

Understanding the Impact of Residual Amblyopia on Functional Vision and Eye-related Quality of Life Using the PedEyeQ



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- **PURPOSE:** To evaluate the effect of residual amblyopia on functional vision and eye-related quality of life (ER-QOL) in children and their families using the Pediatric Eye Questionnaire (PedEyeQ).
- **DESIGN:** Prospective cross-sectional study.
- **METHODS:** Seventeen children with residual amblyopia (no current treatment except glasses), 48 visually normal controls without glasses, and 19 controls wearing glasses (aged 8-11 years) completed the Child 5-11 year PedEyeQ. One parent for each child completed the Proxy 5-11 PedEyeQ, Parent PedEyeQ. Rasch-calibrated domain scores were calculated for each questionnaire domain and compared between amblyopic children and controls.
- **RESULTS:** PedEyeQ scores were significantly lower (worse) for children with residual amblyopia than for controls without glasses across all domains: Child PedEyeQ greatest mean difference 18 points worse on Functional vision domain (95% confidence interval [CI] -29 to -7 ; $P < .001$); Proxy PedEyeQ greatest mean difference 31 points worse on Functional vision domain (95% CI -39 to -24 ; $P < .001$); Parent PedEyeQ greatest mean difference 34 points worse on the Worry about child's eye condition domain (95% CI -46 to -22 ; $P < .001$). Compared with controls wearing glasses, PedEyeQ scores were lower for residual amblyopia on the Child Frustration/worry domain ($P = .03$), on 4 of 5 Proxy domains ($P \leq .05$), and on 3 of 4 Parent domains ($P \leq .05$).
- **CONCLUSIONS:** Residual amblyopia affects functional vision and ER-QOL in children. Parents of amblyopic children also experience lower quality of life. These data help broaden our understanding of the everyday-life impact of childhood residual amblyopia. (Am J Ophthalmol 2020;218:173–181. © 2020 Elsevier Inc. All rights reserved.)

AMBLYOPIA IS THE MOST COMMON CAUSE OF reduced monocular visual acuity (VA) in children, affecting between 0.8% and 5% of children in the United States,¹⁻³ and is associated with dysfunctions of accommodation, fixation, binocularity, vergence, reading speed, contrast sensitivity, and fine motor skills.⁴⁻¹⁴ Despite these well-documented effects of amblyopia on vision-related functioning, the everyday-life impact of amblyopia on a child and their family is poorly characterized. Most previous studies assess the impact of amblyopia treatment,¹⁵ but few have used eye-related or vision-specific instruments to evaluate the effects of amblyopia itself on children and their families. The aim of the present study was to assess the impact of residual amblyopia on eye-related quality of life (ER-QOL) and functional vision, comparing scores with visually normal children with and without glasses. We used the recently developed Pediatric Eye Questionnaire (PedEyeQ), developed to assess functional vision and eye-related quality of life (ER-QOL) in children with any eye condition, and also to assess the quality of life of parents of affected children.^{16,17} In addition, we evaluated the impact of residual amblyopia on general health-related quality of life (HRQOL) using the Pediatric Quality of Life Inventory (PedsQL).

METHODS

INSTITUTIONAL REVIEW BOARD APPROVAL FOR THIS PROSPECTIVE cross-sectional study was obtained from Institutional Review Boards at the Mayo Clinic, Rochester, Minnesota, USA and the University of Texas Southwestern Medical Center, Dallas, Texas, USA. All procedures and data collection were conducted in a manner compliant with the Health Insurance Portability and Accountability Act and all research procedures adhered to the tenets of the Declaration of Helsinki. Written informed consent and assent was obtained according to local institutional review board requirements. Consecutive eligible children with residual amblyopia were prospectively enrolled from pediatric ophthalmology outpatient clinics at a tertiary medical center (Mayo Clinic, Rochester, Minnesota, USA), and in research clinics (Retina Foundation of the Southwest, Dallas, Texas, USA)

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TABLE 1. Demographics of 8- to 11-Year-Old Children With Residual Amblyopia, Being Currently Treated With Glasses Alone, Visually Normal Controls Without Glasses, and Visually Normal Controls Wearing Glasses, Along With 1 Parent for Each Child

	Residual Amblyopia (N = 17)	Visually Normal Controls Without Glasses (N = 48)	Visually Normal Controls Wearing Glasses (N = 19)
Sex of child, n (%)			
Female	9 (53)	26 (54)	9 (47)
Median age, y	10	9	10
Race/ethnicity, n (%)			
White	13 (76)	31 (65)	11 (58)
Hispanic/Latino	1 (6)	2 (4)	2 (11)
Black/African American	2 (12)	2 (4)	0 (0)
Other	1 (6)	10 (21)	5 (26)
More than 1	0 (0)	2 (4)	1 (0)
Not reported	0 (0)	1 (2)	0 (0)
Visual acuity (logMAR): median (range)			
Amblyopic eye	0.4 (0.2 to 1.2)	NA	NA
Fellow eye	0.0 (-0.2 to 0.5)	NA	NA
Right eye	NA	0 (-0.2 to 0.1)	0 (-0.1 to 0.1)
Refractive error spherical equivalent: median (range)			
Amblyopic eye	+4.50 D (+0.88 D to +9.00 D)	NA	NA
Fellow eye	+1.63 D (-1.50 D to +7.88 D)	NA	NA
Right eye	NA	NA	+0.88 D (-2.88 D to +7.00 D)
Cause of residual amblyopia, n (%)			
Anisometropic	7 (41)	NA	NA
Strabismic	1 (6)	NA	NA
Combined mechanism	9 (53)	NA	NA

D = diopter; NA = not applicable

between December 2017 and October 2019. Subjects were identified in outpatient or research clinics, referred by friends or colleagues, or identified through a recruitment flyer. The few patients who declined participation did so primarily owing to lack of time to complete the questionnaires. For all included subjects VA was assessed in each eye using age-appropriate clinical tests (testing method not standardized).

• **CHILDREN WITH RESIDUAL AMBLYOPIA:** Seventeen children aged 8-11 years, with a current diagnosis of residual, unilateral amblyopia (strabismic, anisometropic, or combined mechanism) were prospectively enrolled. Residual amblyopia met the following criteria: (1) interocular VA difference of 2 or more logMAR lines (letter optotype values converted to logMAR); (2) amblyopic-eye VA below 20/25¹⁸; (3) a history of treatment with patching (n = 16), atropine (n = 5), binocular treatment (n = 7), vision therapy (n = 1), optical penalization (n = 1), or a combination of treatments (n = 10); (4) no treatment other than glasses for at least the past month (all other treatments having been discontinued). Any manifest strabismus was required to be <10 prism diopters by simultaneous prism cover test in refractive correction at distance and near (present in 5 of 17 [29%]). Significant coexistent eye disease was excluded (Table 1).

• **VISUALLY NORMAL CONTROLS:** Forty-eight 8- to 11-year-old children, with no glasses or other refractive correction, normal VA for age,¹⁸ and no eye condition or history of an eye condition (including strabismus), were enrolled as the primary control group. Thirty-four of these control subjects were reported in previous studies.¹⁹⁻²¹

• **GLASSES CONTROLS:** We defined a second control group of 19 children with normal VA for age but who were wearing glasses for refractive error. Since most children with residual amblyopia wear glasses, we thought it would be helpful to know whether the impact of residual amblyopia is different from the impact of glasses wear itself. All glasses controls had no eye disease other than refractive error, no previous eye treatment other than glasses, and no history of other eye problems. Fifteen of these glasses controls were reported in a previous study.²⁰

• **QUESTIONNAIRES:** All children completed the Child PedEyeQ and the Child PedsQL and 1 parent or legal guardian for each child completed the Proxy PedEyeQ, Parent PedEyeQ, Proxy PedsQL, and the PedsQL Family Impact module. The majority of children/parents completing questionnaires did so electronically on an iPad; others completed on paper.

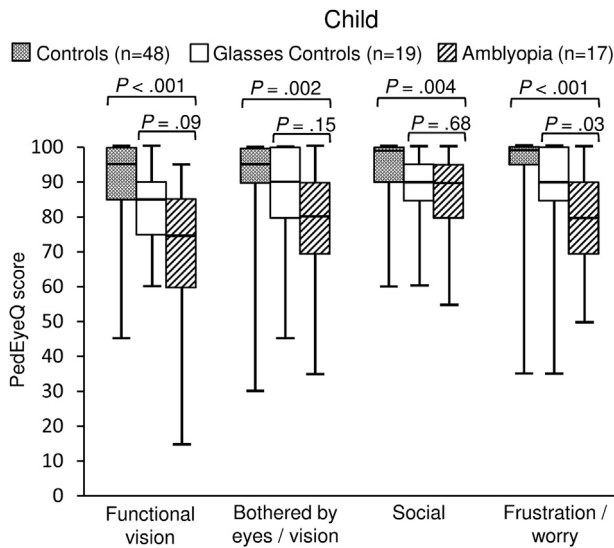


FIGURE 1. Child Pediatric Eye Disease Questionnaire (PedEyeQ) domain scores for children with residual amblyopia compared with visually normal controls not wearing glasses and compared with visually normal controls wearing glasses. Amblyopic children had lower scores than controls not wearing glasses on all 4 domains, and lower scores than controls wearing glasses on the Frustration/worry domain.

• **PEDIATRIC EYE QUESTIONNAIRE:** The PedEyeQ^{16,17} comprises Child, Proxy, and Parent components, each with distinct, separately scored domains, using a 3-point frequency scale for responses (“Never,” “Sometimes,” “All of the time”). The Child 5-11 PedEyeQ (used in the present study) consists of Functional vision, Bothered by eyes/vision, Social, and Frustration/worry domains.¹⁶ The Proxy 5-11 PedEyeQ consists of 5 domains: Functional vision, Bothered by eyes/vision, Social, Frustration/worry, and Eye care¹⁶; and the Parent PedEyeQ assesses the effect of the child’s eye condition on the parent and family in 4 domains: Impact on parent and family, Worry about child’s eye condition, Worry about child’s self-perception and interactions, and Worry about child’s functional vision.¹⁶ (Full questionnaires in English and Spanish, with Rasch-scoring look-up tables, are freely available at https://public.jaeb.org/pedig/view/Other_Forms.)

• **PEDIATRIC QUALITY OF LIFE INVENTORY:** The PedsQL is a general HRQOL questionnaire. For the present study we used the Child module (5-7- and 8-12-year-old versions), each with 23 items in 4 domains (physical, emotional, social, and school functioning), the Proxy module (parallel to Child), and the Family Impact PedsQL module (8 domains).^{22,23} PedsQL questionnaires use 5 response options with the exception of the Child 5-7, which uses 3 options, and the respondent is instructed to respond based on their experience over the past month

(http://www.pedsq.org/about_pedsq.html; full questionnaires available by purchase only).

• **ANALYSIS:** Rasch-calibrated PedEyeQ domain scores were calculated for each participant, using previously published Rasch look-up tables (freely available at https://public.jaeb.org/pedig/view/Other_Forms), and converted to 0 (worst) to 100 for interpretation. All VA data were converted to logMAR for analysis, calculating a logMAR letter score (Snellen equivalent reported for ease of interpretation). Median and range of VA and refractive error were calculated for amblyopic and fellow eyes for children with residual amblyopia and right eyes for normal controls and glasses controls.

The primary analysis was a comparison of median PedEyeQ domain scores and PedsQL domain scores between children with residual amblyopia and visually normal controls not wearing glasses. In secondary analyses, we compared PedEyeQ domain scores and PedsQL domain scores in children with residual amblyopia and visually normal controls wearing glasses. Pairwise Wilcoxon tests were used for all analyses. Mean differences with a 95% confidence interval (CI) around the mean difference were also calculated.

RESULTS

• **PATIENTS:** Demographics and clinical characteristics for all enrolled children and parents are shown in Table 1. Median amblyopic-eye VA was 20/50 (range 20/32 to 20/320) (Table 1). No children had developmental delay.

• **RESIDUAL AMBLYOPIA VS VISUALLY NORMAL CONTROLS (NOT WEARING GLASSES):** *Child PedEyeQ.* Children with residual amblyopia had lower (worse) scores than visually normal controls not wearing glasses, on each of the 4 Child PedEyeQ domains ($P \leq .004$ for each; Figure 1; Table 2). The greatest difference was on the Functional vision domain (median 75 vs 95; mean difference -18 ; 95% CI -29 to -7 ; $P < .001$; Figure 1; Table 2).

Proxy PedEyeQ. Using the Proxy PedEyeQ, amblyopic children again had lower scores across the 5 domains than visually normal controls not wearing glasses ($P < .001$ for each; Figure 2; Table 2). The greatest difference was on the Functional vision domain (median 65 vs 100; mean difference -31 ; 95% CI -39 to -24 ; $P < .001$; Figure 2; Table 2).

Parent PedEyeQ. Parent PedEyeQ scores were lower on each domain for parents of children with residual amblyopia than for parents of visually normal children ($P < .001$ for each; Figure 3; Table 2). The greatest difference was on the Worry about child’s eye condition domain

TABLE 2. PedEyeQ Domain Scores for Children With Residual Amblyopia, Visually Normal Controls Without Glasses, and Visually Normal Controls Wearing Glasses

PedEyeQ Domains	Median (Range) PedEyeQ Scores			P Value for Difference, Amblyopia vs Normal	Mean Difference (95% CI), Amblyopia - Normal	P Value for Difference, Amblyopia vs Glasses	Mean Difference (95% CI), Amblyopia - Glasses
	Residual Amblyopia (N = 17)	Normal Controls Without Glasses (N = 48)	Glasses Controls (N = 19)				
Child PedEyeQ domains							
Functional vision	75 (15-95)	95 (45-100)	85 (60-100)	<.001*	-18 (-29 to -7)	.09	-12 (-23 to 0)
Bothered by eyes/ vision	80 (35-100)	95 (30-100)	90 (45-100)	.002*	-13 (-23 to -3)	.15	-6 (-18 to 5)
Social	90 (55-100)	100 (60-100)	90 (60-100)	.004*	-7 (-13 to -2)	.68	-1 (-9 to 7)
Frustration/worry	80 (50-100)	100 (35-100)	90 (35-100)	<.001*	-16 (-23 to -8)	.03*	-9 (-18 to 1)
Proxy PedEyeQ domains							
Functional vision	65 (35-95)	100 (80-100)	90 (40-100)	<.001*	-31 (-39 to -24)	.008*	-15 (-26 to -3)
Bothered by eyes/ vision	75 (45-100)	100 (80-100)	95 (55-100)	<.001*	-22 (-30 to -13)	.006*	-13 (-23 to -2)
Social	88 (44-100)	100 (94-100)	94 (56-100)	<.001*	-23 (-34 to -12)	.049*	-14 (-26 to -2)
Frustration/worry	70 (40-100)	100 (80-100)	100 (40-100)	<.001*	-25 (-37 to -13)	.050*	-14 (-29 to 1)
Eye care	67 (42-100)	100 (67-100)	100 (50-100)	<.001*	-28 (-40 to -16)	.06	-16 (-30 to -2)
Parent PedEyeQ domains							
Impact on parent and family	90 (60-100)	100 (85-100)	100 (60-100)	<.001*	-16 (-23 to -9)	.02*	-9 (-17 to -1)
Worry about child's eye condition	60 (0-100)	100 (40-100)	80 (35-100)	<.001*	-34 (-46 to -22)	.01*	-17 (-31 to -3)
Worry about child's self-perception and interactions	71 (21-100)	100 (64-100)	93 (7-100)	<.001*	-27 (-38 to -16)	.07	-11 (-26 to 4)
Worry about child's functional vision	62 (6-100)	100 (50-100)	87 (12-100)	<.001*	-30 (-42 to -18)	.050*	-13 (-28 to 2)

Asterisk (*) on P values indicates significant difference between groups.

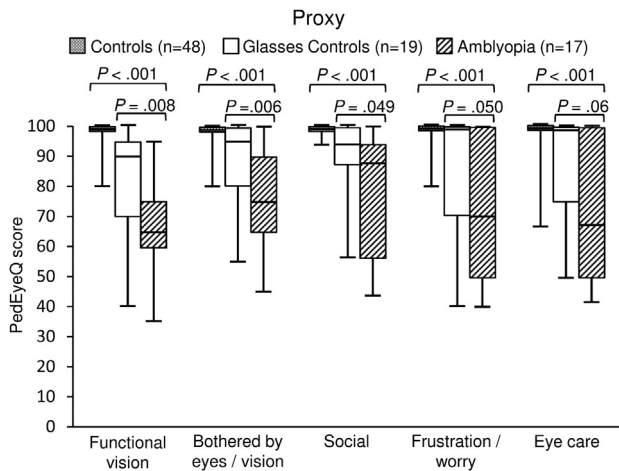


FIGURE 2. Proxy Pediatric Eye Disease Questionnaire (PedEyeQ) domain scores for children with residual amblyopia compared with visually normal controls not wearing glasses and compared with visually normal controls wearing glasses. As reported by the parent, amblyopic children had lower scores than controls not wearing glasses on all 5 domains, and lower scores than controls wearing glasses on 4 of the 5 domains (Functional vision, Bothered by eyes/vision, Frustration/worry, and Eye care).

(median 60 vs 100; mean difference -34 ; 95% CI -46 to -22 ; $P < .001$; Figure 3; Table 2).

PedsQL. Child 8-12 years PedsQL scores were similar between children with residual amblyopia and visually normal controls not wearing glasses ($P \geq .35$ for each; Figure 4; Supplemental Table, available at AJO.com). By proxy report, scores were lower for amblyopic children on the School functioning domain (median 75 vs 93; mean difference -10 ; 95% CI -19 to -1 ; $P = .01$; Figure 5; Supplemental Table) but similar on other Proxy PedsQL domain scores ($P \geq .09$ for each; Figure 5; Supplemental Table). Using the PedsQL Family Impact Module, scores were lower for 3 of the 8 domains: Physical functioning (median 90 vs 100; mean difference -9 ; 95% CI -16 to -1 ; $P = .04$), Social functioning (median 97 vs 100; mean difference -6 ; -15 to 2 ; $P = .03$), and Worry (median 80 vs 100; mean difference -19 ; 95% CI -30 to -8 ; $P < .001$) (Figure 6; Supplemental Table).

• **RESIDUAL AMBLYOPIA VS CONTROLS WEARING GLASSES: Child PedEyeQ.** Compared with controls wearing glasses, children with residual amblyopia had significantly lower scores on the Child PedEyeQ Frustration/worry domain (80 vs 90; mean difference -9 ; 95% CI -18 to 1 ; $P = .03$; Figure 1, Table 2). Scores were similar between children with residual amblyopia and glasses controls on the other 3 Child PedEyeQ domains (Figure 1, Table 2).

Proxy PedEyeQ. Using the Proxy PedEyeQ, children with residual amblyopia scored significantly lower than

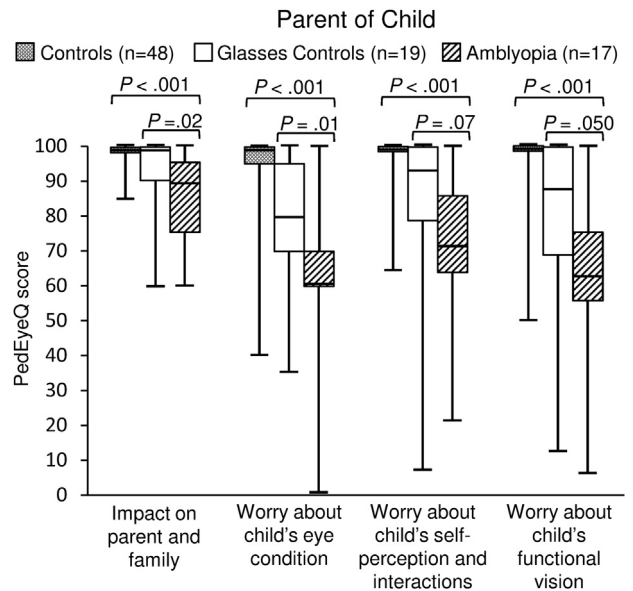


FIGURE 3. Parent Pediatric Eye Disease Questionnaire (PedEyeQ) domain scores for parents of children with residual amblyopia compared with parents of visually normal controls not wearing glasses and compared with visually normal controls wearing glasses. Parents of amblyopic children had lower scores than parents of visually normal controls not wearing glasses on each of the 4 domains, and lower scores than parents of visually normal controls wearing glasses on 3 of the 4 domains (Impact on parent and family, Worry about child's eye condition, and Worry about child's self-perception and interactions).

controls wearing glasses on 4 of the 5 domains: Functional vision (65 vs 90; mean difference -15 ; 95% CI -26 to -3 ; $P = .008$), Bothered by eyes and vision (75 vs 95; mean difference -13 ; 95% CI -23 to -2 ; $P = .006$), Social (88 vs 94; mean difference -14 ; 95% CI -26 to -2 ; $P = .049$), and Frustration/worry (70 vs 100; mean difference -14 ; 95% CI -29 to 1 ; $P = .050$) (Figure 2, Table 2).

Parent PedEyeQ. Parent PedEyeQ scores were lower for parents of children with residual amblyopia than for parents of controls wearing glasses on 3 of the 4 domains: Impact on parent and family (90 vs 100; mean difference -9 ; 95% CI -17 to -1 ; $P = .02$), Worry about child's eye condition (60 vs 80; mean difference -17 ; 95% CI -31 to -3 ; $P = .01$), and Worry about functional vision (62 vs 87; mean difference -13 ; 95% CI -28 to -2 ; $P = .050$) (Figure 3, Table 2).

PedsQL. All domains of the Child and Proxy PedsQL were similar between children with residual amblyopia and controls wearing glasses ($P \geq .18$ for each; Figures 4 and 5, Supplemental Table). Using the PedsQL Family Impact Module, scores were lower only on the Worry domain (median 80 vs 87; mean difference -14 ; 95% CI -27 to -2 ; $P = .02$; Figure 6, Supplemental Table).

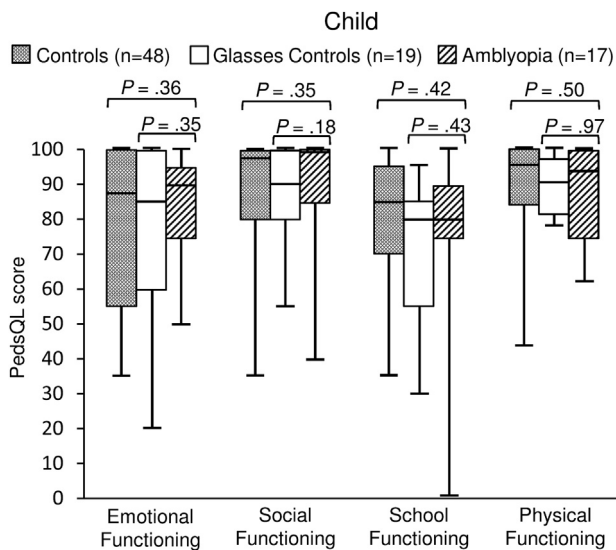


FIGURE 4. Child Pediatric Quality of Life Inventory (PedsQL) domain scores for children with residual amblyopia compared with visually normal controls not wearing glasses and compared with visually normal controls wearing glasses. Scores were similar across domains between amblyopic children and controls not wearing glasses, and between amblyopic children and controls wearing glasses.

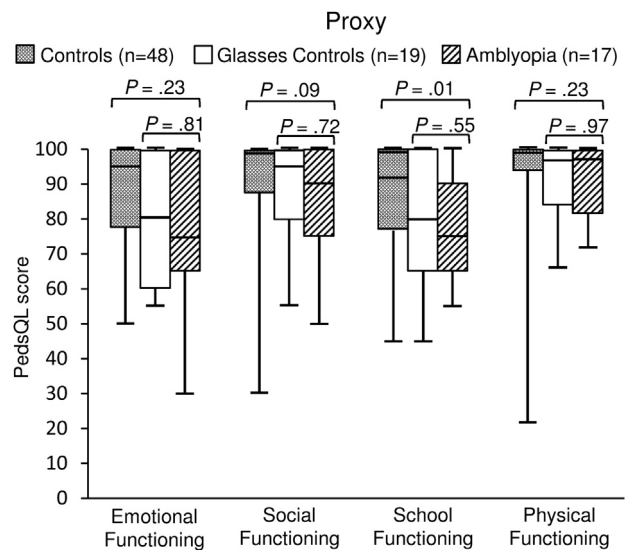


FIGURE 5. Proxy Pediatric Quality of Life Inventory (PedsQL) domain scores for children with residual amblyopia compared with visually normal controls not wearing glasses and compared with visually normal controls wearing glasses. As reported by the parent, amblyopic children had lower scores than controls not wearing glasses on the School functioning domain. There were no differences between amblyopic children and controls wearing glasses.

DISCUSSION

CHILDREN WITH RESIDUAL AMBLYOPIA HAVE REDUCED functional vision and ER-QOL across domains compared with visually normal controls, by both child self-report (using the Child PedEyeQ) and proxy report (using the Proxy PedEyeQ). Parents of children with residual amblyopia also report reduced quality of life compared with parents of visually normal children (using the Parent PedEyeQ). Assessing general HRQOL using the child and proxy PedsQL, there was minimal impact of amblyopia. Nevertheless, parents of amblyopic children reported significant impact using the PedsQL Family Impact Module.

Most previous studies assessing quality of life in children with amblyopia by child self-report are designed to assess the impact of specific amblyopia treatments. Nevertheless, Webber and associates²⁴ found lower social acceptance in children with residual/recovered amblyopia assessed using the Self Perception Profile for Children and Birch and associates²⁵ found reduced scholastic, social and athletic competence in children with residual amblyopia. Sabri and associates²⁶ found worse scores on the Psychological Impact Questionnaire for older teenagers (16-18 years old) with residual amblyopia when compared with normal controls. In the present study we directly measured child-reported ER-QOL using the Child component of the PedEyeQ, and found scores were significantly lower across Bothered by eyes/vision, Social, and Frustration/worry domains when compared with visually normal controls, confirming that

children with residual amblyopia experience a range of quality-of-life concerns in their everyday life.

Regarding Proxy reporting, there are few previous data on the impact of amblyopia. Bogdănici and associates²⁷ assessed quality of life in children with amblyopia (prior to treatment) by proxy evaluation and reported that the majority had poor school results, but did not report other concerns. We also found significantly lower school functioning scores in 8- to 11-year olds with residual amblyopia, compared with normal controls not wearing glasses using the proxy PedsQL (Supplemental Table). In addition, the Proxy PedEyeQ Functional vision domain includes questions regarding schoolwork, and these domain scores were lower for children with residual amblyopia, compared with normal controls not wearing glasses (Table 2, Figures 1 and 2). Proxy evaluation of a child's quality of life remains an important avenue of assessment, especially in young children where self-report may be limited. The PedEyeQ provides a means of assessing ER-QOL from both child and parent/caregiver perspectives. Data from the present study confirm that the PedEyeQ is sensitive to concerns of children with residual amblyopia when made by proxy report.

Considering functional vision, as distinct from ER-QOL, we found reduced functional vision in children with residual amblyopia, both by child self-report and by proxy report. Concerns included problems with schoolwork, learning and concentrating, general difficulties seeing, and running into

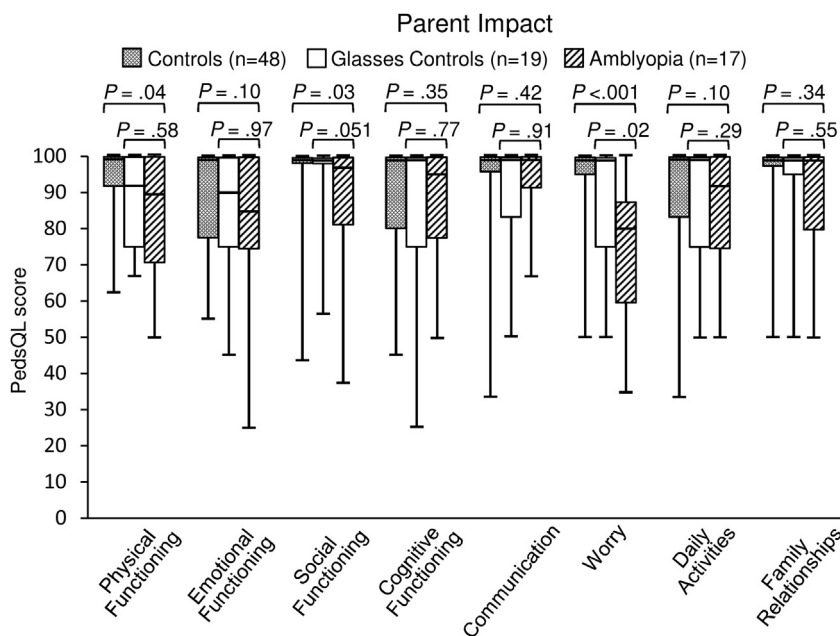


FIGURE 6. Pediatric Quality of Life Inventory (PedsQL) Family Impact Module scores for parents of children with residual amblyopia compared with parents of visually normal controls not wearing glasses and parents of visually normal controls wearing glasses. Scores were lower for parents of amblyopic children than for parents of visually normal controls not wearing glasses on 3 of the 8 domains (Physical functioning, Social functioning, Worry) and lower for parents of amblyopic children than controls wearing glasses on the Worry domain.

things (full questionnaires available at https://public.jaeb.org/pedig/view/Other_Forms). Impaired functional vision in amblyopia has been reported by others: Sabri and associates²⁶ administered the Visual Function-14 questionnaire and found worse scores in 16- to 18-year olds with amblyopia when compared with normal controls. In addition, in skill-based assessments, amblyopia has been associated with poor reading speed,¹¹ reduced scholastic and athletic competence,²⁵ and reduced physical competence.²⁸ Data from the present study suggest that the new PedEyeQ provides insight regarding the type of functional vision deficits experienced by children with residual amblyopia.

Since glasses wear is almost universally a part of amblyopia treatment, and we had previously found that glasses wear for refractive error reduces functional vision and ER-QOL,²⁰ we performed secondary analyses to evaluate the impact of residual amblyopia, above and beyond the impact of glasses wear itself. Given our previous findings regarding the impact of glasses wear,²⁰ we anticipated that differences between children with residual amblyopia and normal controls wearing glasses might be less pronounced than when comparing with controls without glasses. The findings of the present study suggest that there is an impact of amblyopia that exceeds the impact of glasses wear alone. In other studies, Koklanis and associates²⁹ aimed to identify the effects of amblyopia itself as distinct from the effects of treatment, but concluded that there is little impact of amblyopia until treatment is commenced.³⁰

compared psychosocial well-being (proxy-rated) and parental stress before any amblyopia treatment and then again while wearing glasses, and also occlusion, and did not find any differences. Guimarães and associates³¹ evaluated HRQOL, stress, anxiety, and depression using generic instruments in children with refractive amblyopia treated with glasses alone or with glasses plus occlusion and found no differences at least 1 year following cessation of occlusion. The absence of differences in previous studies may be attributable in part to the use of generic instruments that were insensitive to amblyopia-specific concerns, and it would be of value to further evaluate the impact of amblyopia itself vs the impact of specific amblyopia treatments using the PedEyeQ.

In addition to evaluating functional vision and ER-QOL, we also assessed general HRQOL using the generic PedsQL instrument. By child and proxy report we found few differences between children with residual amblyopia and controls (the only difference was school functioning domain on proxy report). These findings are consistent with those of Wen and associates,³² who found no differences between children with amblyopia (n = 71) and those without amblyopia (n = 3,247) using the proxy PedsQL. Although we found few differences between amblyopic children and controls using the PedsQL, we did find differences between amblyopic children and controls using the PedEyeQ, suggesting that the PedEyeQ is more sensitive to the specific concerns of children with residual amblyopia than the

PedsQL. There were numerically small but statistically significant differences in median values on some PedsQL scales, reflecting different distributions within each population, but these may not reflect meaningful differences.

This study is not without limitations. By requiring at least 1 month with no treatment other than glasses, we aimed to isolate the effect of residual amblyopia per se on functional vision and ER-QOL, as distinct from the effects of amblyopia treatments. However, it is unknown whether the memory of previous treatments affected responses, despite being instructed to consider experience over the past month only. Ideally, the impact of residual amblyopia itself would be evaluated prior to the commencement of any treatment, but this may be practically difficult to achieve, and evaluation of residual amblyopia provides a reasonable surrogate. An additional limitation is that when administering any questionnaire it is possible that the respondent is alerted to a concern that they may not otherwise have articulated. Nevertheless, in designing the PedEyeQ, items were generated based on semi-structured interviews with children and their parents and worded to minimize leading the respondent. We had relatively small numbers, which precluded

analyses of the potential impact of severity of residual amblyopia on functional vision and ER-QOL, or of the broader relationship with normal and varying degrees of subnormal VA, but we plan to evaluate this in future studies. We also had insufficient numbers to analyze the effect of small-angle strabismus, or the type and magnitude of refractive error; nevertheless, the focus of the present study was on evaluating the overall impact of residual amblyopia. In addition, we did not study the relative changes in PedEyeQ scores from before to after treatment, or evaluate interventions to improve quality of life, or determine if these would be of interest in future studies.

Residual amblyopia affects reported functional vision and ER-QOL in children, as assessed using both child and proxy components of the recently developed PedEyeQ. Parents of amblyopic children also report lower quality of life as assessed using the Parent PedEyeQ. The nature of concerns in children with residual amblyopia and their parents, reflected in lower scores across distinct PedEyeQ domains, helps broaden our understanding of the everyday impact of this common eye condition. The PedEyeQ may be useful for clinical management and in future amblyopia research.

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