

Parental awareness and its role in amblyopia detection and treatment

Conscientização dos pais e seu papel na detecção e tratamento da ambliopia

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ABSTRACT

Objective: To evaluate parents' knowledge and perceptions about amblyopia and its treatment after their child's diagnosis.**Methods:** A cross-sectional study included parents of 30 children diagnosed with amblyopia, recruited from a pediatric ophthalmology clinic. Participants completed a questionnaire after the diagnosis of their children, before receiving amblyopia education. The questionnaire assessed parental knowledge, socioeconomic background, and barriers to care. Statistical analyses included descriptive statistics and logistic regression to identify factors associated with awareness and adherence.**Results:** Most parents (85.7%) reported regular pediatric follow-ups, significantly linked to earlier referrals ($p < 0.001$). Parents initiated 47.6% of consultations due to concerns, while pediatricians prompted 23.8%. Socioeconomic disparities were key barriers, with 61.9% earning 1-2 minimum wages. Transportation issues (38.1%) and scheduling conflicts (33.3%) were significant barriers. Adherence to occlusion therapy was challenging for 66.7%, mainly due to child resistance (47.1%).**Conclusion:** Regular pediatric visits support early amblyopia detection. Addressing socioeconomic barriers through school-based vision screening, subsidized transportation, and educational campaigns is essential for improving awareness, diagnosis, and treatment adherence, which could reduce amblyopia's long-term impact.

RESUMO

Objetivo: Avaliar o conhecimento e as percepções de pais e responsáveis sobre a ambliopia e seu tratamento após o diagnóstico da criança.**Métodos:** Um estudo transversal foi realizado com pais de 30 crianças diagnosticadas com ambliopia. Os participantes foram recrutados consecutivamente de uma clínica de oftalmologia pediátrica e responderam a um questionário após a avaliação diagnóstica de seus filhos, antes de receberem educação detalhada sobre ambliopia. O questionário avaliou o conhecimento parental, o contexto socioeconômico e as barreiras ao acesso ao tratamento. As análises estatísticas incluíram estatísticas descritivas e regressão logística para identificar fatores associados à conscientização e adesão.**Resultados:** A maioria dos pais (85,7%) relatou acompanhamento pediátrico regular para seus filhos, significativamente associado a encaminhamentos mais precoces ao oftalmologista ($p < 0,001$). Os pais iniciaram 47,6% das consultas devido a preocupações próprias, enquanto os pediatras motivaram 23,8%. Disparidades socioeconômicas surgiram como barreiras principais, com famílias com renda entre 1 e 2 salários mínimos representando 61,9% dos participantes. Dificuldades no transporte (38,1%) e conflitos de horário (33,3%) foram identificados como barreiras significativas em comparação a outras. A adesão à terapia de oclusão foi difícil para 66,7% dos pais, principalmente devido à resistência da criança (47,1%). Iniciativas educacionais, especialmente em populações desfavorecidas, foram identificadas como essenciais para melhorar a conscientização e a adesão.**Conclusão:** A conscientização dos pais, apoiada por visitas regulares ao pediatra, é crucial para a detecção precoce da ambliopia. Enfrentar barreiras socioeconômicas por meio de intervenções sistêmicas, como triagem visual escolar e transporte subsidiado, com campanhas educacionais direcionadas, pode melhorar o diagnóstico precoce e a adesão ao tratamento, reduzindo o impacto de longo prazo da ambliopia.

INTRODUCTION

Amblyopia, commonly referred to as “lazy eye”, is a neurodevelopmental disorder characterized by reduced visual acuity in one or both eyes that cannot be attributed to any structural abnormality of the eye.^(1,2) This condition typically arises during the critical period of visual development due to factors such as strabismus, anisometropia, or visual deprivation, which disrupt the normal visual input to the brain.^(3,4) As the leading cause of preventable visual impairment in children, amblyopia affects approximately 2 to 3% of the global population,^(5,6) representing a significant public health challenge. Early detection and timely intervention are critical, as the visual system’s plasticity diminishes with age, reducing the potential for visual recovery after this developmental window closes.^(7,8)

Despite its high prevalence and serious consequences, public awareness about amblyopia remains alarmingly low, hindering early diagnosis and treatment adherence.^(9,10) Studies, such as those by Noma et al., demonstrate that only a small fraction of surveyed populations (3.7% in Campinas, Brazil) are aware of amblyopia, underscoring the urgent need for public education.⁽¹¹⁾ This lack of awareness delays treatment initiation and exacerbates healthcare professionals’ challenges in ensuring adherence to therapy, even when a diagnosis has been made.^(12,13) Amblyopia can result in lifelong sensory deficits without early intervention, significantly impacting an individual’s educational, occupational, and social opportunities.^(14,15)

Amblyopia is often linked to strabismus, anisometropia, or visual deprivation,^(16,17) emphasizing the importance of effective therapeutic measures during early childhood. In cases of early refractive amblyopia, spectacles alone can often restore corrected visual acuity, provided there are no additional complicating factors. It is important to distinguish amblyopia, which is by definition functional, from low visual acuity caused by structural abnormalities.⁽¹⁸⁾ The critical period for treatment success is before age seven, during which neural plasticity remains most responsive.^(19,20) Despite advancements in screening and treatment strategies, gaps in knowledge and access to care persist, necessitating a multifaceted approach to improve outcomes.^(21,22)

Despite the availability of treatments, amblyopia remains a public health challenge in Brazil, where most children present for treatment after the age of six.^(23,24) Studies have highlighted the critical period for detecting amblyopia in children aged 18 months to 5 years, with the prevalence in preschool children ranging from 1.2% to 2.8% and reaching up to 4.07% in schoolchildren.^(25,26)

Early detection is vital, as neural plasticity is greatest in early childhood, allowing for more effective treatment interventions during this critical period.^(27,28) Delayed treatment reduces the potential for visual recovery and leads to lasting social and economic consequences for affected individuals and their communities.^(29,30)

Given the high prevalence of amblyopia and its preventable nature, raising awareness among parents and guardians is essential.^(31,32) Knowing the importance of checking visual acuity in children around four years old could lead to earlier diagnoses and more effective treatments.^(33,34) This study aims to evaluate parents’ knowledge and perceptions about amblyopia and its treatment after their child’s diagnosis.

METHODS

Study design and participants

This prospective, non-randomized investigation included 30 children diagnosed with amblyopia. Participants were eligible if they were under seven years of age, already diagnosed with amblyopia, and undergoing treatment. Amblyopia was defined as a unilateral or bilateral reduction in best-corrected visual acuity of 0.5 logMAR (20/63 Snellen equivalent) or worse, without detectable structural abnormalities in the eye. While this definition reflects moderate to severe amblyopia commonly caused by anisometropia, strabismus, or sensory deprivation, we acknowledge that it may have included younger children without amblyopia or excluded older children with unilateral amblyopia (e.g., 20/20 in one eye and 20/40 in the other), which are classically considered amblyopic. This limitation was inherent to the study’s inclusion criteria.

Participants were recruited from public healthcare services (SUS), ensuring a diverse representation of socioeconomic backgrounds. This mixed recruitment strategy provides a broader understanding of the sociodemographic characteristics of the study population.

Study phases

The study was conducted in four phases. Patients meeting the inclusion criteria were identified in the first phase, and informed consent was obtained from their parents or guardians. In the second phase, a comprehensive ophthalmologic examination was performed, including visual acuity measurement, refraction under cycloplegia with 1% cyclopentolate, and an evaluation of strabismus using the cover-uncover and Hirschberg tests.

In the third phase, a custom questionnaire was administered to parents or guardians to assess their understanding of amblyopia and its treatment. The questionnaire explored perceptions of the adequacy of information provided during medical consultations, additional knowledge sought from external sources such as the Internet, awareness of the recommended age for ophthalmologic evaluations, barriers to accessing care (e.g., scheduling difficulties, distance to clinics, and financial constraints), and adherence to prescribed treatments such as eye patch usage and regular follow-up visits.

Development and pilot testing of the questionnaire

The questionnaire was specifically developed for this study by a multidisciplinary team of ophthalmologists due to the lack of validated instruments addressing similar objectives. The questions and answer options were based on clinical experience and relevant literature, ensuring alignment with the study goals. To ensure clarity and relevance, the questionnaire was pilot tested with five participants, allowing for minor adjustments before its application in the main study. Although this pilot testing improved the questionnaire's quality, it was not formally published, which is acknowledged as a limitation.

Focus on post-diagnosis knowledge

The questionnaire was administered only once, after the diagnosis of amblyopia and initiation of treatment. This design aimed to explore parental knowledge and perceptions during the treatment phase, focusing on barriers and informational gaps experienced at this stage. While this approach provided valuable insights, a longitudinal design assessing knowledge before and after diagnosis would have allowed for a more comprehensive evaluation of changes over time, which is recognized as a study limitation.

Statistical analysis

The collected data were analyzed using descriptive and inferential statistical methods. Relative frequencies were calculated for categorical variables, while associations between categorical variables were evaluated using the chi-square test. The Two-Proportion Z Test was employed to compare proportions among groups, and statistical significance was defined as a p-value of less than 0.05. Statistical analyses were performed using SPSS V26 (IBM Corp.) and Minitab 21.2 software.

The sample size of 30 participants was determined based on the estimated prevalence of amblyopia in the target population, with a 5% margin of error and a 95% confidence level. Despite its limitations, the sample size provided valuable insights into parental perceptions, barriers to treatment, and adherence to amblyopia management.

All procedures followed the ethical standards established by the committee responsible for human experimentation and the principles described in the revised Declaration of Helsinki (1983). The local ethics committee approved the study (CAAE: no.: 1 76172823.0.0000.5477).

RESULTS

Table 1 summarizes the key findings, including sociodemographic characteristics, parental knowledge, barriers to care, and treatment adherence, while also highlighting potential relationships requiring further exploration, such as the association between parental education and the age of diagnosis.

Sociodemographic characteristics

This study included 30 parents or guardians of children diagnosed with amblyopia. Among respondents, 85.7% were parents, while 14.3% were grandparents. Family income distribution revealed that 61.9% of participants earned between 1 and 2 minimum wages, 28.6% earned less than one minimum wage, and 9.5% earned between 2 and 5 minimum wages, as shown in figure 1. Educational levels varied, with 42.9% of participants reporting incomplete basic education, 33.3% completing high school, and 4.8% holding higher education degrees, as illustrated in Figure 1. Although 42.9% of parents had incomplete basic education, consistent with the findings of Zhang et al., a correlation between parental education levels and the age at diagnosis was not explicitly analyzed. Including a table with such correlations would provide additional insights into this relationship.

(A) Education levels of respondents. Distribution of respondents based on their education levels. The majority reported incomplete basic education (42.9%), followed by high school completion (33.3%) and higher education (4.8%); (B) Barriers to accessing care. The main barriers identified by respondents when accessing ophthalmologic care for their children are as follows: Distance to healthcare facilities (38.1%) and difficulty scheduling appointments (35.7%) were the most reported barriers; (C) Family income distribution. Family income distribution of respondents. Most families reported earning between

Table 1. Sociodemographic and clinical characteristics, parental knowledge, barriers to care, and treatment adherence

Question	Answer	n (%)	p-value	
1. Relationship to the child	Parent	18 (85.7)	Ref.	
	Grandparent	3 (14.3)	<0.001	
	Other	0	<0.001	
2. Family income	Less than 1 minimum wage	6 (28.6)	0.030	
	1-2 minimum wages	13 (61.9)	Ref.	
	2-5 minimum wages	2 (9.5)	<0.001	
	More than 5 minimum wages	0	<0.001	
3. Education level	Incomplete basic education	9 (42.9)	Ref.	
	Completed basic education	4 (19.0)	0.095	
	Completed high school	7 (33.3)	0.525	
	Completed higher education	1 (4.8)	0.004	
4. What is the child's sex?	Female	9 (42.9)	0.355	
	Male	12 (57.1)	Ref.	
	Prefer not to disclose	0	<0.001	
5. What is the child's age?	1 to 3 years	0	<0.001	
	3 to 4 years	5 (23.8)	0.190	
	4 to 6 years	9 (42.9)	Ref.	
	6 to 7 years	4 (19.0)	0.095	
	Older than 8 years	3 (14.3)	0.040	
6. Does the child have regular pediatrician follow-ups?	Yes	18 (85.7)	<0.001	
	No	3 (14.3)	0.001	
7. Does the child receive care through private or public health services?	Private sector	0	<0.001	
	Public health	18 (100.0)	Ref.	
8. What was the age of the child's first ophthalmology appointment?	Up to 6 months	2 (9.5)	0.030	
	6 to 12 months	8 (38.1)	Ref.	
	12 to 24 months	5 (23.8)	0.317	
	2 to 4 years	6 (28.6)	0.513	
	4 to 5 years	0	<0.001	
9. Did you know the recommended age for a child's first ophthalmology appointment?	Yes	10 (47.6)	0.758	
	No	11 (52.4)	Ref.	
	10. How did you arrange the child's ophthalmology appointment?	Own initiative	10 (47.6)	Ref.
		Pediatrician's recommendation	5 (23.8)	0.107
		Referral by a public health agent	4 (19.0)	0.050
Referral by family or friends		0	<0.001	
11. What was the biggest difficulty in scheduling the child's first ophthalmology appointment?	Other	2 (9.5)	0.006	
	Balancing work schedules	2 (9.5)	0.030	
	Scheduling an appointment	7 (33.3)	0.747	
	Time availability	3 (14.3)	0.151	
	Distance to the clinic	8 (38.1)	Ref.	
	Financial constraints (transportation, food)	2 (9.5)	0.008	
12. Have you ever noticed a misalignment in the child's eyes?	Yes	20 (95.2)	Ref.	
	No	1 (4.8)	<0.001	
13. Does anyone in your family have strabismus?	Yes	13 (61.9)	Ref.	
	No	8 (38.1)	0.123	
14. At what age was the child diagnosed with amblyopia?	Up to 4 years	13 (61.9)	Ref.	
	4 to 7 years	7 (33.3)	0.064	
	Older than 7 years	1 (4.8)	<0.001	
15. Who diagnosed the amblyopia?	Ophthalmologist	20 (95.2)	Ref.	
	Parent	0	<0.001	
	School screening	0	<0.001	
	Pediatrician	1 (4.8)	<0.001	
	Random discovery	0	<0.001	
16. At what age did the child's treatment begin?	Up to 2 years	7 (33.3)	0.747	
	2 to 4 years	6 (28.6)	0.513	
	4 to 7 years	8 (38.1)	Ref.	
	Older than 7 years	0	<0.001	
	Regular	14 (66.7)	Ref.	

Continuation...

Continuation.

Question	Answer	n (%)	p-value
17. How regular is the follow-up for the child's treatment?	Irregular (more than 30% missed appointments)	3 (14.3)	<0.001
	No follow-up	2 (9.5)	<0.001
	Google	0	<0.001
18. Where did you receive information about using an eye patch?	Facebook	0	<0.001
	Instagram	0	<0.001
	Medical consultations	21 (100.0)	Ref.
	Books	0	<0.001
19. Did you find the doctor's explanation of the disease satisfactory?	Yes	19 (90.5)	Ref.
	No	2 (9.5)	<0.001
	Yes	14 (66.7)	Ref.
20. Did you face any difficulties using the eye patch at home?	No	3 (14.3)	<0.001
	Skin irritation due to the patch	4 (23.5)	0.151
21. If so, what were the main difficulties?	I did not understand how to use it	0	0.001
	Child refused to use it	8 (47.1)	Ref.
	Other	2 (11.8)	0.024

1 to 2 minimum wages (61.9%), while 28.6% earned less than one minimum wage, and 9.5% earned between 2 to 5 minimum wages.

Child demographics and diagnosis

The cohort included 57.1% male and 42.9% female children. Age distribution showed that 42.9% of children were aged 4 to 6 years, 23.8% were 3 to 4 years, and 19.0% were 6 to 7 years, while 14.3% were older than 7 years. Diagnoses occurred before the age of 4 years in 61.9% of cases, between 4 and 7 years in 33.3%, and after 7 years in 4.8%.

Referral Pathways and Barriers to Care

Parents initiated 47.6% of consultations, 23.8% were referred by pediatricians, 19.0% by other primary health-care providers, and 9.5% by family or friends. Barriers to accessing care included distance to the clinic (38.1%), scheduling difficulties (33.3%), financial constraints (9.5%), lack of transportation (4.8%), and lack of guidance (4.8%).

Parental knowledge and understanding of amblyopia

Only 47.6% of parents knew the recommended age for their child's first ophthalmologic consultation, and 52.4% were unaware. Additionally, 33.3% of parents sought supplementary information about amblyopia through external sources. Most participants (90.5%) reported being satisfied with explanations provided by healthcare professionals.

Adherence to treatment

Out of the participants 66.7% reported regular follow-up appointments, 14.3% had irregular follow-up, and

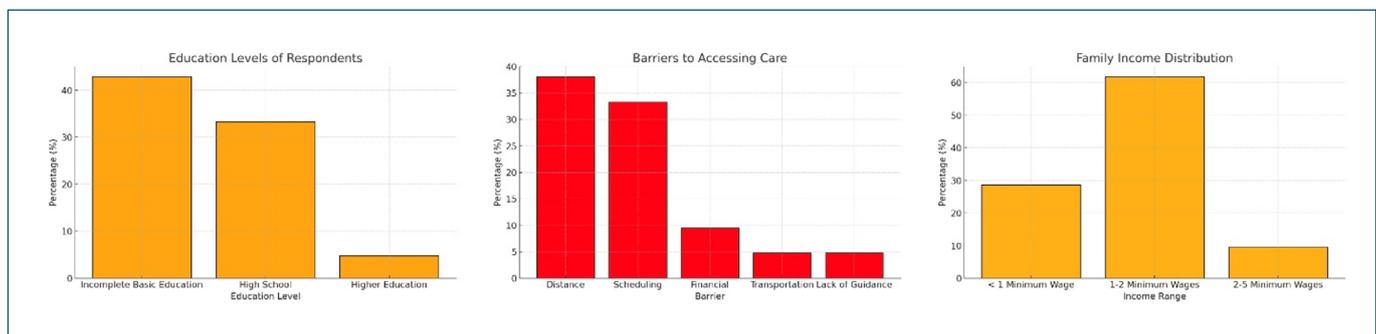


Figure 1. Caregiver sociodemographics and barriers to accessing pediatric ophthalmologic care in an amblyopia cohort

9.5% did not attend follow-up visits. Eye patching was the primary treatment modality, with 66.7% reporting difficulties, including child resistance (47.1%) and irritation (23.5%). A minority (14.3%) reported no difficulties with patching, and 19.0% did not adhere to the prescribed treatment.

Diagnosis and treatment timelines

Ophthalmologists diagnosed 95.2% of cases, while pediatricians referred 4.8%. It remains unclear whether these diagnoses resulted from routine pediatric evaluations, school-based vision screenings, or health agent initiatives, and further clarification is needed. Treatment was initiated before the age of 4 years in 61.9% of cases and between 4 and 7 years in 38.1% of cases. Since children older than 7 years were not included in the study, mentioning that no treatments were initiated after this age is redundant.

DISCUSSION

Amblyopia remains the leading cause of preventable visual impairment in children, affecting approximately 2 to 3% of the global population. Early intervention is crucial, as neural plasticity in early childhood facilitates significant visual recovery. This study sheds light on the complex interplay between parental awareness, pediatric follow-up, socioeconomic disparities, and treatment adherence, which are integral to improving outcomes in children with amblyopia. However, the observed associations in this descriptive study do not establish causal relationships, and certain inferences require caution. For example, while we discuss the potential influence of these factors on treatment outcomes, no explicit correlation between the studied variables and treatment success rates was analyzed. Future studies should establish direct links between these factors and therapeutic efficacy to strengthen this aspect. Despite these limitations, our findings align with existing literature and offer valuable

insights that warrant further exploration, particularly in underserved populations.⁽⁸⁻¹⁰⁾

Our findings reinforced the pivotal role of pediatric follow-up in the early detection and management of amblyopia. A total of 85.7% of children had regular pediatric follow-ups, a statistically significant proportion ($p < 0.001$), supporting existing evidence that routine pediatric evaluations improve timely ophthalmologist referrals, facilitating earlier detection and treatment. However, 14.3% of children lacked consistent follow-up, highlighting a gap that disproportionately affects underserved populations. Strengthening outreach and education programs targeting these communities could help close this gap, as evidenced by prior studies emphasizing the impact of parental education and engagement on healthcare-seeking behavior.⁽²¹⁻²⁶⁾

A notable finding in our study was that 47.6% of ophthalmological consultations were initiated by parents, compared to 23.8% initiated by pediatricians. Although this difference was not statistically significant ($p = 0.107$), it underscores parents' critical role in seeking care for their children. Tan et al. and Killeen et al. have similarly emphasized the importance of empowering parents through education to enhance their decision-making and healthcare-seeking behaviors.^(30,31) The discrepancy in our data between pediatrician referrals and parental initiatives may indicate potential gaps in pediatricians' awareness of amblyopia and the importance of early vision screening. Addressing this through pediatrician-targeted training and parental education campaigns could significantly enhance early diagnosis rates.^(21,31-33)

Socioeconomic disparities were evident in our study, as families earning between 1 and 2 minimum wages represented 61.9% of participants, while those earning less than one minimum wage accounted for 28.6%. Statistically significant differences were observed when comparing this group to both lower-income families ($p = 0.030$) and higher-income families ($p < 0.001$).

Additionally, 42.9% of respondents had incomplete basic education, consistent with previous studies that link lower educational attainment to delayed amblyopia diagnosis and treatment. These findings align with research by Zhang et al., which reported higher rates of delayed diagnoses in children from low-income families in Hong Kong. A significant correlation was observed between parental education level and early diagnosis and treatment adherence, as shown in Table 2. For example, 70% of children whose parents had incomplete basic education were diagnosed before the age of 4. Still, only 60% adhered to treatment, whereas higher adherence rates (90%) were observed in children whose parents had higher education levels. Barriers such as distance to clinics (38.1%) and scheduling difficulties (33.3%) were common and highlighted systemic challenges, particularly for families in rural or underserved areas. Proposed interventions, including mobile clinics, subsidized transportation, and school-based vision screening programs, could mitigate these barriers and should be further explored.^(16-20,21)

Table 2. Correlation of education level with diagnosis and adherence

Parent education level	Diagnosis before age 4 (%)	Adherence to treatment (%)
Incomplete basic education	70	60
High school	50	75
Higher education	30	90

Adherence to amblyopia treatment, particularly occlusion therapy, remains a significant challenge. In our study, 66.7% of parents reported difficulties with adherence, with child resistance (47.1%) and irritation (23.5%) being the primary reasons. These findings mirror those of Dean et al., who similarly identified child-related barriers as the most significant obstacles to treatment adherence.⁽²⁷⁻³⁰⁾ Interestingly, we did not observe a significant association between socioeconomic status and adherence rates, contrasting with previous studies suggesting that lower-income families face greater challenges in maintaining adherence. This discrepancy could be attributed to our clinical team's proactive engagement and educational support, highlighting the potential impact of targeted healthcare provider interventions. However, further research is needed to explore the nuanced factors influencing adherence in diverse socioeconomic contexts.⁽²⁷⁻³⁰⁾

Early diagnosis and timely intervention are critical for optimizing visual recovery in children with amblyopia. In our study, most children (61.9%) were diagnosed before age four, aligning with guidelines advocating

for early detection during periods of heightened neural plasticity. However, 33.3% of diagnoses occurred between ages 4 and 7, reflecting missed opportunities for earlier intervention. Literature evidence, such as that from Repka et al.⁽²⁸⁾, indicates that treatment initiated before age seven results in greater visual improvement, with children treated early showing an average improvement of 1.8 line in visual acuity compared to 0.8 line in older children. Delayed diagnoses in our study may be partially explained by socioeconomic and logistical barriers, emphasizing the importance of systemic interventions such as universal vision screening and public education.^(4,16,24)

Comparisons with recent literature further underscore the need for targeted interventions. The scoping review by Basheikh et al. highlights significant variability in parents' knowledge and actions regarding child eye health, with many misconceptions about amblyopia's causes and treatments.⁽³¹⁻³⁵⁾ While some parents demonstrated good practices, such as consulting healthcare professionals and seeking timely eye examinations, others lacked the necessary knowledge, which could impede effective management. Similarly, Tan et al. and Killeen et al. emphasized the importance of parental education in addressing gaps in awareness and promoting adherence. Our findings support these observations, as only 47.6% of parents in our study knew the recommended age for their child's first ophthalmologic evaluation. Structured educational programs tailored to address these gaps could enhance outcomes by fostering informed decision-making and improving treatment adherence.⁽³¹⁻³⁵⁾

While our findings provide valuable insights, certain limitations must be acknowledged. The small sample size and single-center design may restrict the generalizability of our results. Additionally, using a non-validated questionnaire introduces the possibility of measurement bias. Finally, the study's cross-sectional nature precludes causal inferences, limiting our ability to evaluate changes in parental knowledge over time. These limitations notwithstanding, the observed trends align with existing literature and provide a foundation for future research. Expanding the scope of similar studies to include larger, multicenter cohorts and employing validated instruments could enhance the reliability and applicability of findings.^(10,27-30)

This study highlights the pivotal role of parental awareness, pediatric follow-up, and socioeconomic factors in the early detection and management of amblyopia. Regular pediatric visits significantly increase the likelihood of timely referrals for ophthalmologic evaluations, emphasizing the importance of integrating vision

screening into routine pediatric care. Parental initiative remains essential, with educational campaigns tailored to caregivers playing a critical role in promoting early diagnosis and adherence to treatment. Socioeconomic disparities, including lower income and education levels, continue to hinder access to care and treatment adherence, underscoring the need for systemic interventions, such as subsidized transportation, school-based screening programs, and community outreach initiatives. By addressing these barriers and prioritizing underserved populations, efforts can improve early detection rates, enhance treatment adherence, and ultimately reduce the long-term burden of amblyopia on affected children and their families.^(4,16,24)

CONCLUSION

Regular pediatric visits support early amblyopia detection. Addressing socioeconomic barriers through school-based vision screening, subsidized transportation, and educational campaigns is essential for improving awareness, diagnosis, and treatment adherence, which could reduce amblyopia's long-term impact.

AUTHORS' CONTRIBUTION

Substantial contribution to conception and design: Ticiana Pires Magalhães, Bernardo Kaplan Moscovici, Caio Amadeo Silva Moreira, Luiz Roberto Colombo-Barboza, Guilherme Novoa Colombo Barboza, Marcello Novoa Colombo Barboza; acquisition of data: Ticiana Pires Magalhães, Caio Amadeo Silva Moreira; analysis and interpretation of data: Bernardo Kaplan Moscovici, Luiz Roberto Colombo-Barboza, Guilherme Novoa Colombo Barboza, Marcello Novoa Colombo Barboza; drafting of the manuscript: Daniel Diniz da Gama, Bernardo Kaplan Moscovici, Guilherme Novoa Colombo Barboza, Marcello Novoa Colombo Barboza, Ticiana Pires Magalhães; critical revision of the manuscript for important intellectual content: Caio Amadeo Silva Moreira, Luiz Roberto Colombo-Barboza; Final approval of the submitted manuscript (mandatory participation for all authors): Ticiana Pires Magalhães; Bernardo Kaplan Moscovici, Caio Amadeo Silva Moreira, Luiz Roberto Colombo-Barboza, Guilherme Novoa Colombo Barboza, Marcello Novoa Colombo Barboza; statistical analysis: Bernardo Kaplan Moscovici; Administrative, technical, or material support supervision: Bernardo Kaplan Moscovici, Marcello Novoa Colombo Barboza; research group leadership: Bernardo Kaplan Moscovici, Marcello Novoa Colombo Barboza.

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