PREVALENCE OF REFRACTIVE ERRORS IN SCHOOLCHILDREN RANGING FROM 6 TO 18 YEARS OF AGE

Wstęp: Celem pracy było przeprowadzenie oceny częstości występowania krótkowzroczności, nadwzroczności i niezborności u uczniów w wieku 6–18 lat.

Material i metody: Przebadano 5724 dzieci – uczniów szkół podstawowych, gimnazjów i szkół średnich (2765 chłopców i 2959 dziewcząt, w wieku 6–18. roku życia, średni wiek 11,7 lat, SD = 3.2). Badani uczniowie należeli do rasy kaukaskiej, mieszkaśli w Szczecinie i jego okolicach. Wykonywano skiaskopię po cykloplegii. Wyniki wad refrakcji wyrażono w formie ekwiwalentu sferycznego (SE). Przyjęto, że w krótkowzroczności SE < -0.5 D, a w nadwzroczności SE > +1.0 D. Astygmatyzm rozpoznawano, gdy różnica refrakcji w osiach oka była > 0.5 DC. Dane opracowano statystycznie, oblicząc współczynniki korelacji liniowej i współczynniki równania regresji. Dodatkowo obliczono współczynnik korelacji r Spearmana. Przyjęto poziom istotności p < 0.05.

Wyniki: Zaobserwowano, że 13% polskich uczniów w wieku od 6 do 18 roku życia ma krótkowzroczność, 38% nadwzroczność, a 4% niezborność (tab. 1). Stwierdzono również statystycznie dodatnią korelację pomiędzy krótkowzrocznością a wiekiem (p < 0.001) oraz ujemną korelację pomiędzy nadwzrocznością i wiekiem (p < 0.001). Nie zaobserwowano związku pomiędzy częstością występowania astygmatyzmu a wiekiem (ryc. 1, 2, 3).

Summary

Purpose: The aim of the paper was to study the prevalence of myopia, hyperopia and astigmatism in schoolchildren ranging from 6–18 years of age.

Material and methods: 5724 children from elementary schools, junior high schools and high schools were examined (2765 boys and 2959 girls, aged 6–18 years, mean age 11.7, SD = 3.2). The examined students were Caucasian and resided in and around Szczecin, Poland. The examination included retinoscopy under cycloplegia. The refractive error readings were expressed as the spherical equivalent (SE). Myopia was defined as SE of at least -0.5 D, hyperopia as SE of at least +1.0 D. Astigmatism was diagnosed when the difference in the refraction of axes in one eye was greater than 0.5 DC. The statistical analysis of data was performed by calculating the linear correlation coefficients and the coefficients for the regression equation. Additionally, Spearman's rank correlation coefficient was calculated. P values of less than 0.05 were considered statistically significant.

Results: It was observed that 13% of Polish students in the age group from 6 to 18 were myopic, 38% of students were hyperopic and 4% were astigmatic (tab. 1). Besides, a positive correlation was found between the prevalence of myopia and age (p < 0.001) as well as a negative correlation between prevalence of hyperopia and age (p < 0.001). An association between the prevalence of astigmatism and age was not observed (figs. 1, 2, 3).

Key words: refractive errors – schoolchildren.
Introduction

Recently, a significant increase in the prevalence of myopia has been noted. This trend is most probably due to the occurrence of civilizational changes such as the increase in intensive near work − reading, writing and working on a computer [1, 2, 3, 4, 5, 6, 7].

The occurrence of hyperopia among children, however decreases with age [7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22]. Children are born with physiological hyperopia. In the course of time, the optical components in the eyeball change, and hyperopia gradually decreases [2, 4, 7, 8, 9, 14, 17, 23, 24, 25, 26, 27]. Prevalence of astigmatism among schoolchildren remains at the same level of a few per cent [7, 28, 29].

The existence of a growing demand for different clinical studies dealing with the development of the eye is based on the increasing use of contact lenses and the performance of corneal refractive surgeries, as well as intraocular lens applications at the time being.

Despite the fact that it is such a serious problem, only a few papers on the prevalence of refractive errors among schoolchildren in Europe [14, 23, 24, 25, 27, 30, 31] and Poland [3, 8, 9, 17, 20, 28, 29, 32, 33, 34, 35, 36, 37] have been published so far.

Having this in mind we decided to study more closely the prevalence of myopia, hyperopia and astigmatism in schoolchildren ranging from 6 to 18 years of age.

Material and methods

5724 children from elementary schools, junior high schools and high schools were examined (2765 boys and 2959 girls, aged 6−18 years, mean age 11.7, SD = 3.2). The examined students were Caucasian and resided in and around Szczecin, Poland.

Participation was voluntary and informed consent was obtained from the school principals and parents of all schoolchildren. The studies were approved by the Bioethics Committee of the Pomeranian Medical University. The research protocol adhered to the provisions of the Declaration of Helsinki for research involving human subjects.

The children were examined in the school’s consulting rooms. The examination included retinoscopy under cycloplegia. Cycloplegia was induced with two drops of 1% tropicamide administered 5 minutes apart. Thirty minutes after the last drop, pupils’ dilation and the presence of light reflex were evaluated as later retinoscopy was performed.

Retinoscopy was performed in a dark room and all schoolchildren were examined by two doctors (AM, MU). According to Zadnik et al. [38] 95% limits of agreement for cycloplegic retinoscopy are ± 0.95 D.

The refractive error readings were expressed as the spherical equivalent (SE) − sphere power plus half negative cylinder power. Myopia was defined as SE of at least -0.5 D, hyperopia as SE of at least +1.0 D. Astigmatism was diagnosed when the difference in the refraction of axes in one eye was greater than 0.5 DC. Both eyes were examined, but only data gathered from the right eye were analysed.

The statistical analysis of data was performed by calculating the linear correlation coefficients and the coefficients for the regression equation. Additionally, Spearman’s rank correlation coefficient was calculated. P values of less than 0.05 were considered statistically significant.

Results

It was observed that 13% of Polish students in the age group from 6 to 18 were myopic, 38% of students were hyperopic, and 4% were astigmatic (tab. 1).

Besides, a positive correlation was found between the prevalence of myopia and age (p < 0.001) as well as a negative correlation between prevalence of hyperopia and age (p < 0.001). An association between the prevalence of astigmatism and age was not observed (figs. 1, 2, 3).

Discussion

A very high prevalence of myopia has been described among elementary school and high school students in Hong Kong, Shanghai, Singapore as well as in Taiwan [1, 2, 3, 5, 6, 7, 12, 39, 40, 41, 42, 43]. In those studies myopia, which was assumed to be a refractive error ≤ -0.5 D, has been present among 42% of elementary school students and 62% of high school students in Hong Kong [12, 41]. In Shanghai 27% of elementary school students and 68% of high school students have myopia [40]. In Singapore 37% of elementary school students and 74% of high school students have myopia [42, 43]. In Taiwan 33% of elementary school students and 83% of high school students are myopic [39].

The high prevalence of myopia in those countries is probably associated with more near-work activity of the children. For the moment it is being assumed that reading and writing at close distances and a more intensive education system are possible risk factors for myopia [1, 2, 3, 4, 5, 6, 7].

Lately, in countries with a high percentage of people with myopia such as China, Japan, Singapore and Taiwan a decrease in the occurrence of hyperopia has been noted [12, 15, 26, 40, 41, 42, 43, 44, 45]. A similar occurrence was observed in countries with a lower prevalence of myopia including Scandinavian countries [23, 24, 27, 29, 31]. In the carried out studies an increase in prevalence of myopia and a decrease in prevalence of hyperopia have also been observed.

In the performed investigations it was also confirmed that with age the prevalence of myopia increases, whereas the prevalence of hyperopia decreases. These findings are consistent with the observations of other authors and probably result from the growth of the eyeball, which progresses along with age [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 30, 31, 32, 39, 40, 41, 44].
Table 1. Number of examined schoolchildren

<table>
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<tr>
<th>Age (years)</th>
<th>Total</th>
<th>Myopia</th>
<th>Hyperopia</th>
<th>Astigmatism</th>
</tr>
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<tr>
<td></td>
<td>Razem</td>
<td>Krótkowzroczność</td>
<td>Nadwzroczność</td>
<td>Niezborność</td>
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<td>3</td>
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<td>720</td>
<td>2182</td>
<td>202</td>
</tr>
</tbody>
</table>

Fig. 1. Myopia occurrence among students ranging from 6–18 years (vertical axis – prevalence in %; horizontal axis – age in years)

Ryc. 1. Występowanie krótkowzroczności wśród uczniów w wieku 6–18 lat (oś pionowa – częstość występowania w %; oś pozioma – wiek w latach)

Fig. 2. Hyperopia occurrence among students ranging from 6–18 years (vertical axis – prevalence in %; horizontal axis – age in years)

Ryc. 2. Występowanie nadwzroczności wśród uczniów w wieku 6–18 lat (oś pionowa – częstość występowania w %; oś pozioma – wiek w latach)

Fig. 3. Astigmatism occurrence among students ranging from 6–18 years (vertical axis – prevalence in %; horizontal axis – age in years)

Ryc. 3. Występowanie niezborności wśród uczniów w wieku 6–18 lat (oś pionowa – częstość występowania w %; oś pozioma – wiek w latach)

In the performed examinations it was observed that 13% of Polish students living in and around Szczecin were myopic while 38% of students were hyperopic. Astigmatism was present in 4% schoolchildren.

Our data differ from the results gathered in Poland by Baran and Buła [32], Mikulski [17], Miratyńska-Rusinowa [35], Ogielska et al. [20]. This surely has to do with the fact that the authors mentioned carried out their examinations on smaller and less representative groups of schoolchildren. The results of the performed investigations are similar to the results presented by Czepita et al. [8, 9, 28, 33], Korszewska-Matuszewska and Illg [34], Muszyńska-Lachota et al. [36], Szaflik et al. [37]. This surely has to do with the fact that the authors mentioned above carried out their examinations on larger and more representative groups of schoolchildren.

It should be noted, that presented data are the most accurate since current guidelines, such as cycloplegia and the
calculation of the spherical equivalent only for the right eye [46], on carrying out this sort of research have been met.

References


