Contents lists available at ScienceDirect

Journal of Acute Disease

journal homepage: www.jadweb.org

Document heading doi: 10.1016/S2221-6189(13)60096-7

Incidence of the refractive errors in children 3 to 9 years of age, in the city of Tetovo, Macedonia

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ARTICLE INFO

Article history:
Received 9 November 2012
Received in revised form 15 January 2013
Accepted 15 March 2013
Available online 20 March 2013

Keywords:
Amblyopia
Refractive errors
Astigmatism
Strabismus

ABSTRACT

Objective: To determine the incidence of refractive errors at children 3 to 9 years of age in the area of Tetovo, Macedonia in rural and urban population. **Methods:** Population-based cross-sectional samples of children 3 to 9 years in rural and urban population were obtained through full ophthalmologic examination, and they underwent slit-lamp examination, ocular motility and refraction. They were presenting uncorrected and best-corrected visual acuity, along with refractive error under topical cycloplegia. Children 3 to 6 years of age with a visual acuity of 20/40 or worse and those 6 to 9 years of age with a visual acuity of 20/30 or worse underwent a complete ophthalmic examination to determine the cause of visual impairment. A spherical equivalent of -0.5 diopter (D) or worse was defined as myopia, +2.50 D or more was defined as hyperopia and a cylinder refraction greater than 0.75 D was considered astigmatism plus or minus. **Results:** The uncorrected visual acuity was 20/45 or worse in the better eye of 119 children, 59 male / 60 female (5.1% of participants). According to results of cycloplegic refraction, 1.6% of the children were myopic, 7.3% were hyperopic and the incidence rate of astigmatism was approximately 0.7%. In the multivariate logistic regression myopia and hyperopia were correlated with age ($P = 0.040$ and $P < 0.002$, respectively). **Conclusions:** The study showed a considerable prevalence rates of refractive errors myopia , hypermethropia , astigmatism and amblyopia at children of 3-9 years of age in Tetovo. There was no correlation between sex of the children's and the refractive errors founds. There was a correlation with the need for corrective spectacles and the refractive errors they represent. Refractive errors was registered in high percentage at rural area than in urban area. Although with best corrected vision the prevalence of impairment was less in urban than in rural populations, blindness remained nearly twice as high in the rural population as in the urban population with both baseline and best corrected visual acuity.

1. Introduction

1.1. Normal refraction

Refraction is the bending of light rays as they pass from one transparent medium to another medium with a different density. During vision, light that is reflected from an object is refracted by the cornea and lens and focused on the retina. In emmetropia (an eye with normal refractive error), parallel light rays from a distant object are brought into focus precisely on the retina, and a clear image is perceived (Figure 1). Perfect emmetropia rarely exists. The majority of individuals have some degree of refractive error, although most do not require correction.

1.2. Refractive errors

Refractive errors and / or squint may be present from an early age and persist into childhood Refractive errors are present when the optical image does not accurately focus

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on the retina. There are three types: myopia, hyperopia, and astigmatism (Figure 1, 2, 3). Refractive errors requiring correction are uncommon in preschool children[1] However, nearly 20 percent of children develop refractive errors that require the use of eyeglasses before late adolescence[2] Risk factors for refractive error include retinopathy of prematurity and family history of high refractive error.

1.2.1. Myopia

Myopia (nearsightedness) occurs when the refracting power of the eye is too strong. It commonly occurs when the anterior–posterior diameter of the eye is too long relative to the refracting power of the cornea and lens. The focal point of the image is anterior to the retina and the image that reaches the retina is blurred. Patients with myopia have better near vision than distance vision when they are uncorrected. The prevalence of myopia increases during and after puberty, when the eye undergoes its adolescent growth phase. Myopia is corrected with a concave spherical lens to focus the light rays on the retina. Mild myopia does not require correction. However, myopia[3] of any magnitude should be corrected if it alters a child's education or social function. Severe myopia (approximately >5 diopters) should be corrected, even in an apparently asymptomatic child, because of the risk of developing refractive amblyopia Degenerative myopia (sometimes also called progressive myopia) is similar to simple myopia except that the degenerative changes occur in the optic disk, choroid and retina, sclera, and vitreous, and are not related to the degree of myopia (i.e., the myopia does not increase; the structure of eye parts changes in such a way that visual function is negatively affected). Loss of central vision, retinal detachment, and vitreous opacities are typical: cataracts and secondary glaucoma may be additional complications. Progressive myopia is genetically determined as a recessive trait.

1.2.2. Hyperopia

Hyperopia (farsightedness) is the opposite of myopia. Hyperopia occurs when the refracting power of the eye is too weak. Most commonly, the hyperopic eye is too short relative to the refracting power of the cornea and lens. The focal point of the image is posterior to the retina, and the image that reaches the retina is blurred. High degrees of hyperopia are associated with amblyopia and accommodative esotropia. Mild hyperopia is the normal refractive state for infants and children. Children have the ability to "accommodate" or focus by contracting the ciliary body, which changes the shape and power of the lens and focuses the image appropriately on the retina. Without the ability to accommodate (eg, after cycloplegic drops), patients with hyperopia have better distance vision than near vision. Hyperopia is corrected with a convex spherical lens to focus the light rays on the retina. Mild hyperopia generally does not require optical correction in children. Higher degrees of hyperopia (ie, >4 diopters) should be corrected in asymptomatic children because of the risk of developing refractive amblyopia (Figure 5) and/or accommodative esotropia. Any degree of hyperopia may warrant correction if the child is symptomatic.

1.2.3. Astigmatism

Astigmatism (from Greek: "a" = lack of, "stigma" = point) occurs when the optical system of the eye, particularly the cornea, is not perfectly spherical. The refractive power of the eye is different in different meridians, and the light rays cannot be brought to a single point (Figure 3). Astigmatism may occur with myopia or hyperopia. Children with moderate or more severe astigmatism have difficulty performing visual tasks at both distance and near fixation. Astigmatism is corrected with a cylindrical lens. Astigmatism should be corrected in symptomatic children and in asymptomatic children with large degrees of astigmatism (ie, approximately >1.75 to 2 diopters)[4] Astigmatism may also be "mixed" (when myopia is combined with hyperopic astigmatism, or when hyperopia is combined with myopic astigmatism). Refractive errors tend to be inherited, but there is no pattern of inheritance. Size of the eyeball, shape of the cornea, shape of the lens, and depth of the anterior chamber are all variables in refractive errors. These variables increase the possible ocular combinations for refractive errors. Symptoms of myopia include squinting and frowning; hyperopia may cause a lack of interest in reading, rubbing of the eyes, or even headache, dizziness, or nausea. Astigmatism may cause visual fatigue, headaches, frowning, and squinting.

1.3. Treatment

Myopia[5] and hyperopia are treated by the use of spherical concave and convex lenses, respectively. Astigmatic corrections are cylindrical and are added to any prescription for myopia or hyperopia.

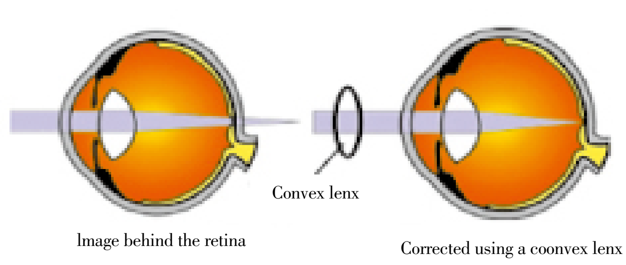

Figure 1. Hyperopic eye.

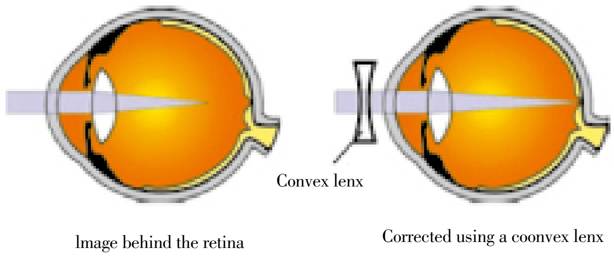

Figure 2. Myopic eye.

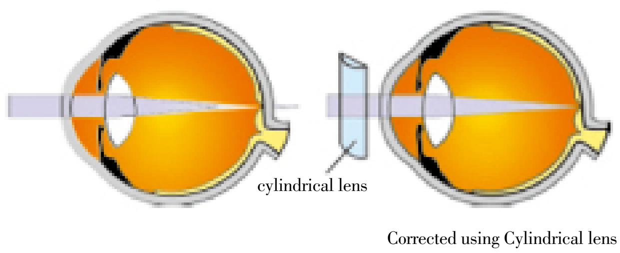

Figure 3. Astigmatic eye.

2. Materials and methods

Fieldwork was performed between July 2011 and January 2012, proceeding in Tetovo. 119 children was examinee 59 male and 60 female. The name age (completed years), gender, years of schooling were collected for each child 3to 9 years of age. Children with spectacles were requested to bring them on the day of the examination. Children who could not keep the scheduled date were given another date within the same week or were offered an examination near the end of the study. Age was verified before the examination process was initiated .All patients underwent retinoscopy examination under topical cycloplegia (Figure 4).

2.1. Clinical examination

Examinations were generally performed during standard clinic hours weekly. In brief, the examination included distance visual acuity measurements, ocular motility evaluation. Visual acuity was measured. The right eye was tested first and then the left, both with (presenting visual acuity) and without glasses (uncorrected visual acuity), if the child brought them. Ocular motility was evaluated at both 0.5 and 4.0 m. Subjective refraction was performed in children with uncorrected visual acuity of 20/40 or worse in either eye. The principal cause of visual impairment of 20/40 or worse was assigned after completion of the ocular examination, using a seven-item list (refractive error, amblyopia, corneal opacity due to corneal illness/ other corneal opacity, cataract, retinal disorder, other causes). Refractive error[6] was recorded as the cause of visual impairment in eyes improving to 20/32 or better with refractive correction. Amblyopia was considered the cause of impairment in eyes with best corrected visual acuity of 20/40 or worse and no apparent organic lesion. Children whose vision improved with refractive error correction in either eye were prescribed and spectacles were advised. Children needing medical or surgical treatment were referred to the rural eye center for treatment.

2.2. Management and Analysis

Prevalence of visual impairment (visual acuity 20/40 or worse) and blindness (visual acuity of <20/200) was calculated for uncorrected visual acuity, baseline (presenting) visual acuity, and best measured visual acuity. The latter measurement was based on subjective refraction obtained in those with reduced uncorrected visual acuity. A child was considered an emmetrope if neither eye was myopic or hyperopic, a myopic if either or both eyes had myopia, and a hyperope if one or both eyes had hyperopia, so long as neither eye had myopia. Age-specific prevalence of myopia and hyperopia were estimated. Population-based cross-sectional samples of children 3 to 9 years were obtained through full ophthalmologic examination, underwent slit-lamp examination, ocular motility and refraction. They were presenting uncorrected and best-corrected visual acuity, along with refractive error under topical cycloplegia. Children 3 to 5 years of age with a visual acuity of 20/40 or worse and those 5 to 9 years of age with a visual acuity of 20/30 or worse underwent a complete ophthalmic examination to determine the cause of visual impairment. A spherical equivalent of -0.5 diopter (D) or worse was defined as myopia, +2.50 D or more was defined as hyperopia, and a cylinder refraction greater than 0.75 D was considered astigmatism[4] plus or minus.

3. Results

The uncorrected visual acuity was 20/40 or worse in the better eye of 119 children, 59 male/60 female aged 3-9 years old (5.1%of participants). According to results of cycloplegic refraction, 1.6% (24/119) of the children were myopic, 7.3% (78/119) were hyperopic and the incidence rate of astigmatism was approximately 0.7% (17/119). In the multivariate logistic regression myopia and hyperopia were correlated with age (P = 0.040 and P < 0.002, respectively). The rate of myopia was higher. At rural area the incidence of refractive errors is higher than in urban area of Tetovo. The difference in visual impairment at initial examination between these urban and rural populations would have been even greater, the incidence for refractive error is 22.8% versus 7.3% in the rural population.

4. Discussion

This is a population-based cross-sectional survey of school–aged children between 3 and 9 years of age in a rural and urban population of Tetovo in Macedonia. Three and six year–olds were finding it very difficult to comprehend the visual acuity test particularly, those without prior schooling experience. Although with best corrected vision the prevalence of impairment was less in urban than in rural populations, blindness remained nearly twice as high in the rural population as in the urban population with both baseline and best corrected visual acuity. The burden of visual impairment in both urban and rural populations was mostly due to refractive error. The difference in visual impairment at initial examination between these urban and rural populations would have been even greater, approaching a threefold difference. Percentage of children in the urban population had correction for refractive error was 22.8%, versus 7.3% in the rural population. Review of age–specific data indicates that this low prevalence is not explained by the exclusion of 3 and 6 year olds in this rural population. There were no significant associations of age or gender with hyperopia. The age–related shift from hyperopia to myopia was not as prominent in our study population as in the urban population in Tetovo , which could be related to the increased intensity of schooling in the urban population compared with that in our rural population. Because of the cross sectional nature of these studies, it is possible to comment only on the association between refractive error prevalence and possible risk factors, and not on the more specific causes. Refractive error[7] was shown to be the leading cause of visual impairment among rural and urban children 3 to 9 years of age accounting for (58.8% of impairment, with amblyopia included).

Significant proportion of children of rural area had uncorrected refractory errors warrant urgent action to correct the visual error by providing adequate spectacles. This will further help to improve his/her school and social participation and psycho social development[8]. As the defective vision is obstacle to learning process and are prone to road accident. It also help to prevent the further deterioration of vision and blindness and irreversible changes in retina and macula. Many children with severe visual disability can benefit greatly from optical correction .Epidemiological studies are required to identify the refractory errors quantum and efforts are to be focused on the time correction of refractory errors to prevent irreversible visual loss and primary prevention of blindness .In this context, Information, education and communication amongst people in primary health care play important role in prevention and early detection of refractory errors[4]. Primary teacher, parents are also to be educated and made aware of early detection of refractory errors. In conclusion, significant visual impairment due to refractive error was found among and pre–school and school aged children living in a rural and urban district of Tetovo. Because most refractive error can be easily corrected with spectacles and because visual impairment can have a detrimental impact on education and development in a child's life, cost–effective strategies to eliminate this easily treatable cause of visual impairment are warranted. From a public health perspective, vision screening is an appropriate strategy to reduce vision impairment. Most of this impairment is caused by refractive error, for which treatment is simple, effective and inexpensive. A few factors should be considered, however, in establishing screening programs: First, vision screening should take place only if adequately trained personnel are available who can perform refraction of reasonable quality in children identified with vision impairment. Second, provision of good–quality and affordable spectacles should be an integral part of the vision–screening program. Third, an attempt should be made to include all pre–school, school–aged children. Fourth, target populations should be prioritized using available population–based data on the age distribution of refractive error.

Conflict of interest statement

We declare that we have no conflict of interest.

References

[1] Giordano L, Friedman DS, Repka MX. Prevalence of refractive error among preschool children in an urban population: the Baltimore pediatric eye disease study. *Ophthalmology* 2009; **116**: 739.

[2] Eye examination and vision screening in infants, children, and young adults. American Academy of Pediatrics Committee on Practice and Ambulatory Medicine, Section on Ophthalmology. *Pediatrics* 1996; **98**: 153.

[3] Lin LL, Shih YF, Tsai CB. Epidemiologic study of ocular refraction among schoolchildren in Taiwan in 1995. *Optom Vis Sci* 1999; **76**: 275.

[4] The Ophthalmic News & Education (O.N.E.) Network. Preferred Practice Pattern® guidelines. American Academy of Ophthalmology[Online]. Available at: www.aao.org/education/guidelines/ppp/index.cfm.[Accessed on November 20, 2007].

[5] Saw SM, Shih–Yen EC, Koh A, Tan D. Interventions to retard myopia progression in children: an evidence–based update. *Ophthalmology* 2002; **109**: 415.

[6] Kleinstein RN, Jones LA, Hullett S. Refractive error and ethnicity in children. *Arch Ophthalmol* 2003; **121**: 1141.

[7] Maly E. Frequency and natural history of retinopathy of prematurity (ROP). A prospective study in a Swedish city 1986–1990. *Acta Ophthalmol Suppl* 1993; **210**: 52.

[8] Daoud YJ, Hutchinson A, Wallace DK. Refractive surgery in children: treatment options, outcomes, and controversies. *Am J Ophthalmol* 2009; **147**: 573.