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General Health-Related Quality of Life in Preschool Children with Strabismus or Amblyopia

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Abstract

Objective—To explore the associations of general health-related quality of life (GHRQOL) with strabismus or amblyopia in preschool children.

Design—Population-based study.

Participants—Sample of children aged 25 to 72 months in the Multi-ethnic Pediatric Eye Disease Study (MEPEDS).

Methods—The Pediatric Quality of Life Inventory (PedsQL), a measure of GHRQOL, was administered to the parents of the children.

Main Outcome Measures—The PedsQL consists of 4 sub-scales (physical, emotional, social, and school functioning) and 3 composite scores (physical summary, psychosocial summary, and total). Regression models were used to evaluate the associations of GHRQOL with strabismus (in children 25 to 72 months) or amblyopia (in children 30 to 72 months), respectively.

Results—Of the 4,218 children aged ≧ 25 months, 121 (2.9%) were diagnosed with strabismus. Significant differences were found in all 3 composite scores between children with and without strabismus, before and after controlling for gender, age, race, family income, systemic health conditions, and prior knowledge of strabismus diagnosis ($p<0.05$). These differences were present in both esotropes and exotropes, and in both children with intermittent and constant strabismus. 3,318 children were ≧ 30 months and 71 (2.1%) had amblyopia. There were no significant differences in any PedsQL scores between children with and without amblyopia, even after adjusting for gender, age, race, and family income ($p>0.05$).

Conclusions—Strabismus was associated with significantly worse GHRQOL in preschool children. While we did not find any detectable association between amblyopia and GHRQOL, further study using vision-specific instruments is required to explore the impact of both strabismus and amblyopia on pediatric quality of life.

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Keywords

amblyopia; strabismus; general health-related quality of life

Despite improved clinical screening methods and treatment options in children over the past few decades, there is a lack of population-based data on the burden and impact of ocular conditions on children. The Multi-ethnic Pediatric Eye Disease Study (MEPEDS) is one of the first studies to explore the relationship between general health-related quality of life (GHRQOL) and various ocular conditions in a population-based pediatric sample. The emphasis of this report is to assess the relationship between GHRQOL and two important ocular conditions of childhood: strabismus and amblyopia.

Strabismus may interfere with normal binocular depth perception and thereby hinder normal physical functioning. Further, visibly noticeable strabismus may have negative impact on a child's self-image, with potentially significant psychosocial consequences[1–7]. Amblyopia is the inability of the visual centers of the brain to resolve details from one or both eyes even with glasses. Unilateral amblyopia often impacts depth perception, and causes reduced sensitivity to motion, poor contrast sensitivity, and poor visual acuity in the affected eye[8], while children with bilateral amblyopia have reduced visual acuity in both eyes.

It is important to explore whether strabismus or amblyopia impact GHRQOL using a well-established instrument. While we would also like to explore vision-specific quality of life, there is currently no validated instrument to assess vision-specific quality of life for children within the normal range of vision. The Pediatric Quality of Life Inventory 4.0 Generic Core Scales (PedsQL)[9] was selected because it is a brief and developmentally appropriate instrument designed to measure core dimensions of pediatric GHRQOL and its feasibility and reliability have been demonstrated by a number of studies evaluating children with and without a variety of health conditions [10–21].

Participants and Methods

Study Design

The MEPEDS is a multiethnic, population-based study of preschool children in southern California. Its protocol and informed consent forms were reviewed and approved by the Institutional Review Board (IRB)/Ethics Committee of the Los Angeles County University of Southern California Medical Center. The study design and sampling plan have been described previously[22]. In brief, the primary goals of the study are to establish the prevalence of common eye conditions in a population-based sample of African-American, Hispanic, Asian and Non-Hispanic White children, identify risk factors associated with these conditions, and explore the relationship between physical and psychosocial functioning and the prevalence and severity of various ocular disorders.

Study Population

Eligible MEPEDS participants included children aged 6 months to 72 months, living in one of several selected census tracts in and around the city of Inglewood in Los Angeles County and in the city of Riverside in Riverside County, California at the time of the clinical examination and parental interview. Other eligibility criteria included: (1) child was 5 to 70 months on the day of the door-to-door household screening and (2) a parent or legal guardian (hereafter referred to as parent) confirmed that the child was a resident of one of the selected census tracts. Informed consent was obtained from the parent of eligible children followed by a brief in-home interview that included basic demographic information and history of known eye conditions. Eligible children were then scheduled for a

comprehensive eye examination at the local MEPEDS clinic. A more detailed in-person interview with the child's parent including the PedsQL was also administered at the clinic (see details below). The current study focuses on Hispanic and African American participants for whom we have complete clinical data and PedsQL information. Collection of data on other racial/ethnic groups is ongoing.

In-Clinic Eye Examination and Parental Interview

In-Clinic Eye Examination—All children underwent a comprehensive eye examination, which has been previously described in detail[23]. Briefly, the protocol included assessment of ocular alignment, measurement of visual acuity using the HOTV Amblyopia Treatment Study (ATS) protocol on the Electronic Visual Acuity tester[24], cycloplegic refraction, and ocular health assessment. Strabismus was assessed in children aged 6 months to 72 months by cover-uncover testing (for which Krimsky testing was substituted only if the child would not permit cover testing) and alternate cover testing, and defined as any strabismus, at distance or near fixation, with or without glasses. Amblyopia was defined as a 2-line difference in visual acuity between eyes (20/32 or worse in the worse eye) with a corresponding unilateral amblyopia risk factor (strabismus, anisometropia, or visual axis occlusion), or bilaterally decreased visual acuity (worse than 20/50, or worse than 20/40 if >=48 months of age) with a bilateral amblyopia risk factor (bilateral visual axis occlusion or bilateral high ametropia). Amblyopia was evaluated in children 30 to 72 months of age who were able to complete testing using 'HOTV' optotypes[24–26].

Parental Interview—The questionnaire consisting of sociodemographic, medical, ocular history items, and the PedsQL, was administered by a study interviewer to the parent of each child at the time of the clinical examination, or subsequently by telephone if the child was accompanied to the exam by a person other than a parent. The PedsQL was only administered to parents of children aged 25 months or older. The medical history portion included questions about whether a doctor had ever told the parent that the child had health conditions such as mental retardation, cerebral palsy, Down syndrome, convulsions or seizures, retinopathy of prematurity (hereafter referred to as co-morbid conditions), and whether a doctor had ever diagnosed the child with strabismus or amblyopia. Further details of the interview have been described elsewhere.[22]

PedsQL—The 23-item instrument is designed to measure core dimensions of pediatric GHRQOL. Each question is scored on a 0–4 scale, which can be reversely transformed to a 0–100 linear scale, where higher scores indicate better GHRQOL. Sub-scale scores are computed as the average score of the individual items answered in each sub-scale. A physical health summary score is the same as the physical functioning sub-scale (8 items). A psychosocial health summary score is computed as the mean of the 15 items answered in the emotional, social, and school functioning sub-scales. The total score is computed as the mean of all 23 items. In MEPEDS, the parent-proxy report version of the instrument was used.

Statistical Analysis

T-tests were performed to compare the mean scores (sub-scale and total scale) between children with and without strabismus or amblyopia; two-sided p-values were reported. Analysis of covariance was used to compare the mean scores by disease status after controlling for potential confounders such as age, gender, race, and family income. For strabismus, all sub-scale and total scale scores were additionally adjusted for parental report of co-morbid conditions and prior knowledge of strabismus diagnosis.

Generalized linear models were used to further evaluate associations of GHRQOL with eye disease characteristics. For strabismus, the disease characteristics of interest were esotropia or exotropia, intermittent or constant, and severity: mild (0–9 prism diopters), moderate (10–30 prism diopters), and severe (>30 prism diopters). All the scores were also compared for strabismic children with good depth perception and strabismic children with poor depth perception. For amblyopia, the disease characteristics of interest were unilateral or bilateral, and severity, classified as severe (visual acuity in either eye <=20/80) or not severe. Analyses were conducted using SAS software 9.1 (SAS Institute, Inc., Cary, NC) at the 0.05 significance level.

Results

Study Population

A total of 6,072 eligible Hispanic and African American children in the census tracts surveyed by MEPEDS completed the clinical examination. Of the 6,072 children, 4,218 (69.5%) were 25 months or older and had been evaluated for GHRQOL as well as strabismus; these children were eligible for our strabismus-related analyses. Of the 6,072 children, 3,318 (54.6%) were 30 months or older and were evaluated for amblyopia based on optotype visual acuity measurements; these children were eligible for our amblyopia-related analyses. In the strabismus cohort (n=4,218), 121 (2.9%) children were diagnosed with strabismus and in the amblyopia cohort (n=3,318), 71 (2.1%) were diagnosed with amblyopia. Their characteristics are shown in Table 1.

The Associations of GHRQOL with Strabismus or Amblyopia

The means and standard deviations of the PedsQL sub-scale and total scale scores for the entire cohort and for children stratified by presence or absence of strabismus or amblyopia are shown in Table 2.

Children with strabismus had lower GHRQOL scores and the score differences ranged from approximately 3 to 5 points. Statistically significant differences were found between children with and without strabismus for the total scale score, both summary scores (physical and psychosocial health), and for 2 of the 3 psychosocial sub-scales (emotional and school functioning) ($p<0.05$). The difference in the social functioning score by strabismus status did not reach statistical significance ($p=0.17$). In contrast, none of these scores were significantly different between the children with amblyopia and those without amblyopia ($p>0.05$ for all). The strabismus and amblyopia analysis groups were not mutually exclusive. When we repeated the analyses restricting to children with only strabismus or only amblyopia, the results were similar; however the p-values were slightly larger for the strabismus analysis due to the decrease in sample size. The results also remained the same after adjusting for the presence of the other eye condition as a covariate in the model.

When we looked at the 23 PedsQL items individually, a significantly higher proportion of strabismic children had problems in at least half of the items, compared to the proportion in non-strabismic children (Table 3, available at http://aaojournal.org). These items included all four dimensions (physical, emotion, social and school) of the GHRQOL measure. No significant differences in the proportions of amblyopic or non-amblyopic children having problems were found for any of the PedsQL individual items (Data not provided here).

The associations of strabismus or amblyopia with GHRQOL were also evaluated after adjusting for potential confounders. In the strabismus models, all the adjusted scores (total, physical summary, psychosocial summary, emotional and school functioning scores) remained statistically significantly different between children with and without strabismus

($p<0.05$), except for the social functioning score ($p=0.06$) (Table 4). For amblyopia, there were no significant differences between the amblyopia and non-amblyopia groups for any of the PedsQL scores after adjusting for potential confounders ($p>0.05$) (Table 4).

We further evaluated the impact of co-morbid conditions, and of parents' knowledge of the child's history of strabismus on the association of strabismus with GHRQOL. Children with a known history of co-morbid health conditions had significantly lower GHRQOL scores than children without such a history. However, among children who did not have a history of co-morbid conditions, strabismus was still significantly associated with lower GHRQOL scores including the total score, psychosocial summary score, and emotional functioning sub-scale scores ($p<0.05$). Among those children who were not diagnosed with strabismus before participating in the MEPEDS, strabismus was still significantly associated with a lower values for the total score, both summary scores, and the emotional sub-scale scores ($p<0.05$).

The Associations of GHRQOL with the Characteristics of Strabismus or Amblyopia

We examined the associations between type of strabismus or amblyopia and severity of disease with GHRQOL. The association between strabismus and GHRQOL scores did not differ for children with esotropia versus exotropia, or between children with intermittent or constant strabismus ($p>0.05$). All 3 composite scores were significantly lower for children with esotropia or exotropia, compared to those with normal eye alignment ($p<0.05$). Children with intermittent strabismus had worse composite scores (all 3) than normal children, while children with constant strabismus had lower physical summary and total scale scores ($p<0.05$).

Among the 121 children with strabismus, 11 had a magnitude of 1–9 prism diopters, 79 had a magnitude of 10–30 prism diopters, and 21 had a magnitude greater than 30 prism diopters (10 children lacked this data and could not be classified). The strabismus group with a magnitude of 10–30 prism diopters had the worst GHRQOL scores and differed significantly from the non-strabismus group for all the 3 composite scores ($p<0.05$). No significant differences in composite scores were found for children in the other strabismus angle categories. However, the small numbers of children in these sub-groups may reduce the power of the statistical tests.

Because strabismus is often associated with deficient stereopsis, we also tested whether the association of strabismus with GHRQOL scores was dependent on the presence or absence of stereopsis. The physical and psychosocial summary scores did not differ significantly according to stereopsis, suggesting that impaired depth perception is not the basis for the impact of strabismus on GHRQOL.

There were no significant differences in any of the composite or sub-scale scores between children with either unilateral or bilateral amblyopia, and normal children ($p>0.05$). Pair-wise comparisons indicated that all 3 composite scores were not significantly different for children with mild/moderate or severe amblyopia, compared to children without amblyopia ($p>0.05$). In addition, no individual etiological subtype of unilateral amblyopia (eg strabismic, anisometropic, etc.) showed a significant difference in PedsQL score compared to children without amblyopia. Furthermore, children with both amblyopia and strabismus did not show a significantly worse PedsQL than children with strabismus alone.

Discussion

In a population-based sample of preschool children, we found that strabismus was associated with significantly worse GHRQOL, including physical, emotional, social, and school

functioning as measured by the PedsQL. The associations existed even after controlling for gender, age, ethnicity, and family income level. The apparent associations were not explained by parents' knowledge of strabismus diagnosis prior to their child's examination, or by the association of strabismus with other systemic diseases that could themselves influence quality of life. Even after restricting the analysis to children without a history of co-morbidities or a diagnosis of strabismus prior to the clinical examination, a significant relationship of strabismus with worse physical and psychosocial health remained.

The negative association of strabismus with GHRQOL was seen both for esotropia and exotropia, and both for intermittent and constant strabismus. Strabismus could affect GHRQOL through deficient depth perception, or cosmetically visible misalignment of the eyes to others, or both. Yet the fact that an impact was seen for both intermittent and constant strabismus, and the PedsQL scores were no higher in strabismic children with stereopsis than in those without stereopsis, suggests that the most important factor is the cosmetically visible misalignment of the eyes.

Studies on the impact of strabismus have been conducted previously in both adults and children. By means of simulation photographs, the influence of strabismus was found to play a very significant role in adults selecting a partner[5] or in children selecting a playmate.[3] These photograph-based studies assessed the responses of others to an individual's cosmetic appearance, but unlike the present study, did not directly or quantitatively assess the experience of the strabismic individual. In older age groups (adults and teenagers), it has been shown that strabismus causes embarrassment to the patient, and corrective surgery for strabismus significantly improves patients' psychological and physical functioning using standard measures or questionnaires such as the Hospital Anxiety and Depression Scale and the WHO Quality of Life measure[2, 6]. Our results are consistent with the general conclusions of studies in older age groups, in terms of the overall negative impact of strabismus on an individual's GHRQOL.

MEPEDS is one of the first studies to provide a direct measure of the likelihood of physical and psychosocial consequences in a population-based pediatric population. The differences in mean PedsQL scores between children with and without strabismus in this study ranged from approximately 2 to 5 points in all domains. The range of differences is similar to clinic-based studies of other pediatric medical conditions that used the parent proxy version of PedsQL[13]. However, the mean scores for children participating in MEPEDS were on average higher. The reason could be that the children in our cohort were relatively young. As they grow older and enter more complicated social environments, the impact of strabismus may increase. An age-related trend can be seen in MEPEDS too: among 4–5 year-old strabismic children, a higher proportion had problems with a wider range of PedsQL items (8 items including walking, running, etc), compared to 2–3 year-old strabismic children (3 items including sleeping, worrying and not being able to do things that others can do). (Table 3, available at http://aaojournal.org)

In MEPEDS, we did not detect a measurable impact of amblyopia on GHRQOL. There are several possible reasons for this. First, the PedsQL instrument may be insensitive to the effects of amblyopia on specific vision-related aspects of GHRQOL. Studies in adults have concluded that vision-specific instruments are more sensitive than general GHRQOL instruments in quantifying the impact of vision disorders[27–29]. Pediatric vision-specific instruments are required to fully evaluate the potential impact of amblyopia on vision-related HRQOL. Second, it may be that the influence of amblyopia only becomes apparent at older ages, when more visually demanding school and sports-related activities come into play. Third, most amblyopia in this population was anisometropic rather than strabismic[23], and therefore the disorder, unlike strabismus, was not apparent to casual observers. This

would reduce the likelihood of the child being teased or self-conscious about the eye condition, and thus make it less likely to have an impact on social and emotional functioning. Finally, it may be that unilaterally decreased vision (constituting the majority of the amblyopia in this population[23]) impacts GHRQOL minimally in childhood, because the child can see well with the better-seeing eye; it should be noted, however, that this assessment does not take into account the child's future, lifetime risk of developing bilateral visual impairment as a result of later disease or damage to the good eye[30].

Strengths of our study include that the study cohort is comprised of a large population-based sample of children with a significant number of them having strabismus. In addition, our high response rate of 96% to the PedsQL among parents of eligible children makes it likely that our findings are representative of all eligible study children and our findings may be generalizable to other children of similar age range and ethnic group. The results may vary in populations with different characteristics, or dwelling in other geographic areas. Age, ethnicity, social economic status and other cultural or environmental factors may be confounders, and how they affect the associations between strabismus/amblyopia and quality of life is not well studied.

In this study we found that strabismus was associated with significantly worse GHRQOL in preschool children based on the parents' proxy report. These associations still existed after controlling for differences in gender, age, race, family income, systemic health conditions, and prior knowledge of the diagnosis. Early detection and treatment of strabismus may have far-reaching benefits for children, although further studies are required to assess whether GHRQOL improves following strabismus treatment. In contrast, amblyopia was not associated with worse pediatric GHRQOL in this study. Given that amblyopia is a common and treatable condition, further investigation of vision-specific quality of life is necessary to fully understand the impact of this condition on children.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Characteristics of Children in the Amblyopia and Strabismus analysis samples by disease status, The Multiethnic Pediatric Eye Disease Study.[a]

	Amblyopia Sample			Strabismus Sample		
	Total (N=3,318)	Non-Amblyopia (N=3,247)	Amblyopia (N=71)	Total (N=4,218)	Non-Strabismus (N=4,097)	Strabismus (N=121)
Gender						
Male	1618 (48.8)	1582 (97.8)	36 (2.2)	2123 (50.3)	2069 (97.5)	54 (2.5)
Female	1700 (51.2)	1665 (98.0)	35 (2.0)	2095 (49.7)	2028 (96.8)	67 (3.2)
Age (months)						
25–36[b]	342 (10.3)	340 (99.4)	2 (0.6)	1117 (26.5)	1097 (98.2)	20 (1.8)
37–48	944 (28.5)	921 (97.6)	23 (2.4)	1050 (24.9)	1026 (97.7)	24 (2.3)
49–60	1051 (31.7)	1026 (97.6)	25 (2.4)	1065 (25.3)	1021 (95.9)	44 (4.1)
61–72	981 (29.6)	960 (97.9)	21 (2.1)	986 (23.4)	953 (96.7)	33 (3.4)
Race						
Hispanic	1689 (50.9)	1644 (97.3)	45 (2.7)	2132 (50.5)	2076 (97.4)	56 (2.6)
African-American	1629 (49.2)	1603 (98.4)	26 (1.6)	2086 (49.5)	2021 (96.9)	65 (3.1)
Family Income Level[c]						
≥$20,000	1034 (34.7)	1013 (98.0)	21 (2.0)	1277 (33.7)	1244 (97.4)	33 (2.6)
< $20,000	1944 (65.3)	1901 (97.8)	43 (2.2)	2512 (66.3)	2433 (96.9)	79 (3.1)

These samples are different as testing for amblyopia could only be done in children who were ≥ 30 months of age as they could reliably complete visual acuity testing. While strabismus testing could be performed in children aged 6–72 months, the PedsQL can only be reliably assessed in children >25 months. Thus, the sample for the amblyopia assessment is smaller than the sample for strabismus assessment.

[a] In each cell, the numbers are counts and percents are in parenthesis. In the total columns, the percents are out of the entire cohort of each disease; while in other columns, the percents are out of the total number of each stratum.

[b] For amblyopia, the first age group is 30–36 months.

[c] For amblyopia, 340 refused to answer this question or answered ‘do not know’; for strabismus, 429 refused to answer or answered ‘don’t know’.

Table 2

Mean Pediatric Quality of Life Inventory (PedsQL) Scores for Total, Summary and Sub-scales stratified by Strabismus or Amblyopia, The Multi-Ethnic Pediatric Eye Disease Study.

Strabismus							
General Health-related Quality of Life Scores	**Total Sample (N=4,218)**		**Children without Strabismus (N=4,097)**		**Children with Strabismus (N=121)**		
	Mean	**SD** [a]	**Mean**	**SD**	**Mean**	**SD**	***p*-value** [b]
Total Scale Score	91.8	9.6	91.9	9.4	88.0	14.8	<**0.01**
Physical Health Summary Score	94.1	9.8	94.2	9.5	90.1	17.0	<**0.01**
Psychosocial Health Summary Score	90.4	11.2	90.6	11.1	86.8	15.5	<**0.01**
Emotional Functioning	87.3	14.8	87.5	14.6	82.3	18.9	<**0.01**
Social Functioning	93.0	12.6	93.1	12.4	90.5	17.4	0.17
School Functioning	90.5	13.3	90.6	13.2	86.4	15.9	**0.04**
Amblyopia							
	Total Sample (N=3,318)		Children without Amblyopia (N=3,247)		Children with Amblyopia (N=71)		
	Mean	SD	Mean	SD	Mean	SD	*p* value [b]
Total Scale Score	91.8	9.3	91.8	9.3	91.4	9.0	0.72
Physical Health Summary Score	94.1	9.4	94.1	9.4	94.5	9.1	0.74
Psychosocial Health Summary Score	90.3	11.0	90.4	11.0	89.5	11.0	0.50
Emotional Functioning	87.0	15.0	87.1	15.0	85.3	14.2	0.33
Social Functioning	93.0	12.2	93.0	12.2	93.6	12.0	0.68
School Functioning	90.8	12.8	90.8	12.8	90.6	12.3	0.93

[a] SD = Standard Deviation.

[b] The scores are compared using 2-sample t-tests and p-values are reported. Significant p-values are bolded.

Table 4

Adjusted Pediatric Quality of Life Inventory (PedsQL) Mean[a] Composite and Sub-scale Scores Stratified by Strabismus or Amblyopia Status, The Multiethnic Pediatric Eye Disease Study.

	Non-Strabismus (N=4,097)	Strabismus (N=121)		Non-Amblyopia (N=3,247)	Amblyopia (N=71)	
	LS Mean[b]	LS Mean	*p* value	LS Mean	LS Mean	*p* value
Total Scale Score	91.8	88.0	**<0.01**	92.0	92.0	0.94
Physical Health Summary Score	94.1	90.2	**<0.01**	94.3	95.7	0.31
Psychosocial Health Summary Score	90.4	86.7	**<0.01**	90.5	89.6	0.60
Emotional Functioning	87.2	81.9	**<0.01**	87.0	85.5	0.52
Social Functioning	93.1	90.8	0.06	93.3	94.9	0.40
School Functioning	90.5	86.0	**0.01**	90.8	90.5	0.90

[a] Adjusted for age, gender, race and family Income; significant p-values are bolded.

[b] LS means (least square means) are within-group means appropriately adjusted for the other effects in the model.