0% (0)	0.1% (1)
unilateral isoametropic amblyopia	0.1% (1)	0.2% (2)
Bilateral amblyopia	0% (0)	0.1% (1)

* 95% Confidence Intervals ([CI] Poisson); reported by race/ethnicity for overall amblyopia prevalence only.

** Bilateral with any type of amblyopia (case is definite isoametropia)

Table 5

Amblyopia Prevalence in White and African-American Children by Age

Age	White			African American		
	Any Amblyopia Prev. (n) (95% Confidence Interval)	Anisometropic Amblyopia * Prev. (n)	Age	Any Amblyopia Prev. (n) (95% Confidence Interval)	Anisometropic Amblyopia Prev. (n)	
30–35 months (n=91)	1.1% (1) (0.03, 6.0)	1.1% (1)	30–35 months (n=127)	0.8 (1) (0.02, 4.3)	0% (0)	
36–47 months (n=210)	0.5% (1) (0.1, 2.6)	0.5% (1)	36–47 months (n=240)	0.4 (1) (0.01, 2.3)	0% (0)	
48–59 months (n=201)	2.5% (5) (0.8, 5.7)	1.0% (2)	48–59 months (n=261)	0.8% (2) (0.09, 2.7)	0% (0)	
60–71 months (n=171)	2.9% (5) (1.0, 6.7)	0.6% (1)	60–71 months (n=245)	1.2% (3) (0.3, 3.5)	0.4% (1)	

* All cases are definite anisometropic amblyopia