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A study comparing intelligence scores of patients of hypermetropia and myopia in children

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Abstract

This study aimed to evaluate the association between intelligence and refractive error in children. Children with refractive error were consecutively enrolled from the outpatient eye disease clinic at the blinded for peer review. Seventy-six Turkish children were thirty-two female and Forty-four male, aged 6–16 years, participated in this study. Wechsler Intelligence Scale for Children Revised was used for Intelligence quotient. Full Intelligence quotient score and verbal Intelligence quotient, picture completion, similarities comprehension, digit span subgroups in children with myopia were higher than that of hypermetropia group ($p<0.05$). Present study indicated cognitive ability in children with myopia is higher than that of hypermetropia children. The mechanisms of high cognitive ability in children with myopia should be described in further studies.

Keywords: intelligence, children, hypermetropia, myopia

1. Introduction

Vision problems in childhood are frequently seen (1). Myopia, is a kind of vision impairment, is a defect where by rays of light from a distant object come to focus in front of the retina rather than on it and it resulting in the observer seeing a blurred image (2). Also, it is known that, in hypermetropia the light falls behind the retina because of a short eye or insufficiently curved cornea and it is difficulty seeing close objects clearly (2).

Myopia and hypermetropia are seen more frequently than other visual impairments and the prevalence is increasing globally.(3). In Turkey, a study done in year of 2007, it was founded that about one-third of Turkish medical students had myopia (4), while a met-analyse showed that close to half of the world's population may be myopia by 2050 (5).

There are many literatures about the reasons of myopia. The risk factors like environmental factors such as time spent outdoors (6), near work, educational level and parental history, a possible indicator of genetic susceptibility, are most often investigated (7, 8). In another study, it was revealed factors associated with reading may play a part in myopia development (9).

Association between intelligence with visual function in children is being investigated frequently in the recent period (9–15). A review concerning the relation between refractive errors and intelligence quotient (IQ) concluded that children with myopia may have a higher IQ probably identified by genetic and environmental factors (16). Large eyes (as measured by axial length) may lead to myopia and large brains may be more intelligent. This relation may arise because of a single genetically controlled mechanism affecting both brain size and eye size. It was found that no statistically appreciable difference in measured intelligence, thus suggesting that the myopia and high intelligence may be more related to environment than any other factor (17). At the same time, there is uncertainty about whether IQ is associated with myopia; some authors say that near-work activity result children perform better in IQ tests (1). Additionally, in a study which determined whether myopia is associated with cognitive function, it was founded that cognitive function, especially verbal intelligence, was strongly and consistently associated with myopia among adolescents (18). Further, some studies suggested that the most frequent refractive error was mixed astigmatism and followed by hypermetropia, in children with intellectual disabilities (8).

Because of myopia is a leading cause of visual impairment worldwide, we aimed to investigate whether the intelligence test based on the type of visual deficits in children with visual impairment in this study.

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2. Materials and Methods

The study was designed case-control and cross sectional. Children with refractive error were consecutively enrolled from the outpatient Eye Diseases clinic at the blinded for peer review. Seventy-six Turkish children which thirty-two females and forty-four males, aged 6–16 years, participated in this study. All children underwent a detailed ocular examination including ocular history, ocular motility assessment, external inspection of the eyes and lids, vision assessment, fundus and pupil examination. Exclusion criteria's for the study are presence of motor deficits, poor head control, anti-convulsive treatment, previous eye operations and speech problems.

Wechsler Intelligence Scale for Children—Revised (WISC-R) was used for Intelligence quotient (IQ). The WISC-R is an intelligence test prepared by David Wescler in 1939. The test, first appeared for adults, has been redesigned for children. The WISC-R test is suitable for children aged 6 to 16 years. This individually administered test takes 1-1.5 hours. The WISC-R test is divided into two main sections; the Verbal and Performance Sections, each with six subtests (19). The Verbal Section assesses Information, Similarities, Comprehension, Arithmetic, Digit Span and Vocabulary. We used five verbal subtests of the WISC-R: Information, Similarities, Comprehension, Arithmetic and Digit Span. The Performance Scale measures are Picture Arrangement, Picture Completion, Object Assembly, Block Design, Coding and Labyrinths. The WISC-R by Savasir et al was translated and standardized in Turkey in 1997 (20).

We used five efficiency tests of the WISCR: Picture Completion, Arrangement, Block Design, Object Assembly and Coding. The Verbal IQ and Performance IQ acquired from the test are the brief measures of verbal and efficiency skills, and the Full Scale IQ, based on the 10 tests included in the Verbal IQ and Performance IQ scales, is a general measure of intellectual functioning.

Protocol adhered to the tenets of the Declaration of Helsinki and all patients provided written informed consent. This study was approved by the local ethics committee and written informed consent was obtained from the parents of subjects.

2.1. Statistical analysis

Statistical analysis was performed using SPSS software (version 18, SPSS Inc). All clinical variables were evaluated as mean±SD. The categorical variables with the x^2 test and continuous data with student *t* and Mann-Whitney tests were compared. The proportional contribution of confounding factors to IQ to determine was performed multiple stepwise linear regression tests. *p* -value < 0.05 is considered to be statistically significant.

3. Results

Table 1 shows characteristics of the myopia and hypermetropia groups. Subtest scores and composite scores of the myopia and hypermetropia groups are seen in Table 2. Children with myopia had a higher IQ score compared to hypermetropia group at all scales significantly (*p* =0.03).

Table 1. Characteristics of the myopia and hypermetropia group

Characteristic	Myopia N=20	Hypermetropia N=56	P value
Age	9.0±2.4	9.2±2.5	0.7
Gender (f/m)	11/9	21/35	0.1
Education	1.1±0.5	1.2±0.6	0.4

Table 2. Subtest scores and composite scores of the myopia and hypermetropia group

WISC-R Scores	Myopia N=20	Hypermtropia N=56	*p*
Full Scale IQ	98.4±20.3	86.1±26.4	**0.03**
Verbal IQ	99.6±16.4	89.5±19.7	**0.03**
Performance IQ	48.0±11.3	43.0±14.1	0.10
Similarities	12.0 ± 4.9	9.0 ± 4.6	**0.01**
Information	9.5 ± 3.0	8.3 ± 3.6	0.10
Digit Span	10.6± 2.6	9.1 ± 3.0	**0.04**
Arithmetic	10.1 ± 2.6	9.5 ± 3.8	0.50
Comprehension	8.3 ± 3.0	6.6 ± 3.1	**0.04**
Picture completion	10.3± 3.8	8.1 ± 3.3	**0.01**
Picture arrangement	8.2 ± 3.7	8.1 ± 4.4	0.90
Block design	9.7 ± 3.9	9.0 ± 5.2	0.60
Object assembly	10.4 ± 1.8	9.7 ± 3.3	0.30
Coding	9.3 ± 3.5	8.4 ± 3.2	0.30

Ten subtests scores: each with M=10, SD=3, Three composite scores: verbal, performance, full scale, each with M=100, SD=15

Verbal IQ, similarities, digit span, picture completion and comprehension scores were higher in myopia group compared to hypermetropia group, too. (respectively; *p*=0.03, *p*=0.01, *p*=0.04, *p*=0.01, *p*=0.04).

Ten subtests scores: each with M=10, SD=3, Three composite scores: verbal, performance, full scale, each with M=100, SD=15

Table 3 reveals significant relationship between cognitive ability, measured by Full Scale IQ score as dependent variable and myopic group, age, gender as independent variables in multivariate model.

Table 3. Relationship between cognitive ability as dependent variable and age, gender as independent variables in only myopic children in multivariate model

Multivariate model	Full Scale IQ score	
	β	*p* value
	R^2=0.33	
Intercept		**0.0001**
Age	-0.53	**0.0001**
Gender(male)	-0.12	0.2
Education	0.12	0.5
Myopic group	0.19	**0.04**

*β is the standardized regression coefficient

4. Discussion

According to literature, there have been many inherited and

acquired factors affecting intelligence scores (21). Some studies relieved the relationship between reading and IQ scores; anymore reading books may cause pathological eye growth and myopic refractive error. There was a positive correlation between academic success and myopia as independent of relation with reading book and IQ test scores in another study by Saw et al (12). Like this, there are some finding about the association higher educational achievements more often were myopic than individuals with less education (22). Saw et all postulated that myopic children, with their cumbersome glasses, may be less likely to play sports outdoors and more likely to spend time on their school studies, thus attaining their full 'potential' in educational and IQ tests (7). So, it is thought that for the development of myopia, near work, level of education, reading book has been considered environmental risk factors. In our study, there was no difference in educational levels between the two groups. A cohort study of the population-based Gutenberg Health Study revealed that cognitive performance is linked to myopia, too. However, this study suggests that education level is more directly and strongly related to myopia than to cognitive performance. Cognitive ability has been interpreted as being related to myopia with its effect on education level firstly (23). In this respect, the confusing effect of the educational level must be considered.

Performance component of IQ test, such as personality, intelligence, and discipline may be related with myopia as inherited. The children's IQ is important risk factors for incident myopia (11). Williams et al indicated that shared genetic factors contribute significantly to the covariance between myopia and intelligence (24). In a study in school population, myopic students had higher score on IQ tests than non-myopias (10). Another study which done with twins was published in 2015 and revealed that evidence for genetic pleiotropy between IQ and myopia. And they found that a higher IQ polygenic risk scores were associated with a lower spherical equivalent (25). As Verma at al. reviewed with analysed studies that there may be a positive association between myopia and high intelligence. While the mechanism of the link between these two phenomena is not clearly understood and is confounded by a number of factors, there is evidence to suggest that both environmental and genetic factors may contribute to this relationship (26). In a study which done with 3 to 7-year-old Strabismic and Nonstrabismic Children in an Iranian Population, did not found a significant negative interference of strabismus on IQ score of preschool children (27). Considering all these studies, there seems to be a common genetic basis of between intelligence and myopia, in this respect, further studies on genetic regions are needed.

Therefore, we have thought that the developmental genetic foundations of the relation between intelligence and myopia must be investigated and the effects of the environmental factors must be revealed.

Another study compared a group of 14-year-old myopic children with hypermetropia children of the same age and reported that myopic students were more intelligent than that their poors of the same age (13). And there are some studies suggesting that hypermetropia is probably disadvantageous when performing a intelligence test and that it has lower scores as it cannot adapt to the test (28). In our study, a significant difference was found between these two groups and myopic group's intelligence scores were higher than hypermetropic group; cognitive ability in children with myopia is higher than that of hypermetropic children. In this respect, it is one of the rare studies comparing myopic and hypermetropic groups in terms of intelligence scores.

The mechanisms of high cognitive ability in children with myopia should be studied in further studies both environmental and genetic factors. Because of our study is cross sectional, causality must be revealed by follow-up studies. By increasing the number of the participants, it will be possible to obtain more reliable results with repetitive studies. Thus, it is possible to understand the factors affecting the intelligence score and its relationship with visual function.

Conflict of interest

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript. This manuscript has not been submitted to, nor is under review at, another journal or other publishing venue.

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References

1. Kaur G, Koshy J, Thomas S, Kapoor H, Zachariah JG, Bedi S. Vision Screening of School Children by Teachers as a Community Based Strategy to Address the Challenges of Childhood Blindness. J Clin Diagn Res. 2016 Apr;10(4):NC09-14.
2. Curtin BJ. The myopias : basic science and clinical management,Harper and Row,Philadelphia Pa, USA. USA; 1985.
3. Williams KM, Bertelsen G, Cumberland P, Wolfram C, Verhoeven VJM, Anastasopoulos E, et al. Increasing Prevalence of Myopia in Europe and the Impact of Education. Ophthalmology. 2015 Jul;122(7):1489–97.
4. Onal S, Toker E, Akingol Z, Arslan G, Ertan S, Turan C, et al. Refractive errors of medical students in Turkey: one year follow-up of refraction and biometry. Optom Vis Sci Off Publ Am Acad Optom. 2007 Mar;84(3):175–80.
5. Holden BA, Fricke TR, Wilson DA, Jong M, Naidoo KS,

Sankaridurg P, et al. Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050. Ophthalmology. 2016 May;123(5):1036–42.

6. Sherwin JC, Reacher MH, Keogh RH, Khawaja AP, Mackey DA, Foster PJ. The association between time spent outdoors and myopia in children and adolescents: a systematic review and meta-analysis. Ophthalmology. 2012 Oct;119(10):2141–51.

7. Saw SM, Katz J, Schein OD, Chew SJ, Chan TK. Epidemiology of myopia. Epidemiol Rev. 1996;18(2):175–87.

8. Morgan IG, French AN, Ashby RS, Guo X, Ding X, He M, et al. The epidemics of myopia: aetiology and prevention. Prog Retin Eye Res. 2018;62:134–49.

9. Williams C, Miller LL, Gazzard G, Saw SM. A comparison of measures of reading and intelligence as risk factors for the development of myopia in a UK cohort of children. Br J Ophthalmol. 2008 Aug;92(8):1117–21.

10. Dolezalová V, Mottlová D. [Relation between myopia and intelligence].[Article in Czech]. Cesk Slov Oftalmol. 1995 Sep;51(4):235–9.

11. Saw S-M, Tan S-B, Fung D, Chia K-S, Koh D, Tan DTH, et al. IQ and the association with myopia in children. Invest Ophthalmol Vis Sci. 2004 Sep;45(9):2943–8.

12. Saw S-M, Shankar A, Tan S-B, Taylor H, Tan DTH, Stone RA, et al. A cohort study of incident myopia in Singaporean children. Invest Ophthalmol Vis Sci. 2006 May;47(5):1839–44.

13. Saw S-M, Cheng A, Fong A, Gazzard G, Tan DTH, Morgan I. School grades and myopia. Ophthalmic Physiol Opt. 2007 Mar;27(2):126–9.

14. Akrami A, Bakmohammadi N, Seyedabadi M, Nabipour I, Mirzaei Z, Farrokhi S, et al. The association between schoolchildren intelligence and refractive error. Eur Rev Med Pharmacol Sci. 2012;16:908–11.

15. Karlsson JL. Genetic Factors in Myopia. Acta Genet Med Gemellol (Roma) [Internet]. 2014/08/01. 1976;25(1):292–4. Available from: https://www.cambridge.org/core/article/genetic-factors-in-myopia/B104F1D28B05813B0B1BC1EC6F1EB0C0

16. Czepita D, Lodygowska E, Czepita M. Are children with myopia more intelligent? A literature review. Ann Acad Med Stetin. 2008;54(1):13–6; discussion 16.

17. 1Miller EM. On the correlation of myopia and intelligence. Genet Soc Gen Psychol Monogr. 1992;118(4):361–83.

18. Megreli J, Barak A, Bez M, Bez D, Levine H. Association of Myopia with cognitive function among one million adolescents. BMC Public Health [Internet]. 2020;20(1):647. Available from: https://doi.org/10.1186/s12889-020-08765-8

19. Wechsler D. Wechsler Intelligence Scale for Children - Revised. New York: The Psychological Corporation; 1974.

20. Savaşır I, Şahin N. Wechsler Intelligence Scale for Children-Revised (WISC-R) manual (in Turkish). Turkish Assoc Psychol Ankara. 1995;

21. Pan C, Ramamurthy D, Saw S. Worldwide prevalence and risk factors for myopia. Ophthalmic Physiol Opt. 2012;32(1):3–16.

22. Mirshahi A, Ponto KA, Hoehn R, Zwiener I, Zeller T, Lackner K, et al. Myopia and level of education: results from the Gutenberg Health Study. Ophthalmology. 2014;121(10):2047–52.

23. Mirshahi A, Ponto KA, Laubert-Reh D, Rahm B, Lackner KJ, Binder H, et al. Myopia and cognitive performance: results from the Gutenberg Health Study. Invest Ophthalmol Vis Sci. 2016;57(13):5230–6.

24. Williams KM, Hysi PG, Yonova-Doing E, Mahroo OA, Snieder H, Hammond CJ. Phenotypic and genotypic correlation between myopia and intelligence. Sci Rep. 2017 Apr;7:45977.

25. Williams KM, Venturini C, Yonova EH, Hysi PG, Plomin R, Hammond CJ. Evidence for shared genetic factors between myopia and intelligence in the Twins Early Development Study (TEDS). Invest Ophthalmol Vis Sci. 2015 Jun 11;56(7):907.

26. Verma A, Verma A. A novel review of the evidence linking myopia and high intelligence. J Ophthalmol. 2015;2015:271746.

27. Ghaderpanah M, Farrahi F, Khataminia G, Jahanbakhshi A, Rezaei L, Tashakori A, et al. Comparing Intelligence Quotient (IQ)among 3 to 7-year-old strabismic and nonstrabismic children in an Iranian population. Glob J Health Sci. 2016 Jun;8(3):26–36.

28. Sorjonen K, Farioli A, Hemmingsson T, Melin B. Refractive state, intelligence, education, and Lord's paradox. Intelligence. 2017;61:115–9.