Scientific Research Publishing

Open Journal of Ophthalmology, 2025, 15(3), 122-131
https://www.scirp.org/journal/ojoph
ISSN Online: 2165-7416
ISSN Print: 2165-7408

Eyeing the Difference: A Cross-Sectional Study Analyzing Vision Screening Disparities in Public vs Private Daycares in East-Central Alabama

Eric Marin, Mary H. Mims, David Redden, Katie Wolter

Edward Via College of Osteopathic Medicine, Auburn Campus, Auburn, USA
Email: emarin@vcom.edu

How to cite this paper: Marin, E., Mims, M.H., Redden, D. and Wolter, K. (2025) Eyeing the Difference: A Cross-Sectional Study Analyzing Vision Screening Disparities in Public vs Private Daycares in East-Central Alabama. *Open Journal of Ophthalmology*, **15**, 122-131.
https://doi.org/10.4236/ojoph.2025.153017

Received: June 30, 2025
Accepted: August 10, 2025
Published: August 13, 2025

Abstract

Objective: This study aims to evaluate disparities in vision screening outcomes among children attending Head Start programs compared to those in private daycare settings in East-Central Alabama. It further explores the implications of these disparities for improving early childhood vision care policies and interventions. **Methods:** Data from Impact America: FocusFirst were analyzed for screenings conducted in Alabama between 2019 and 2024. A total of 9266 children were screened, including 3143 from Head Start centers and 6123 from private daycare facilities. The failure rates of vision screenings were compared between the two groups across six counties in Central Alabama using chi-square tests and Cochran-Mantel-Haenszel statistics. **Results:** The analysis revealed that children in Head Start centers had higher failure rates in vision screenings compared to those in private daycare settings. Statistical significance was observed in four counties: Chambers, Lee, Macon, and Tallapoosa. Children attending Head Start programs were 1.59 times more likely to fail vision screenings than their peers in private daycare centers ($p < 0.0001$). **Conclusions:** Children in publicly funded daycare programs, such as Head Start programs, are more likely to fail vision screenings than those in private daycare settings, reflecting significant disparities in eye health. The findings emphasize the need for timely interventions to improve health and learning outcomes for all children. These interventions may include mandatory vision screenings, increased parental education, and enhanced follow-up care. Further research is necessary to identify and address specific barriers contributing to these disparities.

Keywords

Pediatrics, Ophthalmology, Preventative Medicine, Vision Screening

1. Introduction

In light of research showing persistent health disparities among individuals of varying socioeconomic statuses, we are studying whether or not disparities can be seen in child vision screenings. Vision is a fundamental sense that, with impairment, can affect all aspects of an individual's life. Vision plays a crucial role in educational environments as well, and Ambrosino *et al*. (2023) indicated that enhanced visual acuity is linked to improved academic success [1]. Additionally, educational attainment—a key social determinant of health—provides long-term benefits that extend to overall health and health literacy, including eye health [1]. Addressing these disparities, especially in vision care, is essential to enhance the quality of life for individuals in socioeconomically disadvantaged groups.

In the United States, research by Elam *et al*. (2022) highlights a concerning association between low income, unemployment, and limited education with an increased risk of vision impairment (VI), blindness, and sudden vision loss. Children from families living below the federal poverty line are nearly twice as likely to experience VI compared to peers from families with incomes above 200% of the poverty level [2]. With the recent expansion of Medicaid, more access to these initial screenings is available but are underutilized in lower socioeconomic status families [2]. And because comprehensive eye examinations are often excluded from essential primary care services, many Americans tend to seek them only after serious problems and symptoms have developed [2]. Therefore, it is crucial to establish interventions that can reduce preventable causes of visual impairment in these socioeconomically disadvantaged groups, especially among children, where establishing adequate vision is vital [2].

Beyond socioeconomic status, other social determinants of health, such as geographic location and racial identity, contribute to barriers to accessing vision care. Elam *et al*. (2022) showed a significant correlation between the severity of vision loss and poverty, particularly in southern states where there is a high burden of vision impairment [2]. Ethnic and racial minority populations are also at greater risk for various forms of visual impairment and blindness as they age [2]. These disparities are further compounded by structural racism, which underscores that race is not a biological determinant of disease but rather a social construct influencing health outcomes [2]. The persistently higher prevalence of visual impairment in minority populations highlights a critical issue that requires further investigation and targeted interventions.

Early detection of visual impairments in children is essential for mitigating risk factors and enhancing overall quality of life [2]. It is recommended by the American Association of Ophthalmology (AAO) that children under 5 years of age should already have had their vision checked at least three times, once before their 12 months of life, again between 1 year and 3 years of life, and the third between 3 years and 5 years of life [3] [4]. It has also been established that multiple screenings achieve greater outcomes than one or none at all [1]. Since many visual impairments are asymptomatic in the early stages, early diagnosis can help prevent

potential deterioration if left untreated [1] [4].

The most common eye diagnoses in children include amblyopia, cataracts, strabismus, and refractive errors (myopia, hyperopia, and astigmatism). Amblyopia, often referred to as "lazy eye," is a condition where one or both eyes fails to achieve normal visual acuity, typically due to a lack of visual stimulation during critical developmental periods [5]. Early detection through screening is crucial because timely treatment, such as corrective lenses or eye patching, can improve outcomes [4] [5]. Cataracts, characterized by clouding of the lens, can even occur in infants and require surgical intervention if they significantly impair vision [6]. Strabismus, or misalignment of the eyes, not only affects depth perception but can also lead to amblyopia if left untreated [5]. In younger children, the main objective of screening is to detect the risk of developing amblyopia, while in older children, the focus shifts to detecting the risk of developing refractive errors [1] [4].

One effective and accessible method for conducting eye screenings in children is to implement them within the school setting. Only half of the states in the U.S. currently require eye screenings for preschool children, and the majority require screenings for elementary school-aged children [1]. It is estimated that 1 in 5 preschool children and 1 in 4 school-aged children in the United States have visual impairment, but fewer than 15% of preschoolers receive an eye exam by a healthcare professional, and fewer than 22% receive any type of vision screening [2]. In addition, research shows that after in-school screenings, under-resourced children have difficulty with follow-up referrals [1]. Although there are various screening methods available, a significant barrier to care is a lack of awareness about vision health [7]. As a result, any form of screening can be considered more beneficial than none at all. School-based vision programs (SBVP) can provide screenings, as well as eyeglasses, and increase rates of follow-ups after failed screenings [1].

Head Start is a federally subsidized program designed to provide quality childcare for vulnerable and socioeconomically disadvantaged children across the United States. Head Start primarily serves low-income families, although it also enrolls children from non-disadvantaged backgrounds [8] [9]. Because of this feature, Head Start enrollment is used in this study as a proxy for lower socioeconomic status due to its income-based eligibility criteria. In contrast to private daycare, which often relies on profit and prioritizes the needs of the paying families, Head Start is focused on school readiness and holistic development through a "whole child" model for at-risk children [8]. Head Start offers vital health services to every enrolled child, including annual immunizations, well-child checkups, dental exams, hearing screenings, and vision screenings, all provided if given parental consent. By recognizing the socioeconomic differences between Head Start and private daycare, we can leverage this distinction to examine disparities in health outcomes among children in America.

Numerous organizations have undertaken the vital task of screening children in daycare settings for early eye disease, with one of the most notable being Impact America: FocusFirst. FocusFirst offers free vision screenings to many children enrolled in Head Start programs as well as private daycare programs annually. When

a child receives a "failed screening," FocusFirst facilitates referrals to optometry or ophthalmology specialists for further evaluation [10].

2. Objectives

This study aims to examine the differences in vision screening failure rates between Head Start programs and private daycares, providing insights into the disparities in vision impairment associated with varying socioeconomic statuses. Given the existing gaps in research on visual impairment among preschool children of different backgrounds, our objective is to generate new information that highlights these disparities. Ultimately, this work seeks to raise awareness in clinical settings and stimulate discussions on how to address these inequalities in both educational and healthcare environments.

3. Methods

Data was gathered from all the Impact America: FocusFirst Program vision screenings completed in the Alabama counties of Bullock, Chambers, Lee, Macon, Russel, and Tallapoosa during the years 2019-2024. Volunteer vision screenings were held at each independent daycare using the Welch Allyn Spot cameras. The volunteer vision screeners varied in number anywhere from 1-6 screeners per school at a time. Children were individually screened at a time and usually done class by class until the school was complete.

The program employs specialized Welch Allyn Spot vision cameras that can detect not only vision deficits, as traditional charts do but also conditions such as amblyopia and cataracts, both common in young children. This method is time-efficient, requiring only 30 seconds to 1 minute per child on average to look and make eye contact with the camera, and demonstrates a high positive predictive value for identifying eye disorders in 3- and 4-year-olds [10]. Additionally, young children often struggle with visual acuity charts, leading to significantly higher completion rates of 87% with instrument-based vision screeners like the Welch Allyn Spot camera, compared to only 39% for chart-based screenings [11]. This camera is also recommended by the American Academy of Pediatrics (AAP) to detect pediatric eye disease, which is why Impact America: FocusFirst elects to use it as their method for vision screenings.

The total number of children screened was 9266 with 3143 children from Head Start programs and 6123 children from private preschools and daycares. Private preschools screened included for-profit, non-profit, and faith-based preschools with the majority of schools screened being non-profit or faith-based. Inclusion criteria consisted of preschool-aged children (typically ages 3 - 5) who attended daycare facilities in central Alabama. Consent forms were obtained from the parents prior to the day of screenings. Children whose parents did not provide consent were excluded from the screenings, usually only 0 - 3 students per school. The data was stratified into failure rates among Head Start (HS) program children (public) and private daycare children (See **Table 1**).

Table 1. Pediatric vision screening failure rates in eastern Alabama counties from 2019-2024: head start vs. private daycare centers.

Year	County	SCREENED	FAILED	% FAILED	HS SCREENED	HS FAILED	% HS FAILED	PRIVATE SCREENED	PRIVATE FAILED	% PRIVATE FAILED
2019-2020	BULLOCK	92	19	20.65%	59	13	22.03%	33	6	18.18%
	CHAMBERS	449	52	11.58%	209	33	15.79%	240	19	7.92%
	LEE	872	99	11.35%	332	38	11.45%	540	61	11.30%
	MACON	211	42	19.91%	115	30	26.09%	96	12	12.50%
	RUSSELL	470	56	11.91%	56	9	16.07%	414	47	11.35%
	TALLAP.	389	33	8.48%	153	17	11.11%	236	16	6.78%
2020-2021	BULLOCK	30	3	10.00%	30	3	10.00%	0	0	0.00%
	CHAMBERS	144	13	9.03%	0	0	0.00%	144	13	9.03%
	LEE	605	53	8.76%	177	23	12.99%	428	30	7.01%
	MACON	22	3	13.64%	22	3	13.64%	0	0	0.00%
	RUSSELL	340	21	6.18%	46	2	4.35%	294	19	6.46%
	TALLAP.	267	16	5.99%	0	0	0.00%	267	16	5.99%
2021-2022	BULLOCK	40	4	10.00%	40	4	10.00%	0	0	0.00%
	CHAMBERS	271	36	13.28%	134	21	15.67%	137	15	10.95%
	LEE	581	70	12.05%	190	27	14.21%	391	43	11.00%
	MACON	93	17	18.28%	73	13	17.81%	20	4	20.00%
	RUSSELL	367	38	10.35%	49	5	10.20%	318	33	10.38%
	TALLAP.	207	25	12.08%	86	14	16.28%	121	11	9.09%
2022-2023	BULLOCK	121	9	7.44%	34	2	5.88%	87	7	8.05%
	CHAMBERS	221	28	12.67%	160	21	13.13%	61	7	11.48%
	LEE	724	70	9.67%	162	15	9.26%	562	55	9.79%
	MACON	152	21	13.82%	125	15	12.00%	27	6	22.22%
	RUSSELL	38	5	13.16%	38	5	13.16%	0	0	0.00%
	TALLAP.	206	35	16.99%	125	26	20.80%	81	9	11.11%
2023-2024	BULLOCK	132	21	15.91%	47	10	21.28%	85	11	12.94%
	CHAMBERS	356	35	9.83%	157	15	9.55%	199	20	10.05%
	LEE	1182	95	8.04%	218	29	13.30%	964	66	6.85%
	MACON	233	45	19.31%	154	38	24.68%	79	7	8.86%
	RUSSELL	128	8	6.25%	38	2	5.26%	90	6	6.67%
	TALLAP.	323	44	13.62%	114	27	23.68%	209	17	8.13%

To estimate the proportion of children failing screenings each year from 2019 to 2024, we utilized sample proportions for both Head Start and private daycare participants by county. We employed Pearson Chi-square tests to assess the association between the type of childcare center (Head Start vs. private) and the failure rates within each county. To quantify the degree of association, we calculated odds ratios and 95% confidence intervals. To obtain a pooled estimate across the counties, we applied Cochran-Mantel-Haenszel statistics, also calculating the corre-

sponding 95% confidence intervals. All statistical analyses and graphical representations were performed using SAS 9.4 software.

4. Results

After pooling data from the years 2019-2024, there is a consistent pattern of higher odds of failure for children within Head Start centers compared to odds of failure for children within private centers across multiple counties. Statistical significance was observed for Chambers, Lee, Macon, and Tallapoosa counties. To produce one overall estimate of association, we employed the Cochran-Mantel-Haenszel procedure. The procedure indicated a statistically significant association ($p < 0.0001$) between type of center and failure rate, with the odds of failure given a child attends a Head Start Center being 1.59 times greater than the odds of failure given the child attends a private center, controlling for county (See Table 2). We are 95% confident that the true odds ratio is between 1.38 and 1.82 (See Table 2 and Figure 1).

Table 2. Sample proportions and odds ratios by county.

	Failure Percent				
County	Head Start	Private	Odds Ratio	95% Confidence Interval	p-value
Bullock	15.24%	11.71%	1.36	(0.77, 2.39)	0.2986
Chambers	13.64%	9.48%	1.51	(1.09, 2.09)	0.0132
Lee	12.23%	8.84%	1.44	(1.15, 1.80)	0.0014
Macon	20.25%	13.06%	1.68	(1.08, 2.65)	0.0207
Russell	10.13%	9.41%	1.09	(0.68,1.75)	0.7350
Tallapoosa	17.57%	7.55%	2.61	(1.86, 3.67)	<0.0001
Overall	14.64%	9.08%	1.59*	(1.38,1.82)*	<0.0001*

*Estimated using the Cochran-Mantel-Haenszel procedure.

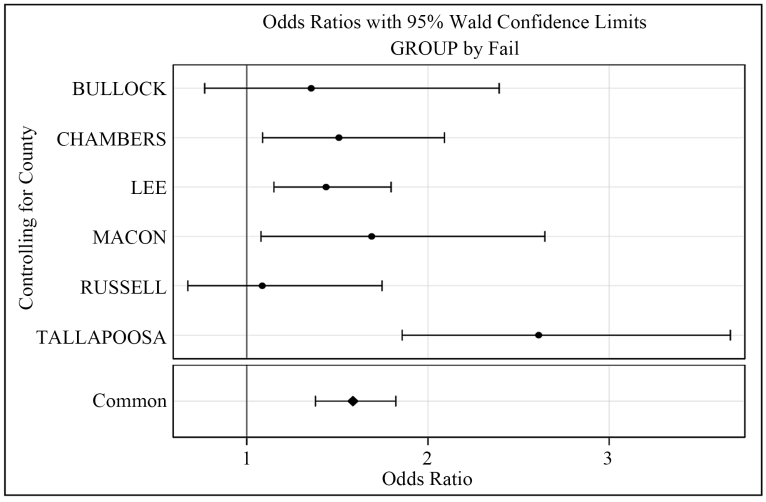

Figure 1. Each county's odds ratio and confidence intervals of failed vision screening rates in Head Start programs compared to private programs. Russell and Tallapoosa Counties were not statistically significant. The overall "Common" odds ratio was found to be 1.59.

5. Discussion

The data indicated that four out of the six counties measured exhibited a statistically significant difference in failed vision screening rates between public and private daycares. In these four counties, children attending public daycares had a higher rate of failed vision screenings than their peers in private daycares. Bullock and Russell Counties were the only two counties that did not show significant differences in failure rates.

These findings emphasize the need for further research to explore the underlying factors contributing to the disparities in failure rates between public and private centers. A variety of influences could account for these differences, including socioeconomic, genetic, or geographic factors [2] [6] [7] [12]-[14]. Understanding these variables is essential for developing targeted interventions. Additional studies should investigate these potential causes to provide a deeper understanding.

Genetic predispositions can play a significant role in children's vision health, with common hereditary conditions such as amblyopia, strabismus, or even pediatric cataracts affecting visual acuity [6] [15]. Understanding how these genetic factors interact with environmental influences, such as socioeconomic status and access to healthcare, is crucial for developing targeted interventions. Further research is needed to clarify these interactions and pinpoint specific genetic risk factors affecting vision health. Once at-risk groups are identified, targeted screenings can facilitate earlier interventions, helping to prevent long-term damage.

Previous research has highlighted the impact of socioeconomic factors on children's vision [2] [7]. If socioeconomic status plays a crucial role, it is imperative to identify specific barriers to healthcare access, nutrition, and education that may affect children early on. For instance, is the primary issue limited access to regular eye exams for children in lower socioeconomic brackets, specific nutritional deficiencies impacting eye health, or both? Additionally, if socioeconomic status is indeed a primary driver of the observed differences, it raises important questions about the specific age at which these effects begin to manifest in children. Identifying the critical development windows for intervention could be a key to preventing long-term vision issues. Also, children from less affluent communities are more likely to have underdiagnosed sight-threatening ocular diseases despite enrollment in services like Medicaid [2]. Thus, identifying the lack of access or lack of education for parents to screen their children is a question that needs to be addressed [2]. Longitudinal studies in which children are tracked over time would help elucidate how vision health evolves in relation to socioeconomic status, providing insight into effective preventative strategies.

Geographic factors could also contribute to the results of this study [13] [14]. It is well established that in the Southern United States, poorer health outcomes are often linked to cultural influences, increased poverty, and limited access to healthcare resources in rural areas. Moreover, the Southern United States has higher rates of chronic diseases, such as obesity and diabetes. The interplay of these factors may contribute to the failure rates observed in our study and war-

rants further investigation in a comparative analysis of failure rates in children across different regions of the United States.

Identifying these issues early provides a vital opportunity for intervention before children enter the school system. Currently, many screening programs are not mandatory and rely on volunteer participation. According to a 2021 analysis of state vision screening requirements in the United States, only half (n = 26) of US states require vision screening for preschool-aged children [1]. Across states, there is also marked variation in the mandated screening methods, screening criteria, settings in which screenings occur, age/grade levels screened, and reporting requirements [1]. By implementing mandatory screening programs and educational initiatives in public centers, we can proactively address these disparities. Additionally, collaborating with community organizations can strengthen support systems for families, ensuring that children receive comprehensive care. Tackling these disparities is not only essential for educational equity but also crucial for the overall well-being and future success of these children.

6. Conclusions

This study utilized FocusFirst vision screenings conducted in east-central Alabama from 2019 to 2024 and found that children attending publicly funded daycares had a higher rate of failed vision screenings compared to their peers in private daycares. While the underlying reasons for this disparity are not fully understood, existing literature suggests that socioeconomic factors likely play a significant role. These findings highlight the need for further investigation into the complex interplay of factors affecting vision health in children. Additionally, it is crucial to explore the issue of parental education regarding the importance of screening. Future research should focus on whether the lack of awareness among parents, logistical challenges with follow-up appointments, limited access to resources or finances, or a combination of factors contributes to this problem. Additionally, the lack of statistical significance in Bullock and Russell counties raises questions about regional differences that warrant exploration. This could likely be due to several factors such as differences in sample size, demographic differences, presence of local health programs, or differences in preschool types.

This study underscores the importance of early detection and intervention in addressing vision issues among children in publicly funded daycare programs. Implementing mandatory screening initiatives and better community support systems can better ensure that every child has the opportunity to thrive early on.

This study has several limitations that should be acknowledged. First, user error with the screening cameras can affect results. Common issues include camera shaking while attempting to focus on the child, inadequate lighting that prevents proper eye dilation, and positioning challenges that lead to discomfort for the child. These factors can contribute to false positive results of failure in vision screening. To mitigate this, FocusFirst recommends that users conduct multiple screening attempts to ensure that results are not compromised by user error. Sec-

ond, not all children in the participating schools are screened, which can lead to variability in sample sizes across different schools and counties, as well as between public and private facilities. Reasons for this include absenteeism due to being sick, lack of cooperation from the child, or parental opt-out decisions. Typically, absenteeism would not be many students per school (usually less than 5 per school), but could vary between the sizes of the schools screened at. To mitigate this limitation, if due to parental consent, parents should be educated and provided with the chance to have their inquiries answered on the process. A third limitation involves the inherent efficacy of the camera in detecting eye conditions. While the device boasts a high rate of accuracy, it is not infallible; some children may receive false positives or false negatives in their screening results. Again, this is the reason why FocusFirst uses the protocol of screening each failed result a second time to make sure that the first one was not a mistake. Lastly, the age range of children screened varied from 2 to 5 years, and the data were not stratified by age. This oversight limits our ability to analyze whether differences in failure rates are influenced by age-related factors. A future study could tackle this by stratifying the results by age to see if age plays a factor in the rates of failed vision screenings in these children.

Acknowledgements

Thanks to Impact America: FocusFirst for supplying the data of their vision screenings of east-central Alabama.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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