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Research Article

Do Social Determinants of Health Impede Refractive Surgery for Autistic Children?

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Abstract

Purpose: Children with Autism Spectrum Disorder (ASD) are often aversive to spectacle and contact lens wear, warranting Refractive Surgery (RS). Social and economic factors may delay health care. Here we measure whether Social Determinants of Health (SDOH) delay RS.

Methods: A retrospective cohort study was conducted, collating the health records of 40 ASD children treated by RS from 2020-2024. Demographic and socioeconomic measures were used to derive SDOH. Age at referral and time to RS were compared to SDOH scores.

Results: Public health insurance, racial minority and greater social vulnerability were not associated with access to RS. No significant differences were found with ASD children who had private insurance (age, $p = 0.1$; time, $p = 0.5$), were white (age, $p = 0.06$; time, $p = 0.1$) and had lower social vulnerability (age, $p = 0.5$; time, $p = 1.0$). The SDOH scores of the study children were consistent with U.S. averages (47th and 50th percentile).

Conclusion: Neither age at referral nor time to RS varied by SDOH, suggesting no association between SDOH and measured access outcomes. Children with ASD treated by RS at our institution had SDOH metrics similar to the U.S. population, including socioeconomic status; transportation access; income inequality and racial minority status.

Keywords: Social Determinants of Health; Pediatric Refractive Surgery; Autism; Spectacle Non-Tolerance; Access to Care; Amblyopia

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disability prevalent in 2% of the U.S. population [1]. Compared to neurotypical children, children with ASD and significant refractive errors are more likely to be nonadherent to spectacle or contact lens wear [2]. The aversion to spectacle wear causes blurred retinal images. The blur may exacerbate the ASD symptoms by degrading visual acuity and/or promoting amblyopia and strabismus ("lazy vision") all forms of neurosensory deprivation. Children with uncorrected myopia (near-sightedness) have been shown to have a significant reduction in quality of life [3]. Refractive Surgery (RS) is a treatment innovation that can restore sharp vision, eliminating the neurosensory deprivation [4-7]. Pediatric RS improves ASD behaviors and enhances quality of life [8-10].

Demographic and socioeconomic factors may impede health care, including access to ocular surgery [11,12]. White children are more likely to have strabismus surgery, restoring binocular vision and to have the surgery more promptly than non-white

children [13]. Adult cataract surgery patients who are on public-aid are less likely to have implantation of premium intra-ocular lenses when compared to private insurance and white patients [14,15].

To evaluate whether all ASD children with substantial refractive errors have ready access to corrective surgery, it is important to examine the impact of Social Determinants of Health (SDOH) on access to pediatric RS. As a national U.S. center for pediatric RS, our facility is in a unique position to examine potential barriers. This study examines SDOH and the relationship to prompt surgical treatment of ASD children. The SDOH analysis encompassed a variety of socioeconomic measures, including insurance type, race, sex, income, employment, marital status, housing and neighborhood for this pediatric population.

Methodology

The retrospective cohort study analyzed data from 40 children who received RS at a tertiary care pediatric hospital from 2020 to 2024. Written informed consent was previously obtained from the parents or legal guardians of all participants before inclusion in the study. Assent was obtained from children when appropriate. The study was approved by the Washington University in St. Louis Institutional Review Board (IRB# 202404114) and adhered to the tenets of the Declaration of Helsinki for research involving human subjects.

Inclusion and Exclusion Criteria

Inclusion encompassed children who carried a diagnosis of ASD, met pediatric criteria for refractive correction, were spectacle aversive for a minimum of 6 months and had no ocular contraindication for RS. Exclusion criteria included those who lived outside of Missouri and Illinois for consistency across SDOH metrics, who did not receive RS, who lacked an official diagnosis of ASD, children with general developmental delays, participants who no longer desired RS and children who became spectacle-adherent during the study period.

Clinical and Socioeconomic Measures

Data were extracted from the electronic health records of eligible patients, including: the date of referral/initial examination, date of RS, insurance type, sex, race, ethnicity and ZIP code. Time to RS was measured by the number of days between RS eligibility and surgery date. This data point was chosen as a proxy measure to identify delays as a measure of access to care. Patient postal (ZIP) codes were used to derive geographical socio-demographic index averages. The indices included: Socioeconomic Status (SS) percentile, Household Characteristics (HC), Racial and Ethnic Minority (REM) status, Housing Type and Transportation (HTT), Social Vulnerability Index percentile (SVI), Area Deprivation Index percentile (ADI), Household Stability Index (HSI), Gini Index of Inequality (GI) and Social Vulnerability Metric percentile (SVM) [16-21].

SS uses the number of persons in a defined area: unemployed, with income < 150% of the poverty line, individuals with no health insurance and those with no diploma. HC evaluates: the ages of household members; the number of persons with disabilities; the number of single-parent households; and those with limited English proficiency. REM is the percentage of individuals who identify as a racial or ethnic minority. HTT assesses the percentage of group quarters, multi-unit homes, crowding, households without a vehicle and mobile homes. The SVI percentile combines SS, HC, REM and HTT to assess a community's "vulnerability to disaster", with a higher percentile indicating greater vulnerability. ADI ranks the level of disadvantage of a population. HSI is the percentage of financially stable households. GI measures "global inequity", with higher scores denoting greater inequality within geographic regions. The SVM uses SDOH and health outcomes, with a larger percentage indicating worse health outcomes.

Statistical Analysis

Descriptive statistics assessed children's characteristics. Mann-Whitney U test compared age at referral and time to RS between groups: private vs. public insurance, sex and race (white vs. nonwhite). Spearman's Rank Correlation was used to compare age and time across SS, HC, REM, HTT, SVI, ADI, HSI, GI and SVM. An Inter-Quartile Range (IQR) was also calculated for some measures. A p-value of < 0.05 was regarded as significant. Analysis was performed using SPSS version 29.0.2.0. A post hoc sensitivity power analysis was performed using G*Power 3.1 given the fixed retrospective sample size. For major two-group comparisons, including insurance status, sex and race, the study had 80% power at $\alpha = 0.05$ to detect only large effect sizes (d = 0.99 to 1.23). Therefore, nonsignificant findings should be interpreted cautiously, as the study may have been underpowered to detect smaller but clinically meaningful disparities in access.

Results

Of the 40 children in the study (Table 1), 12 (30%) had private insurance, 25 (63%) had public insurance, 2 (5%) had combined private and public and 1 (2%) was uninsured. 13 (32%) were female and 27 (68%) were male. The majority were white (33, 82%), followed by black (5, 13%) and Asian (2, 5%). Most of the children resided in Missouri (25, 62%), with the remaining 15 (38%) residing in Illinois.

Variable	n%
Gender	
Male	27 (68%)
Female	13 (32%)
Race	
White	33 (82%)
Black	5 (13%)
Asian	2 (5%)
State	
Missouri	25 (62%)
Illinois	15 (38%)
Insurance	
Private	12 (30%)
Public	25 (63%)
Combined	2 (5%)
Uninsured	1 (2%)

Table 1: Socio-demographic characteristics of 40 children.

The mean (±SD) SS status percentile was 0.5 (0.23), HC index was 0.5 (0.16), REM status was 0.4 (0.27) and HTT index was 0.5 (0.17). These factors contributed to a mean SVI of 0.5 (0.23) or the 50th percentile, representative of a cross-section of the U.S. pediatric population. The median IQR for SVM was 0.47 (15.6 - 80.4) or the 47th percentile for the U.S. The mean (SD) Area Deprivation Index was 0.7 (0.23), Household Stability Index was 1 (0.01) and Gini Index is 0.4 (0.04).

The median age-at-referral for the entire cohort was 6 years (range: 0-18). The median age-of-referral for the publicly-insured population was 9 years (range: 0 - 18) and privately-insured population was 6 years (range: 1 - 18).

The median time to RS for the entire cohort was 157 days (range: 22 - 991 days). The median time to RS for the publicly-insured population was 146 days (range: 22 - 916) and privately-insured population was 168 days (range: 27 - 643).

Correlation analysis revealed no significant associations between indices representing SDOH and age-at-referral (Table 2) or time to RS (Table 3) or between age and time to RS ($r = 0.10$, $p = 0.5$).

Factor	Average	r	p-value
Socioeconomic Status Percentile	0.5	-0.03	0.9
Household Characteristics	0.5	0.11	0.5
Racial and Ethnic Minority Status	0.4	0.20	0.2
Housing Type and Transportation	0.5	0.13	0.4
Social Vulnerability Index	0.5	0.08	0.6
Area Deprivation Index	0.7	-0.24	0.1

Household Stability Index	1	0.14	0.4
Gini Index of Inequality	0.4	-0.05	0.7
Social Vulnerability Metric	0.47	-0.12	0.5

Table 2: Correlation between social determinants of health and age-at-referral for refractive surgery.

Factor	Average	r	p value
Socioeconomic Status Percentile	0.5	0.12	0.5
Household Characteristics	0.5	0.18	0.3
Racial and Ethnic Minority Status	0.4	0.02	0.9
Housing Type and Transportation	0.5	0.14	0.4
Social Vulnerability Index	0.5	0.13	0.4
Area Deprivation Index	0.7	0.08	0.6
Household Stability Index	1	0.05	0.8
Gini Index of Inequality	0.4	0.10	0.6
Social Vulnerability Metric	0.47	0.00	1.0

Table 3: Correlation between social determinants of health and time to refractive surgery.

Analysis was also performed to detect the existence of any significant differences for insurance type, sex and race with regard to age-at-referral or time to RS. No statistically significant association was found for age-at-referral with regard to sex (median difference = 2, 95% CI [-2 - 6], p = 0.3), public vs. privately insurance (median difference = 3, 95% CI [-1 - 7], p = 0.1) or white vs non-white race (median difference = 3, 95% CI [0 - 8], p = 0.06). Likewise, no difference was evident for time to RS with regard to sex (median difference = 14, 95% CI [-76 - 103], p = 0.7), public vs. private insurance (median difference = 12.5, 95% CI [-88 - 144], p = 0.8) or white vs non-white race (median difference = -58, 95% CI [-195 - 28], p = 0.1).

Discussion

We hypothesized that children with ASD, in families at socio-economic disadvantage, would have impaired access to RS. The tools employed to detect a disadvantage are standard measures of SDOH. Our cohort had an SVI and SVM at the 50th and 47th percentile respectively, indicating that RS at our institution can reach a demographic representative of the general U.S. population. Those with public vs. private insurance displayed no significant association with age at or time to RS. Likewise, race did not influence age-at-referral or time to RS.

In previous work, our center has employed the identical SDOH tools to detect barriers to follow-up eye care and barriers to strabismus surgery for disadvantaged children [22,23]. These indices were selected to capture complementary aspects of disadvantage. These indices capture overlapping dimensions of disadvantage and were not intended to assess independent effects, but rather a trend. In children with ASD at our center, this analysis did not identify statistically significant differences between those with low and high SDOH scores and access to RS.

No previous studies have reported on the demographic and socioeconomic factors that influence rates of pediatric RS in the U.S. or abroad. This deficiency is likely due to the paucity of centers and providers performing the procedures. RS in adults is typically performed for convenience and/or cosmetic purposes. In contrast, RS in children is performed only for chronic spectacle aversion causing visual impairment. Adult RS numbers have increased by more than 10% over the past eight years, prompting studies on the demographics. Women, individuals < 40 years old, those living in urban areas, those with high educational attainment and those who earn more, compose the majority treated by RS [18-20].

Our study investigated the effects of SDOH on pediatric patients with ASD, a demographic with unique eye care requirements. Patients with intellectual disability and ASD may be expected to have unmet healthcare needs. However, a study targeting children with ASD found no disparities for dental care or eye examinations [24]. Patients with ASD were more likely to be tested in an eye care practitioner's office, due in part perhaps to the known relationship between visual deficits and ASD [25]. The

exception was children with ASD in non-English speaking households; they were less likely to be tested [25]. ASD children < 5 years were also more likely to have vision testing in school, compared to neurotypical children: 41% vs. 15%, respectively. Curiously, children with ASD were less likely than neurotypical children to have vision screening in a pediatrician's office: 9% vs. 24%, respectively. That discrepancy suggests that testing of children with ASD requires more time and expertise, a potential barrier for these children [25].

Apart from ASD, the effects of SDOH on pediatric eye care have revealed discrepancies. Hispanic and Black children ages 6-11 have a higher prevalence of unmet vision care needs when compared to their white counterparts [26]. Lower odds of pediatric vision screening are associated with: lower household income; lack of insurance coverage; younger age; parental education of high school or less; and a history of fewer health care visits [27]. Nonwhite individuals, those with a non-English household language and those with lower incomes are also less likely to be referred to an eye doctor after a screening failure [27]. Families with greater SDOH risks may have to navigate the referral system independently [28,29]. Furthermore, fewer follow-up visits to eye doctors are linked to the same SODH [27]. Nonwhite patients have been found to have longer delays for treatment by strabismus surgery [23]. Independent of race, public insurance status appears to have contradictory influences on the treatment of strabismus. Children on public insurance had increased odds of undergoing strabismus surgery sooner after diagnosis compared to those with commercial insurance, but attendance at post-operative visits lagged [13,23]. Taken together, these studies provide evidence that discrepancies in access to pediatric eye care do exist.

Some limitations of our study include possible selection bias. We included patients who received refractive surgery and analyzed the time required to receive the surgery, as delays may reflect barriers in access to care. We did not evaluate patients who may have benefited from refractive surgery but did not ultimately undergo the procedure. Additionally, as a highly specialized tertiary center, our patient population may differ from that of the general population, although indices representing SDOH were similar to national averages. Another limitation of our study is the small sample size. Due to the novelty of the procedure, the cohort size was limited and further multi-institutional studies are needed to better evaluate accessibility to refractive surgery across diverse populations. Our study examined barriers through referral timing and time to surgery, rather than the overall ability to obtain surgery. Due to the limited sample size, only large effect sizes could be detected statistically.

Conclusion

Our findings suggest that children with ASD in need of RS at our institution reflect the SDOH distributions of national averages. Within the measured outcomes of referral timing and time to surgery, no statistically significant associations with SDOH were detected. As we expand this service to other institutions, further studies are warranted to ensure that care remains accessible across diverse populations.

Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

The study was approved by the Washington University Human Research Protection Office, ensuring that all procedures and protocols adhered to ethical standards for research involving human subjects. The research conducted in this study adhered to the tenets of the Declaration of Helsinki, ensuring the ethical treatment and protection of all participants.

Informed Consent Statement

Informed consent was obtained from all participants included in the study.

Authors' Contributions

L.T conceived the idea. A.P performed data analysis, calculations and manuscript writing under supervision of L.T. All authors contributed to the design and provided critical feedback. Presented in part at the Association for Research in Vision and Ophthalmology May 2025.

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