Original Article

Intelligence Quotient (IQ) in Congenital Strabismus

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Purpose: To evaluate intelligence quotient (IQ) in patients with congenital strabismus.
Methods: All patients with congenital strabismus scheduled for surgery were enrolled consecutively over a one year period in a cross-sectional study and were evaluated for verbal, performance and total IQ scores, and compared to the mean normal IQ of 100±15.
Results: During the study period, 109 patients with mean age of 18.4±10.5 (range, 4-63) years were included. Educational status in most patients (80%) was less than high-school. Most patients (80%) lived in urban areas and 46 patients (42.2%) had some degrees of unilateral or bilateral amblyopia. Mean verbal IQ was 87.2±19.6 (range, 45-127), performance IQ was 81±15.5 (range, 44-111) and total IQ was 83.5±18.3 (range, 40-120). Total IQ was significantly lower in comparison to the normal population ($P<0.01$) and significantly higher in urban as compared to rural residents (85.1±19.5 versus 77.3±10.8 respectively, $P=0.02$). Patients with coexisting amblyopia and alternate deviation had lower IQ levels. Verbal IQ was insignificantly higher in myopes than emmetropes and hyperopes. IQ was better with vertical deviations and was higher in esotropes than exotropes; however, these differences were not statistically significant ($P>0.05$ for all comparisons).
Conclusion: Patients with congenital strabismus in this study had lower mean IQ scores than the normal population which may be due to genetic background or acquired causes secondary to strabismus.

Keywords: Horizontal Strabismus; Intelligence Quotient (IQ); Vertical Strabismus

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INTRODUCTION

Strabismus is a common condition which occurs in approximately 4% of the adult population.[1-12] In addition to functional limitations (e.g, restriction in visual field and stereopsis), strabismic patients may suffer from significant psychosocial problems including lower self-esteem, lower self-confidence, poor inter-personal relationship, less chance of employment, and poor performance in sports and at school.[1-12] Intelligence is an aspect of psychological adaptation and has been subjectively evaluated in strabismic patients[1-2] but objective evaluation is limited. This study was designed to objectively determine intelligence quotient in strabismic patients.

METHODS

This prospective cross-sectional case series was performed at our strabismus clinic from November 2007 to November 2008. The study was approved by the Ethics Committee of the Ophthalmic Research Center and informed consent for employing the intelligence quotient (IQ) test was obtained from all participants or their legal guardians. All patients older than 4 years of age with congenital strabismus who were referred to our center and scheduled for surgery were included for the current study if they were cooperative for IQ tests. Indications for surgery included horizontal deviation exceeding 15 prism dioptres (PD) and vertical deviation producing cosmetic problems or leading to abnormal head posture. Exclusion criteria were metabolic disorders such as phenylketonuria (PKU) and Maple syrup disease (MSD), or neurologic disorders which could affect intelligence such as convulsions, hydrocephaly or microcephaly; psychiatric disorders such as schizophrenia and bipolar disorder; and history of any ocular surgery or acquired strabismus.

Patient information included age, sex, educational level of the patients and their parents (or guardians), and area of residence (urban versus rural). The outcomes of a complete eye examination by a strabismologist including corrected visual acuity (VA), type and magnitude of eye deviation, and refractive errors were documented. Presence or absence of amblyopia was also evaluated. Other routine tests included slit lamp and fundus examinations.

All IQ tests were performed by one of three psychologists (ST, SV, and SZ) on the day before surgery in a separate room which was quiet, adequately lighted and air conditioned. Enough time (50-120 minutes) was allotted to perform the test for each patient. Patients were divided to three groups based on age. For each group, the test was specially adjusted for that age range: in preschool children (4-6 years) we performed the Wechsler preschool and primary scale of intelligence (WPPSI); in young children (7-13 years) we performed the Wechsler intelligence scale for children revised (WISC-R); in adolescents and adults (>13 years of age) we performed the Wechsler adult intelligence scale revised (WAIS-R).[13-16]

Intelligence tests were divided into two groups: verbal and performance. In verbal tests, the subtests included information, vocabulary, similarities, arithmetic, comprehension, sentences and digit span. The performance tests included animal house differentiation, picture completion, mazes, geometric design, block design, picture arrangement and object assembly coding.

From these subtests each patient accrued a crude number. This number was entered into special tables and three scores for each patient were extracted, one grading his/her verbal score, the other the performance score and the last one was the total score.[13-16] These figures were compared to the Wechsler scoring table[13-16] (Table 1).

Data analysis was performed employing the SPSS version 17 (IBM Corp., New York, NY, USA). Data were compared using the t-test; for correlations, the Spearman and Pearson tests were used. P values <0.05 were considered as statistically significant.

Table 1. Intelligence quotient (IQ) scores in the study population compared to a normal Iranian population

IQ level	IQ score	Expected frequency (%)	Observed frequency (%)	Difference
Very superior	>130	2.7	0	-2.7
Superior	120-129	8.8	2 (1.8)	-6.8
Bright	110-119	18.6	6 (5.5)	-12.6
Normal	90-109	51.8	32 (29.4)	-19.8
Subaverage	80-89	16.8	30 (27.5)	+13.2
Borderline	70-79	8.3	16 (14.7)	+7.7
Retarded	<70	2.5	23 (21.1)	+20.5
Total	–	109.5	109 (100)	

*Sum of expected frequency is 0.5 more than the observed frequency because of rounding error (Difference=Observed frequency – Expected frequency).

RESULTS

Over a one-year period, 113 patients with congenital strabismus were scheduled for surgery. Three patients were excluded due to metabolic disorders or convulsions, and one patient refused to do the test. All other patients agreed to perform these tests.

One hundred and nine patients were evaluated including 58 (53.2%) male and 51 (46.8%) female subjects. Fourteen patients (12.8%) were in the preschool group, 34 patients (31.2%) in the young children group and 61 patients (56%) in the adult group. Mean age of the patients was 18.4±10.5 (range 4-63) years. Eighty-seven (79.8%) of subjects lived in urban areas and 22 patients (20.2%) came from rural regions.

Total mean verbal IQ score was 87.2±19.6 (range, 45-127), performance IQ score was 81±15.5 (range, 44-111) and total IQ score was 83.5±18.3 (range, 40-120). The mean normal value for these scores when the standardized test is used for any population must be 100±15.[16,17] Comparing these IQ scores with norms in the Iranian population revealed that mean IQ level in these patients was lower than expected in the same age group (P<0.01) (Table 1 and Fig. 1).

Educational level of the patients is tabulated against area of residence in table 2. The mean educational level of urban patients was higher than their rural counterparts (P=0.06). This also held true for fathers and mothers of patients from urban areas in comparison to rural subjects

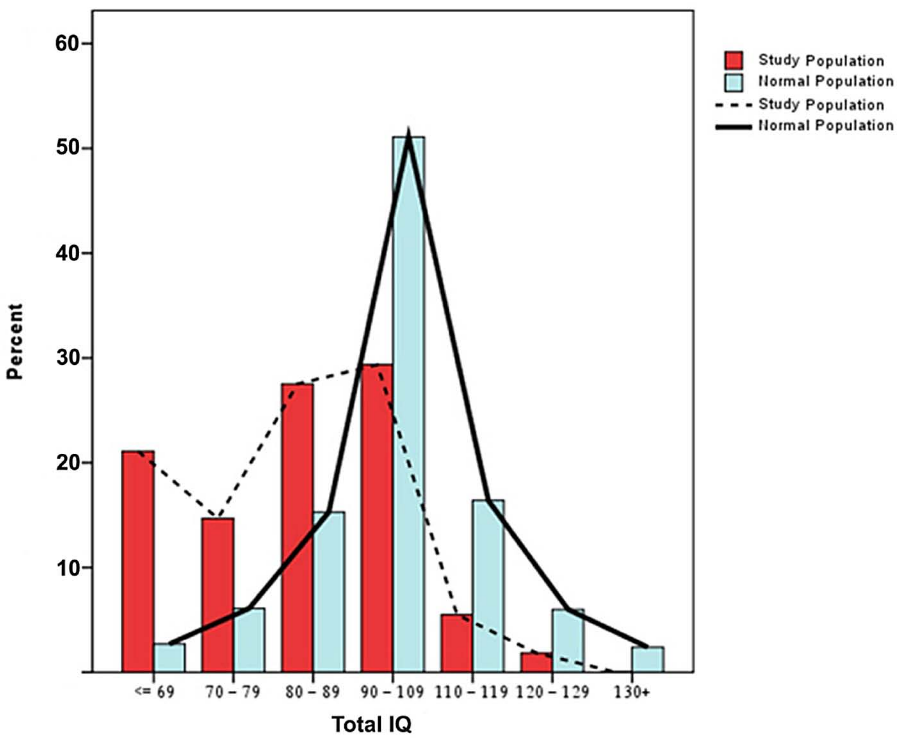

Figure 1. Distribution of intelligence quotient (IQ) scores in study patients compared to the normal population

Table 2. Educational level of patients according to area of residence

	Illiterate	Primary school	Mid school	High school	University	Total
Urban	3 (%4)	24 (%32)	12 (%16)	22 (%29.3)	14 (%18.7)	75 (%100)
Rural	2 (%10)	9 (%45)	4 (%20)	5 (%25)	-	20 (%100)
Total	5 (%5.3)	33 (%34.8)	16 (%16.8)	27 (%28.4)	14 (%14.7)	95 (%100)

*14 preschool children are not included in this table

(P=0.005 for fathers and P=0.04 for mothers).

There was a positive correlation between the educational level of the patients and their IQ score (r=0.61 for total IQ, P<0.0001, Spearman test), but no correlation was observed between the level of parents' education and patients' IQ score (r=0.02 for total IQ score, P=0.8, Spearman test).

Mean IQ score according to the area of residence is presented in table 3. Verbal, performance and total IQ scores were significantly higher in urban residents than rural subjects.

In 108 patients who were cooperative for vision, 46 patients (%42.2) had amblyopia, of whom 32 had unilateral (%29.4) and 14 had bilateral (%12.8) amblyopia. Mean IQ level in relation to amblyopia is presented in table 4. Even though amblyopic patients had lower IQ levels than non-amblyopic counterparts, t-test showed no significant difference in this regard (P>0.05). Lower visual acuity was not significantly associated with less IQ scores. (r=-0.12 for binocular vision, P=0.2, Pearson test).

Evaluation of refractive errors showed that 25 patients (%22.9) were myopic, 25 patients (%22.9) were emmetropic and 44 patients (%40.4) were hyperopic. Six patients (%5.5) were emmetropic/hyperopic, 5 patients (%4.6) were emmetropic/myopic, and 4 patients (%3.7) were myopic/hyperopic which we collectively labelled as the mixed group. Mean level of hyperopia was 1.6±1.3 (range, 0.25-4.50) D and that for myopia was -2±2.5 (range, -0.25 to -10.75) D. Verbal IQ was higher in myopes than emmetropes and hyperopes, even though not statistically significant (Table 5; P>0.05, for all comparisons). Other IQ scores were comparable regardless of refractive error (Table 5).

Overall, 40 patients (%36.7) were purely exotropic (XT), 43 patients (%39.4) were purely esotropic (ET), 9 patients (%8.3) had only vertical deviations, 10 patients (%9.2) had XT with vertical deviations and 7 patients (%6.4) had ET with vertical deviations which we termed the mixed type (Fig. 2). Mean XT was 35.6±17.3 (range, 5-70) PD and mean ET was 34.5±13.6 (range, 8-80) PD. The severity of deviation was not correlated with IQ score (r= -0.14 for total IQ score, P=0.1, Pearson test). IQ evaluation in these groups is presented in table 6. Although mean IQ score in the pure vertical deviation group was higher than patients with ET, and these were also higher than patients with XT, the differences were not statistically significant (P>0.05, for all comparisons).

Twenty-six (23.9%) patients had vertical deviations including 9 (8.3%) patients with pure vertical deviations, and 17 (15.6%) patients with mixed horizontal and vertical deviations (Fig. 3). Mean IQ score of each of these groups

Table 3. Comparison of intelligence quotient (IQ) score according to area of residence

	Mean verbal IQ	Mean performance IQ	Mean total IQ
Urban	88.7±20.9	82.5±16.2	85.1±19.5
Rural	81.7±11.9	75.6±10.8	77.3±10.8
P value (T-test)	0.05	0.07	0.02

Table 4. Relation between amblyopia and intelligence quotient (IQ) scores

	Verbal IQ	Performance IQ	Total IQ
No amblyopia	89±19.8	82.8±14.8	85.5±18.2
Unilateral amblyopia	88.7±18.2	79.3±14.6	83.5±17.5
Bilateral amblyopia	78.6±18.9	77.7±20.4	76.4±19.6
P value (ANOVA)	0.2	0.4	0.2

Table 5. Mean intelligence quotient (IQ) scores according to refractive errors

	Frequency (%)	Verbal IQ	Performance IQ	Total IQ
Myope	25 (22.9)	92.6±21.0	81.8±16.7	87.2±19.7
Hyperope	44 (40.4)	83.9±19.5	82.0±16.4	87.2±19.7
Emmetrope	25 (22.9)	86.9±18.3	81.3±14.0	83.2±16.6
Mixed*	15 (13.8)	88.6±19.3	81.7±14.5	84.5±17.0
P value (ANOVA)	–	0.4	>0.9	0.6

*Mixed type had different refractive state in fellow eyes

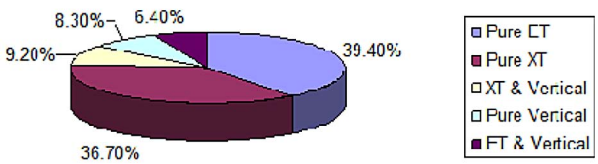

Figure 2. Frequency of different types of deviation

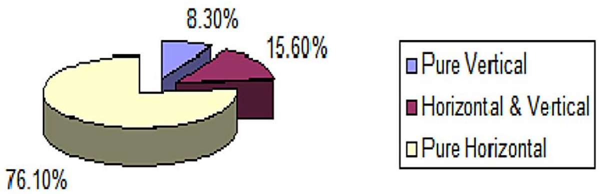

Figure 3. Frequency of different types of deviation

is presented in table 7. Although mean IQ score in patients with pure vertical deviations was higher than those with mixed and pure horizontal deviations, the observed difference did not reach statistical significance.

Eye deviation was constant in 58 (53.2%) patients and alternate in 51 (46.8%) patients. The correlation between IQ scores and constant versus alternate deviation is presented in table 8. Absolute values for mean refractive error in the constant group was 1.2±1.2 D versus 1.5±0.2 D in the alternate group (P=0.5). In the constant deviation group, horizontal deviation was significantly smaller (26±18.8 versus 38.7±14.5 PD) and vertical deviation was significantly greater (7.7±9.8 versus 0 PD) as compared to the alternate deviation group (both P values <0.001, t-test) which may be the cause of higher IQ scores.

DISCUSSION

Intelligence is the ability to deal appropriately with problems and to select priorities in different situations. It is somehow related both to genetic background in addition to acquired and cultural factors.[16,17]

The Wechsler test is the most popular tool for evaluating IQ and has been standardized for our population in a large series of people.[13-15] Other tests such as the Kaufmann assessment battery for children (K-ABC) and Stanford Binet, 4th edition (SB-IV) can also be used; however, they have not been standardized for our population.[16]

The correlation between IQ and refractive errors has been extensively studied and myopic children have been reported to be more intelligent than their classmates.[18-26] This was also observed in myopic strabismic cases in our study.

However, studies on mentally retarded children and cases of cerebral palsy have shown that ophthalmic disorders including strabismus are more common in these patients.[27-31] The

Table 6. Intelligence quotient (IQ) scores according to the type of deviation

	Frequency (%)	Verbal IQ	Performance IQ	Total IQ
Vertical	9 (8.3)	94.9±21.0	88.1±14.5	90.8±17.6
Mixed	17 (15.6)	91.9±23.0	83.8±17.8	88.6±22.5
Esotropia	43 (39.4)	86.2±17.3	80.9±14.4	82.8±16.2
Exotropia	40 (36.7)	84.6±20.0	78.3±15.6	80.5±18.6
P value (ANOVA)	–	0.4	0.3	0.3

Table 7. Intelligence quotient (IQ) scores according to the type of deviation

Deviation	Frequency (%)	Verbal IQ	Performance IQ	Total IQ
Pure vertical deviation	9 (8.3)	94.9±12.0	88.1±14.5	90.8±17.6
Mixed deviation	17 (15.6)	91.9±23.0	83.8±17.8	88.6±22.5
Pure horizontal deviation	83 (76.1)	85.4±18.6	79.7±15.0	81.6±17.3
P value (ANOVA)	–	0.2	0.2	0.2

Table 8. Mean intelligence quotient (IQ) scores in constant and alternate strabismus

Deviation	Verbal IQ	Performance IQ	Total IQ
Constant	90.1±18.6	83.0±13.9	86.4±16.9
Alternate	84.0±20.3	78.9±16.9	80.1±19.5
P value (t-test)	0.1	0.2	0.07

frequency of ocular abnormalities reached 77% in mentally retarded subjects[27] and 68% in cerebral palsy cases.[29,30] These findings may confirm a relationship between mental status and ocular alignment, as also suggested in our study.

Contrary to some previous studies reporting that patients with XT were more intelligent than patients with ET,[1,3] our exotropic subjects were less intelligent than esotropic counterparts. We also found that strabismic patients with vertical deviations were more intelligent than patients with horizontal deviations; this is a previously unreported finding which may be due to compensatory mechanisms for vertical deviations such as abnormal head posture.

Nelson et al[2] reported a correlation between severity of deviation and psychological parameters, however we did not observe such a relationship. We found that patients with constant deviations were more intelligent than patients with alternate deviations. This observation is consistent with the study by Haskell and Hughes[32] who believe constant squinters receive a more stable image of the world and therefore may be more intelligent than alternate squinters.

All of our patients were less intelligent than the general population and we did not see any exceptional (very superior) person among them; the frequency of superior, bright and even average (normal) patients were perceptibility lower than expected. On the other hand, the frequency of dull (sub-normal), borderline and retarded individuals was greater than expected in the general population. Performance IQ was more severely affected than verbal IQ in our cases, which has previously been reported for refractive errors;[21] this finding may be related to change in the visual field and quality of the subject’s perception. For example, a study has shown that completion of images requires a combination of concentration, argumentation, visual attention, visual memory and visual sensorial organization.[13] This underscores the significance of the acquired component of IQ in relation to genetic background and also confirms that IQ is pleotropic.[26]

Verbal IQ in our patients was higher than performance IQ and IQ scores decreased with lower VA. This finding suggests that visual defects may play a role in lower IQ scores in patients with strabismus. In addition to visual perception, IQ is related to other sensorial pathways; collectively lower IQ may be secondary to certain neurological problems in cases of congenital strabismus leading to slower comprehension and judgement.[33]

Intelligence is highly dependent on circumferential causes in addition to background genetic factors.[16,17] However, contrary to a previous study,[13] we found no correlation between the parents’ education and patients’ IQ. We did observe a positive correlation between patient education and IQ scores which confirms the effect of training.

Poor cosmesis associated with strabismus may decrease self-esteem and self-confidence causing social phobia, and hinder social relationships,[1-12, 34-36] possibly leading to lower success in passing IQ tests.

Drawbacks to our study include the small sample size and lack of a control group. Additionally, the current study could not exclude certain subclinical psychological factors such as anxiety and depression which are known to affect IQ scores.[16,17,33] Furthermore, we did not evaluate the IQ postoperatively to determine the effect of surgery on IQ. The positive effect of strabismus surgery on quality of life and other psychological aspects has been previously reported.[37-40] Treating strabismus as soon as possible in addition to developing binocular vision[41-43] and stereopsis,[44] may improve social relationship of these patients.[37-40] The patients must know that strabismus is generally treatable and taboos regarding strabismus (poor success rate and high recurrence rate) must be challenged.[45] We can conclude from the present study that this surgery may help to improve IQ.

Conflicts of Interest

None.

REFERENCES

1. Olitsky SE, Sudesh S, Graziano A, Hamblen J, Brooks SE, Shaha SH. The negative psychosocial

impact of strabismus in adults. *J AAPOS* 1999;3:209-211.

2. Nelson BA, Gunton KB, Lasker JN, Nelson LB, Drohan LA. The psychosocial aspect of strabismus in teenagers and adults and the impact of surgical correction. *J AAPOS* 2008;12:72-76.
3. Uretmen O, Egrilmez S, Kose S, Pamukcu K, Akkin C, Palamar M. Negative social bias against children with strabismus. *Acta Ophthalmol Scand* 2003;81:138-142.
4. Satterfield D, Keltner JL, Morrison TL. Psychosocial aspects of strabismus study. *Arch Ophthalmol* 1993;111:1100-1105.
5. Beanchamp GR, Black BC, Coats DK, Enzenauer RW, Hutchinson AK, Saunders RA, et al. The management of strabismus in adults--III. The effect on disability. *J AAPOS* 2005;9:455-459.
6. Akay AP, Cakaloz B, Berk AT, Pasa E. Psychosocial aspect of mothers of children with strabismus. *J AAPOS* 2005;9:268-273.
7. Hatt SR, Laske DA, Kirgis PA, Bradley EA, Holmes JM. The effects of strabismus on quality of life in adults. *Am J Ophthalmol* 2007;144:643-647.
8. Archer SM, Musch DC, Wren PA, Guire KE, Del Monte MA. Social and emotional impact of strabismus surgery on quality of life in children. *J AAPOS* 2005;9:148-151.
9. Coats DK, Paysse EA, Towler AJ, Dipboye RL. Impact of large angle horizontal strabismus on ability to obtain employment. *Ophthalmology* 2000;107:402-405.
10. Jackson S, Harrad RA, Morris M, Rumsey N. The psychosocial benefits of corrective surgery for adults with strabismus. *Br J Ophthalmol* 2006;90:883-888.
11. Bez Y, Coskun E, Erol K, Cingu AK, Eren Z, Topcuoglu V, et al. Adult strabismus and social phobia: a case-controlled study. *J AAPOS* 2009;13:249-252.
12. Menon V, Saha J, Tandon R, Mehta M, Khokhar S. Study of the psychosocial aspect of strabismus. *J Pediatr Ophthalmol Strabismus* 2002;39:203-208.
13. Razavieh A , Shahim S. Wechsler Preschool and Primary Scale of Intelligence(WPPSI) 4th ed: Shiraz University; 2008:3-41 (Iranian local journal)
14. Shahim S. Wechsler Intelligence Scale for Children-Revised (WISC-R).4th ed. Shiraz: Shiraz University; 2006. Chap 2: 5-30 (Iranian local journal)
15. Orangi M, Baraheni M N. Wechsler adult Intelligence Scale-Revised (WAIS-R).1st ed. Shiraz: Kushamehr publication. 2006:15-67. (Iranian local journal)
16. Palumbo D, Lynch P. Psychological testing in adolescent medicine. *Adolesc Med Clin* 2006;17:147-164.
17. Sadock BJ, Sadock VA. Clinical neuropsychological testing for intelligence and personality. In: Kaplan and Sadock's synopsis of psychiatry: Behavioral sciences/Clinical Psychiatry, 10th ed. Philadelphia, Lippincott, Williams & Wilkins. 2007, Chap 5: 178-184.
18. Dolezalova V, Mottlova D. Relation between myopia and intelligence. *Cesk Slov Oftamol* 1995;51:235-239.
19. Saw SM, Tan SB, Fung D, Chia KS, Koh D, Tan DT, et al. IQ and the association with myopia in children. *Invest Ophthalmol Vis Sci* 2004;45:2943-2948.
20. Saw SM, Cheng A, Fong A, Guzzard G, Tan DT, Morgan I. School grades and myopia. *Ophthalmic Physiol Opt* 2007;27:126-129.
21. Williams SM, Sanderson GF, Share DL, Silva PA. Refractive error, IQ and reading ability: a longitudinal study from age seven to 11. *Dev Med Child Neurol* 1988;30:735-742.
22. Tay MT, Au Eong KG, Ng CY, Lim MK. Myopia and educational attainment in 421116 young Singaporean males. *Ann Acad Med Singapore* 1992;21:785-791.
23. Miller EM. On the correlation of myopia and intelligence. *Genet Soc Gen Psychol Monogr* 1992;118:361-383.
24. Teasdale TW, Fuchs J, Goldschmidt E. Degree of myopia in relation to intelligence and educational level. *Lancet* 1988;2:1351-1354.
25. Rosner M, Belkin M. Intelligence, education and myopia in males. *Arch Ophthalmol* 1987;105:1508-1511.
26. Cohn SJ, Cohn CM, Jensen AR. Myopia and intelligence: a pleiotropic relationship? *Hum Genet* 1988;80:53-58.
27. Sandfeld Nielsen L, Skov L, Jensen H. Visual dysfunctions and ocular disorders in children with developmental delay. II. Aspects of refractive errors, strabismus and contrast sensitivity. *Acta Ophthalmol Scand* 2007;85:419-426.
28. Akinci A, Oner O, Bozkurt OH, Guven A, Degerliyurt A, Munir K. Refractive errors and ocular findings in children with intellectual disability: a controlled study. *J AAPOS* 2008;12:477-481.
29. Lagunju IA, Oluleye IS. Ocular abnormalities in children with cerebral palsy. *Afr J Med Med Sci* 2007;36:71-75.
30. Govind A, Lamba PA. Visual disorders in cerebral palsy. *Indian J Ophthalmol* 1988;36:88-91.
31. Katoch S, Devi A. Ocular defects in cerebral palsy. *Indian J Ophthalmol* 2007; 55:154-156.

32. Haskell SH, Hughes VA. Some observations on the performance of squinters and non-squinters on the Wechsler intelligence scale for children. *Percept Mot Skills* 1965;21:107-112.

33. Shevell M. Global developmental delay and mental retardation or intellectual disability: conceptualization, evaluation and etiology. *Pediatr Clin North Am* 2008;55:1071-1084.

34. Paysse EA, Steele EA, McCreery KMB, Wilhelmus KR, Coats DK. Age of the emergence of negative attitudes toward strabismus. *J AAPOS* 2001;5:361-366.

35. Kostanski M, Gullone E. Adolescent body image dissatisfaction: relationships with self-esteem, anxiety and depression controlling for body mass. *J Child Psychol Psychiatry* 1998;39:255-262.

36. Rumsey N, Harcourt D. Body image and disfigurement: issues and interventions. *Body Image* 2004;1:83-97.

37. Lilakova D, Hejcmanova D, Novakova D. Effect of strabismus on the quality of life in adults. *Cesk Slov Oftalmol* 2003;59:184-187.

38. Mruthyunjaya P, Simon JW, Pickering JD, Lininger LL. Subjective and objective outcomes of strabismus surgery in children. *J Pediatr Ophthalmol Strabismus* 1996;33:167-170.

39. Jackson S, Harrad RA, Morris M, Rumsey N. The psychological benefit of corrective surgery for adults with strabismus.*Br J Ophthalmol* 2006;90:883-888.

40. Burke JP, Leach CM, Davis H. Psychological implications of strabismus surgery in adults. *J Pediatr Ophthalmol Strabismus* 1997;34:159-164.

41. Mets MB, Beauchamp C, Haldi BA. Binocularity following surgical correction of strabismus in adults. *J AAPOS* 2004;8:435-438.

42. Kushner BJ, Morton GV. Postoperative binocularity in adults with longstanding strabismus. *Ophthalmology* 1992;99:316-319.

43. Kushner BJ. Binocular field expansion in adults after surgery for esotropia. *Arch Ophthalmol* 1994;112:639-643.

44. Fawcett SL, Stager DR, Felius J. Factors influencing stereoacuity outcomes in adults with acquired strabismus. *Am J Ophthalmol* 2004;136:931-935.

45. Coats DK, Stager DR Sr, Beauchamp GR, Stager DR Jr, Mazow ML, Paysse EA, et al. Reasons for delay of surgical intervention in adult strabismus. *Arch Ophthalmol* 2005;123:497-499.