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Prevalence of Pediatric Eye Disease in the OptumLabs Data Warehouse

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Abstract

Purpose: To define the prevalence of medical eye disease diagnoses among children enrolled in commercial insurance plans in the United States and to evaluate differences amongst groups based on US census region, race/ethnicity, and familial net worth.

Methods: Retrospective study of de-identified claims data from the OptumLab® Data Warehouse (OLDW) between 2007–2018. All children (<19years) in the OLDW with coverage were studied and those with a claim for a significant eye disease (strabismus, amblyopia, nystagmus or structural eye disorders) with minimum 6-months follow-up were studied. Baseline characteristics were extracted for the calculation of eye disease prevalence, including age, sex, race/ethnicity, region of residence, and family net worth. The prevalence of each type of eye disease was calculated among all children and by baseline characteristics.

Results: 10,759,066 children met study criteria. The presence of any significant eye diagnosis was 6.7%. Disease was diagnosed more often in whites(6.9%) than blacks(5.6%) and Hispanics(5.9%). The most common eye disease diagnosed was strabismus (3.2%) followed by amblyopia (1.5%). In the North-East region, there was a 10.6% prevalence of any significant eye disease diagnosis, whereas in the Mid-West, it was 7.4% followed by the South and West (5.9%

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and 5.3%, respectively) (p<0.001). There was an increase in eye disease diagnoses with increasing income (5.5% in<$25,000 and 9.4% in >$500,000 household net worth groups, p>0.001).

Conclusion: Diagnosis of significant eye diseases is relatively common in American children. The most common medical eye disease diagnosis is strabismus. Prevalence of eye disease diagnosis from claims data varies between geographical regions and different income groups. This may reflect differences in healthcare utilization rather than true disease prevalence.

Keywords

pediatric ophthalmology; healthcare disparity; strabismus; amblyopia; eye disease

Introduction

Pediatric eye diseases are common[1, 2] and known to impact the quality of life of children.[3, 4] The most common significant eye disease other than refractive error in American children is strabismus, occurring in 2–5%.[1, 2] In addition, an estimated 1/10,000 children suffer from low vision or blindness.[5] Two population-based studies have reported the prevalence of common eye diseases such as amblyopia and strabismus in children 6 to 72 months of age. In the Baltimore Pediatric Eye Disease Study (BPEDS), the prevalence of strabismus ranged from 2.1–3.3% depending on race/ethnicity.[1] Similarly, in the Multi-Ethnic Pediatric Eye Disease Study (MEPEDS) in Los Angeles, California the prevalence of strabismus ranged from 2.4%−3.55% depending on race/ethnicity.[2, 6] Amblyopia also varied among race/ethnicity groups between 0.8–1.8% in Baltimore and 1.5–2.6% in Los Angeles.[1, 2] Although these and other large epidemiologic studies provided prevalence estimates for two common pediatric eye diseases, there have been few assessments of the prevalence of other less common significant eye diseases (strabismus, amblyopia, nystagmus or structural eye disorders) in children in the United States.[7]

Furthermore, previous studies have revealed a difference in eye disease diagnosis in children based upon race and socioeconomic factors, but this issue has been studied only in relatively common diagnoses such as amblyopia and strabismus and general visual impairment[8] and has not been addressed in rarer pediatric eye conditions.[9] In this study we use a large insurance company database to address the prevalence and racial/ethnicity variations of these less common significant eye disease diagnoses.

Methods

This study was exempt from review by the institutional review board at the University of California, Los Angeles. All research procedures adhered to the tenets of the Declaration of Helsinki. The study utilized the OptumLabs® Data Warehouse (OLDW). OptumLabs is an open, collaborative research and innovation center founded in 2013 as a partnership between Optum and Mayo Clinic with its core linked data assets in the OLDW.[10] The database contains de-identified, longitudinal health information on enrollees and patients, representing a diverse mixture of ages, ethnicities and geographical regions across the United States.[11] The claims data in OLDW includes medical and pharmacy

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claims, laboratory results and enrollment records for commercial and Medicare Advantage enrollees.

The OptumLabs Data Warehouse (OLDW) was first queried to extract all subjects with medical coverage between 2007 and 2018 using the member coverage data table. The medical claims data tables were then searched for these selected patients to identify those who had a claim for a significant eye disease (strabismus, amblyopia, nystagmus or structural eye disorders including blindness/low vision, glaucoma, congenital retinal disease, congenital optic nerve disease, cataract) from 1/1/2007 to 12/31/2018 based on the diagnosis codes matching to the specific the *International Classification of Disease, Ninth Revision, Clinical Modification* (*ICD-9-CM*)[12] or *International Classification of Disease, Tenth Revision, Clinical Modification* (*ICD-10-CM*)[13] diagnosis codes (Supplemental Table 1). The date of first claim for any medical condition between 1/1/2007 to 12/31/2018 was recorded for all children with and without eye disease diagnosis, and the date of first claim for eye disease was also recorded for those with eye disease diagnoses. The age at first any claim was then calculated for the comparison between the two groups. The age at first claim for eye disease was also calculated for those with eye disease to determine their exclusion criteria. Patients who met the following criteria were excluded from further analysis: 1) those with age at their corresponding first claim older than 18 years; 2) those with their corresponding first claims after 1/1/2018; and 3) those with less than 6 total months of medical coverage from their corresponding first claims until their last known enrollment date or 12/31/2018 if they were still enrolled.

Among patients who had significant eye diseases, each type of eye disease was determined according to the specific ICD-9-CM and ICD-10-CM diagnosis codes, and the date of first claim for each type of eye disease was also recorded to use for the analysis of prevalence of that specific eye disease. The age at first claim of each type of eye disease was then calculated for each type of eye disease and used to determine their status in the corresponding prevalence calculation.

Patients who had a significant eye disease claim that was first claimed when they were older than 18 years of age at the first claim of specific type of a significant eye disease were classified as not having the specific type of eye disease and were included in the denominator when calculating the prevalence of specific eye disease since we are interested in the prevalence of each type of eye disease among patients 18 years of age or younger. In addition to age, other baseline characteristics were extracted for the calculation of prevalence of eye diseases, including sex, race/ethnicity, US census region of residence, and family net worth. The data extractions were conducted using SQL Software DBVisualizer Pro 10.0.15 (DbVis Software AB, Stockholm, Sweden), and all statistical analyses were performed using R (3.5.3) (R Foundation for Statistical Computing: https://www.R-project.org).

Descriptive statistics were calculated for all subjects, along with subjects with and without any eye diseases or each type of eye diseases. Continuous variables, such as age and duration of follow-up, were compared between children with and without eye diseases using T tests and categorical variables, such as sex and race, were compared between children

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with and without eye diseases using Chi-squared tests. The prevalence of each type of eye disease was calculated among all children included in the study, regardless of the presence of other types of eye diseases. The prevalence of eye disease was also calculated for each subgroup of baseline variables. Due to the large number of unknowns in several variables such as race and family net worth, the comparisons of eye disease prevalence for these variables were performed by both: (1) including unknowns as a separate category and (2) excluding subjects with unknowns. In certain variables, if a subgroup contained 10 or fewer subjects, all other reports of this variable were rounded to the nearest hundred to avoid reporting potentially identifiable information. A multivariable logistic regression model was performed to evaluate whether racial differences between the prevalence of diagnosis of eye disease persisted after accounting for census region and family income.

Results

The total number of children in the OLDW who were <=18 years of age and had health coverage between 2007 and 2017 was 19,564,659. The number of children who had at least one claim for eye disease (or any claims for those without eye disease) between 2007 and 2017 and were <=18 years of age at the corresponding first claim was 13,309,035. The number of children with at least 6 months of coverage after the corresponding first claim was 10,759,066 (Table 1). Overall, the diagnosis of any eye disease was 6.7% (some patients had more than one type of eye disease diagnosed, therefore the overall prevalence of eye diseases is less than the sum of these diagnoses) but it varied among groups based on familial net worth, race, and census region. The most common category of eye disease diagnosis was strabismus, with a diagnosis prevalence of 3.2% (1.7% esotropia, 1.5% exotropia, 0.4% hypertropias – some patients had more than one type of strabismus diagnosed, therefore the overall prevalence of strabismus is less than the sum of these diagnoses). Amblyopia diagnosis was also relatively common with a prevalence of 1.5%. All other categories of eye disease diagnoses had a prevalence of less than 1% (Table 2).

In evaluating the prevalence of various eye disease diagnoses by gender, there was no clinically significant difference seen amongst male vs. female patients (Table 2). There was a relatively small difference (1.3% between black and white children) in the prevalence of eye disease diagnoses by race; however due to the large sample size, this 23% increase in the diagnosis of significant eye disease in white children compared to black children may still be clinically significant (Table 3). By census region, there were somewhat larger differences in the diagnosis of certain eye disease by region (Table 4). Notably, in the North-East region, there was a 10.6% prevalence of any medical eye disease diagnosis, whereas in the Mid-West, it was 7.4%, and in the South and West, it was 5.9% and 5.3%, respectively ($p<0.001$). Similarly, amblyopia was diagnosed in 2.3% of children in the North-East vs. 1.4% in the South and West ($p<0.001$). Other rare diseases such as glaucoma, congenital retinal disease, and congenital optic nerve disease were diagnosed in 1% of children in the North-East compared with 0.2–0.4% of children in the other regions (Table 4). This rate varied by region with the diagnosis twice as frequently in the North-East compared with the South and West ($p<0.001$).

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For those children in whom household net-worth data were available, there was a statistically significant increase in the prevalence of any eye disease diagnosis from the lowest to the highest net-worth groups across all the groups ($p<0.001$), and the largest difference was observed between the highest and lowest net-worth groups (5.5% and 9.4% in the <$25,000 and >=$500,000 household net worth groups, respectively). Similarly, amblyopia was diagnosed in 2.1% of children in the highest net worth group vs. 1.2% in the group with the lowest net-worth ($p<0.001$) and strabismus diagnoses were present in 4.9% vs. 2.2% respectively ($p<0.001$). Other rarer disease diagnoses such as cataract, congenital optic nerve disease, congenital retinal disease, and nystagmus were diagnosed more than twice as frequently in the children from households with the highest net worth compared with the lowest ($p<0.001$).

A multivariable logistic regression model evaluating the likelihood of an eye disease diagnosis based on race revealed persistent statistically significant difference between racial groups after accounting for the effects of census region and family income. The adjusted odds ratio of having any eye disease diagnosis was 1.12 (95% CI 1.10–1.13) for Asians, 0.95 (95%CI 0.93–0.96) for Blacks, 0.995 (95% CI 0.99–1.0) for Hispanics, and 1.18 (95% CI 1.17–1.18) for Unknown race when compared to White race as a reference.

Statistical analysis for the above described comparisons was repeated excluding the “unknown” category and the p-values remained unchanged.

Discussion

In this study of more than 10 million children less than 19 years of age, the overall prevalence of a significant eye disease diagnosis (not including refractive error) among children in the OptumLabs data set was 6.7%. The prevalence of diagnoses of amblyopia (1.5%) and strabismus (3.2%) were within the ranges of earlier population-based studies. Although the current study relies on claims data as opposed to population-based studies which utilized expert examinations of all children living in certain census tracts, the consistency of prevalence data lends credibility to the overall prevalence estimates of rarer diseases which have not been as well studied. In the BPEDS study, the prevalence of a similar set of “other ocular disorders” was about 2%.[7] Although this cohort of children was different than the Optum study population in that they were entirely urban-based and likely from lower socioeconomic strata, the prevalence estimates were remarkably similar to those of the Optum cohort. For example, the prevalence of nystagmus in the BPEDS cohort was 0.35% (9 of the 2546 participants), which is similar to the 0.3% prevalence in our cohort. In the BPEDS cohort, the prevalence of retinal and optic nerve diseases were 0.39% and 0.24% respectively,[7] while in this cohort the values were 0.4% and 0.3%, respectively.

Interestingly, when demographic factors were evaluated for each individual disease category, we found that household net-worth and geographic region of residence appeared to be associated with the largest differences in disease prevalence and there were also significant differences by race. With regard to differences based on race, our data are similar to that of the MEPED and BPED studies.[1, 6] In the current study, a diagnosis of esotropia was most common in white patients (1.9%) and least common in black and Hispanic patients

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(1.1% and 1.2%, respectively). Similarly, in the MEPEDS, esotropia was most common in whites (2.31%) and least common in Hispanics (0.9%) and blacks (1.1%). A similar trend was observed in the BPED study. For exotropia, in the current study, a diagnosis was most common in Asian children (2%) and least common in black children (1.1%). This is similar to MEPEDS which reported an exotropia prevalence of 2.1% in Asian children compared to 0.73% in white and 1.4% in black children. In our study, amblyopia was most commonly diagnosed in white children, which is similar to the findings of BPEDS. However, interestingly in the MEPEDS, Hispanic children had the highest prevalence of amblyopia. This difference is concerning for under-diagnosis in our claims-based study in Hispanic children.

The prevalence of any eye disease diagnosis in children who lived in the North-East (10.6%) was double that of children who resided in the West (5.3%) and the trend of higher disease diagnosis prevalence in the North-East persisted across most significant eye disease categories. It is unclear from claims data alone whether these diseases are truly more common in this region, or if access to care, healthcare utilization, commercial insurance availability, and frequency of visits to eye care providers are higher, thus leading to an increase in the prevalence of the disease diagnosis. Under-utilization and under-diagnosis in regions outside the North-East are likely. In a 2007 report of the pediatric ophthalmology work force based on the American Association of Pediatric Ophthalmology and Strabismus (AAPOS) database, all of the 12 metropolitan areas with pediatric populations 35% or greater and no AAPOS members listed were located in the South and west regions of the United States.[14] Furthermore, in a listing of the top 16 metropolitan areas with populations greater than 250,000 having no listed AAPOS or AAO member specifying a pediatric practice focus, 10 were in the South, 2 were in the west, and 4 were in the Midwest.[14] Similarly, it is possible that providers in certain regions may have been more likely to code multiple diagnoses or have been early adopters of electronic medical records facilitating entry of multiple diagnostic codes.

To explore a similar theme, Kemper *et al.*[15] evaluated claims data for children enrolled in Medicaid in Michigan to estimate eyecare utilization and the odds of receiving any eye care or vision services, including eye examinations, refractions, or lens dispensing services, in rural vs. urban counties. Their findings revealed that children living in rural areas had a higher odds of receiving vision care than their urban counterparts. In addition, in urban areas, white/non-Hispanic children had the highest rate of vision care while race was not a significant factor in rural populations. The authors had expected to find a higher rate of eye care utilization in urban areas and hypothesized that the unexpected higher rate of vision care in rural areas may be related to an increased acceptance by physicians in those communities of Medicaid insurance. In comparison, our data suggest that children in the North-East, where proportionately less of the population lives in rural settings, have a higher likelihood of receiving an ophthalmic diagnosis. One important difference between our cohort and that of Kemper *et al.* is that children in our study were enrolled in private insurance plans, which may explain a different distribution of eye care access between the two cohorts.

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Similarly, Ehrlich *et al.*[16] evaluated Medicaid patients, and compared the likelihood of receiving a diagnosis of strabismus in two cohorts of children enrolled in in either Michigan or North Carolina. Their study found that children in the two states had similar proportions receiving diagnoses of an eye disease, but that children in poorer communities were less likely to be diagnosed than those in more affluent communities. This study did not directly evaluate geographic region of residence across the United States, but did compare states within different regions (Mid-West vs. South) and did not find a statistically significant difference. This may be explained by the similarity of the cohorts in terms of socioeconomic level as they were all enrolled in Medicaid. Our study included a more economically diverse cohort of patients (with varying levels of private insurance) than that of Ehrlich et al., yet still found similarly concerning results with lower net-worth patients having a lower rate of eye disease diagnoses, as well as differences across geographic regions.

Contrary to our findings, several population-based studies have revealed a higher prevalence of visual impairment in areas with adults having lower income levels;[17, 18] these findings directly contradict our results as well as those in the studies of children enrolled in Medicaid described above. Importantly, these studies directly examined patients and are therefore more reliable for true prevalence estimates. Although we cannot eliminate the possibility of a true lower prevalence of eye disease in the current study cohort within lower socioeconomic levels and certain racial groups and geographic regions, the lower rate in this study of commercially insured children could also be due to under-diagnosis and under-utilization, by families of lower socioeconomic means simply not accessing their insurance coverage. Families in lower socioeconomic groups may have higher deductible plans which may also limit their ability to access care despite being insured. We were not able to investigate this hypothesis. In their study, Ehrlich *et al.* posited that the lower rate of strabismus diagnoses in areas of lower income in Michigan and North Carolina was due to a lower rate of eye care utilization in these areas since all of the children in their study had insurance coverage with Medicaid.[16] Ehrlich et al. noted that the lower rate of eye care utilization in lower income areas may be due to a lack of resources in schools to offer vision screening and a lack of resources for parents to access care (eg such as time off work, coinsurance, adequacy of the insurance.[16] These findings corroborates the theory that removal of barriers to access supports improved ascertainment of the social patterning of disease.

The Avon Longitudinal Study of Parents and Children, which longitudinally followed 14,541 children born to mothers residing in Avon, England to assess several health care parameters corroborates this theory.[19] In 2008, the data from orthoptic examinations of 7825 seven-year old study participants was reported. After full orthoptic examinations, children from the lowest occupational social class background were more likely to be diagnosed with amblyopia and esotropia, and the risk increased as social class decreased. A recent report by the British Childhood Visual Impairment and Blindness Study 2 (BCVIS2) similarly reported a higher risk of blindness in British children living at the highest levels of deprivation.[8]

Others have attempted to determine which factors influence a child's likelihood of being diagnosed with an ocular disease using larger databases. An analysis of the Medical

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Expenditure Panel Survey in 1996 and 2001 revealed an increased likelihood of being diagnosed with a pediatric eye disease in patients who were white, had a higher level of parental education, and had a more affluent family net worth.[20] Our study supports these data by revealing a clinically significant difference in the rate of significant eye disease diagnosis by race and financial status. We did not examine parental educations level.

In 2016, Stein *et al*.[9] evaluated the Clinformatics Data Mart from Optum Insight to evaluate the number of eye care visits (ophthalmology or optometry) in patients under the age of 21 years. These data revealed that the number of visits to any eye care provider increased with increasing levels of household net worth.[9] This trend persisted within each individual racial group evaluated. Interestingly, when children were stratified by number of eye care visits, the cumulative incidence of strabismus and amblyopia was similar across household net-worth groups indicating that number of eye care visits played a more important role in receiving an eye care diagnosis than actual net worth. These findings lend credence to the possibility that the different rates of eye diseases amongst groups with respect to household net-worth and possibly geographic region may be due to under-utilization as opposed to true differences in prevalence rates.

Although our study provides useful estimates of disease prevalence across the United States, it must be understood within the context of its limitations. First, we utilized low vision codes that included unilateral blindness and low vision in one eye, thereby likely over-estimating childhood blindness in this population. Importantly, the findings are limited by the use of insurance claims data which include the possibility of incomplete or incorrect coding, under-reporting when multiple diagnoses are present, a large amount of unknown data, and a lack of generalization to certain populations (i.e. uninsured patients and Medicaid). In addition, it is not clear whether diagnoses were made by primary care practitioners at the time of referral to eye care providers or if they were made by eye care specialists. This limitation may contribute to overestimation errors as well as coding inaccuracy. Similarly, there may be under-estimation of disease prevalence due to undiagnosed diseases and improper coding when more than one disease is present in the same patient. Another limitation is the large percentage of patients with unknown family net worth and race; however, repeat analysis with those subjects censored yielded similar results. Furthermore, when compared to the most recent US Census data, we found a similar distribution in the known net worth groupings from the Optum database compared to US Census data, implying that the net worth values are missing at random. However, for race, when comparing the known race characteristics from the current study to the US Census data, we found that the majority of unknowns were more likely to be white, Hispanic or black. Therefore, the prevalence of eye disease in these groups may be slightly under-estimated. Despite these limitations, the overall prevalence estimates for several common diseases (amblyopia and strabismus) are consistent with previous estimates based on large-scale screening examinations and the findings of decreased disease diagnosis in lower socioeconomic levels has also been corroborated by other studies.

Despite the limitations of insurance claims data including under-reporting of medical conditions and not including uninsured and children on Medicaid, these findings illustrate the prevalence of rare pediatric eye diseases in the United States. They substantiate concern

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that there may be under-utilization of health care in certain demographic and racial groups and by region, and prompt the need for further investigation into the disparities and barriers to care in certain groups.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Eye Disease Diagnosis in the OptumLabs Data Warehouse

Variable//Levels	All Children N=10,759,066	Children without Any Eye Disease N=10,033,153	Children with Any Eye Disease N=725,913	P-value
Age at first claim in database (years), Mean (SD)	6.54 (5.2)	6.55 (5.3)	6.46 (4.6)	<0.001
Follow-Up Duration (years), Mean (SD)	4.3 (3.3)	4.2 (3.3)	6.2 (3.5)	<0.001
Sex				<0.001
Male	5,483,139 (51.0%)	5,124,153 (93.5%)	358,986 (6.5%)	
Female	5,274,366 (49.0%)	4,907,543 (93.0%)	366,823 (7.0%)	
Family Net Worth				<0.001 *
< $25K	1,331,532 (12.4%)	1,258,294 (94.5%)	73238 (5.5%)	
$24K – $149K	1,478,248 (13.7%)	1,391,173 (94.1%)	87,075 (5.9%)	
$150K – $249K	747,439 (6.9%)	698,728 (93.5%)	48,711 (6.5%)	
$250K – $499K	1,103,148 (10.3%)	1,021,129 (92.6%)	82,019 (7.4%)	
$500K+	1,479,356 (13.7%)	1,340,487 (90.6%)	138,869 (9.4%)	
Unknown	4,619,343 (42.9%)	4,323,342 (93.6%)	296,001 (6.4%)	
Race				<0.001 *
Asian	438,742 (4.1%)	404,341 (92.2%)	34,401 (7.8%)	
Black / African American	639,654 (5.9%)	603,971 (94.4%)	35,683 (5.6%)	
Hispanic	858,594 (8.0%)	808,330 (94.1%)	50,264 (5.9%)	
White	5,076,960 (47.2)	4,729,065 (93.1%)	347,895 (6.9%)	
Unknown	3,745,116 (34.8%)	3,487,446 (93.1%)	257,670 (6.9%)	
Census Region				<0.001
MidWest	2,813,473 (26.1%)	2,606,002 (92.6%)	207,471 (7.4%)	
NorthEast	1,325,485 (12.3%)	1,185,104 (89.4%)	140,381 (10.6%)	
South	4,680,970 (43.5%)	4,404,594 (94.1%)	276,376 (5.9%)	
West	1,897,058 (17.6%)	1,796,887 (94.7%)	10,0171 (5.3%)	
Unknown	42,080 (0.0%)	40,566 (96.4%)	1,514 (3.6%)	

* Statistical analysis was repeated excluding “unknown” category and p-value remained unchanged.

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Table 2:

Prevalence of Eye Disease Diagnosis in the OptumLabs Data Warehouse

Disease Category	Patients with Diagnosis Code, (% of total cohort) N =10,759,066	Prevalence in Males (N=5,483,139)	Prevalence in Females (N=5,274,366)	P-value
Any Eye Disease	725,913 (6.7%)	358,986 (6.5%)	366,823 (7.0%)	<0.001
Strabismus[a]	344,925 (3.2%)	172,396 (3.1%)	172,479 (3.3%)	<0.001
Esotropia	18,1127 (1.7%)	91,183 (1.7%)	89,914 (1.7%)	<0.001
Exotropia	161,588 (1.5%)	79,914 (1.5%)	81,652 (1.5%)	<0.001
Hypertropia	43,693 (0.4%)	21,400* (0.4%)	22,200* (0.4%)	<0.001
Strabismus NOS	45,929 (0.4%)	22,500* (0.4%)	23,400* (0.4%)	<0.001
Amblyopia	166,419 (1.5%)	84,814 (1.5%)	81,581 (1.5%)	0.995
Blindness and Low Vision	42,113 (0.4%)	20,900* (0.4%)	21,200* (0.4%)	<0.001
Glaucoma	46,076 (0.4%)	23,000* (0.4%)	23,000* (0.4%)	<0.001
Congenital retinal disease	43,204 (0.4%)	21,900* (0.4%)	21,200* (0.4%)	0.816
Nystagmus	33,118 (0.3%)	18,600* (0.3%)	14,400* (0.3%)	<0.001
Congenital optic nerve disease	36,118 (0.3%)	17,900* (0.3%)	18,100* (0.3%)	<0.001
Cataract	14,642 (0.1%)	7,000* (0.1%)	7,500* (0.1%)	<0.001
Ocular motor palsy	8,284 (0.1%)	4,321 (0.1%)	3,963 (0.1%)	0.031

[a] Combining esotropia, exotropia, hypertropia, and strabismus NOS

* Numbers rounded to nearest 100 due to a small proportion of patients with “unknown” gender

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Table 3:

Prevalence of Eye Disease Diagnosis by Race

Disease Category	Asian (N=438742)	Black (N=639654)	Hispanic (N=858594)	White (N=507960)	Unknown (N=3745116)	p-value[b]
Any Eye Disease	34,401 (7.8%)	35,683 (5.6%)	50,264 (5.9%)	347,895 (6.9%)	257,670 (6.9%)	<0.001
Strabismus[a]	15,227 (3.5%)	14,462 (2.3%)	20,311 (2.4%)	172,420 (3.4%)	122,505 (3.3%)	<0.001
Esotropia	6,134 (1.4%)	7,282 (1.1%)	9,898 (1.2%)	94,385 (1.9%)	63,428 (1.7%)	<0.001
Exotropia	8,904 (2%)	6,968 (1.1%)	10,227 (1.2%)	76,680 (1.5%)	58,809 (1.6%)	<0.001
Hypertropia	1,985 (0.5%)	1,699 (0.3%)	2578 (0.3%)	21,687 (0.4%)	15,744 (0.4%)	<0.001
Amblyopia	8,393 (1.9%)	7,775 (1.2%)	11,649 (1.4%)	79,725 (1.6%)	58,877 (1.6%)	<0.001
Blindness and Low Vision	1,955 (0.4%)	3,488 (0.5%)	4,133 (0.5%)	17,848 (0.4%)	14,689 (0.4%)	<0.001
Glaucoma	3,254 (0.7%)	3,376 (0.5%)	3,978 (0.5%)	18,266 (0.4%)	17,202 (0.5%)	<0.001
Congenital retinal disease	2,470 (0.6%)	2,544 (0.4%)	3,427 (0.4%)	18,270 (0.4%)	16,493 (0.4%)	<0.001
Nystagmus	934 (0.2%)	1,326 (0.2%)	1,676 (0.2%)	17533 (0.3%)	11,649 (0.3%)	<0.001
Congenital optic nerve disease	1,990 (0.5%)	1,520 (0.2%)	2,315 (0.3%)	16,446 (0.3%)	13,839 (0.4%)	<0.001
Cataract	559 (0.1%)	767 (0.1%)	1,026 (0.1%)	7,241 (0.1%)	5,049 (0.1%)	<0.001
Ocular motor palsy	321 (0.1%)	330 (0.1%)	529 (0.1%)	4,124 (0.1%)	2,980 (0.1%)	<0.001

[a] Combining esotropia, exotropia, hypertropia, and strabismus NOS

[b] Statistical analysis was repeated excluding “unknown” category and p-value remained unchanged.

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Table 4:

Prevalence of Eye Disease Diagnosis by Census Region

Disease Category	Mid-West (N=2813473)	North-East (N=1325485)	South (N=4680970)	West (N=1897058)	P-value
Any Eye Disease	207,471 (7.4%)	140,381 (10.6%)	276,376 (5.9%)	100,171 (5.3%)	<0.001
Strabismus[a]	96,234 (3.4%)	74,110 (5.6%)	125,070 (2.7%)	48,828 (2.6%)	<0.001
Esotropia	53,997 (1.9%)	34,455 (2.6%)	66,344 (1.4%)	25,995 (1.4%)	<0.001
Exotropia	42,241 (1.5%)	40,285 (3%)	56,550 (1.2%)	22,193 (1.2%)	<0.001
Hypertropia	12,161 (0.4%)	9,103 (0.7%)	15,772 (0.3%)	6,531 (0.3%)	<0.001
Amblyopia	43,357 (1.5%)	30,828 (2.3%)	65,047 (1.4%)	26,912 (1.4%)	<0.001
Blindness and Low Vision	10,254 (0.4%)	6,095 (0.5%)	18,160 (0.4%)	7,526 (0.4%)	<0.001
Glaucoma	8,282 (0.3%)	12,643 (1%)	18,977 (0.4%)	6,068 (0.3%)	<0.001
Congenital retinal disease	8,575 (0.3%)	12,611 (1%)	15,920 (0.3%)	5,967 (0.3%)	<0.001
Nystagmus	9,335 (0.3%)	6,869 (0.5%)	11,171 (0.2%)	5,665 (0.3%)	<0.001
Congenital optic nerve disease	6,438 (0.2%)	13,780 (1%)	11,681 (0.2%)	4,138 (0.2%)	<0.001
Cataract	3,868 (0.1%)	2,512 (0.2%)	6,131 (0.1%)	2,086 (0.1%)	<0.001
Ocular motor palsy	1,986 (0.1%)	1,683 (0.1%)	3,173 (0.1%)	1,396 (0.1%)	<0.001

[a]Combining esotropia, exotropia, hypertropia, strabismus NOS

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Table 5:

Prevalence of Eye Disease Diagnosis by Household Net-worth

Disease Category	<$25k (N=1331532)	$25k–149k (N=1478248)	$150k–249k (N=747439)	$259k–499k (N=1103148)	$500k+ (N=1479356)	Unknown (N=4619343)	p-value[b]
Any eye disease	73,238 (5.5%)	87,075 (5.9%)	48,711 (6.5%)	82,019 (7.4%)	1388,69 (9.4%)	296,001 (6.4%)	<0.001
Strabismus[a]	29,938 (2.2%)	39,868 (2.7%)	23,766 (3.2%)	41,147 (3.7%)	72,817 (4.9%)	137,389 (3%)	<0.001
Esotropia	17,076 (1.3%)	22,859 (1.5%)	13,156 (1.8%)	21,700 (2%)	34,495 (2.3%)	71,841 (1.6%)	<0.001
Exotropia	12,532 (0.9%)	16,812 (1.1%)	10,421 (1.4%)	19,072 (1.7%)	37,937 (2.6%)	64,814 (1.4%)	<0.001
Hypertropia	3,623 (0.3%)	4,996 (0.3%)	2,982 (0.4%)	5,179 (0.5%)	9,194 (0.6%)	17,719 (0.4%)	<0.001
Amblyopia	16,305 (1.2%)	20,704 (1.4%)	11,733 (1.6%)	19,261 (1.7%)	30,557 4(2.1%)	67,859 (1.5%)	<0.001
Blindness and Low Vision	5,728 (0.4%)	5,769 (0.4%)	2,772 (0.4%)	4,155 (0.4%)	5,780 (0.4%)	17,909 (0.4%)	<0.001
Glaucoma	4,844 (0.4%)	5,196 (0.4%)	2,827 (0.4%)	4,810 (0.4%)	9,043 (0.6%)	19,356 (0.4%)	<0.001
Congenital retinal disease	4,280 (0.3%)	4,896 (0.3%)	2,643 (0.4%)	4,578 (0.4%)	8,291 (0.6%)	18,516 (0.4%)	<0.001
Nystagmus	2,769 (0.2%)	3,785 (0.3%)	2,227 (0.3%)	4,030 (0.4%)	7,233 (0.5%)	13,074 (0.3%)	<0.001
Congenital optic nerve disease	2,921 (0.2%)	3,525 (0.2%)	2,139 (0.3%)	3,993 (0.4%)	8,363 (0.6%)	15,177 (0.3%)	<0.001
Cataract	1,473 (0.1%)	1,844 (0.1%)	1,054 (0.1%)	1,758 (0.2%)	2,665 (0.2%)	5,848 (0.1%)	<0.001
Ocular motor palsy	768 (0.1%)	956 (0.1%)	603 (0.1%)	945 (0.1%)	1,697 (0.1%)	3,315 (0.1%)	<0.001

[a] Combining esotropia, exotropia, hypertropia, and strabismus NOS

[b] Statistical analysis was repeated excluding “unknown” category and p-value remained unchanged.