

## Research Article

# Role of Gender in the Prevalence of Myopia among Polish Schoolchildren

Maciej Czepita <sup>1</sup>, Damian Czepita <sup>1</sup> and Krzysztof Safranow<sup>2</sup>

<sup>1</sup>2nd Department of Ophthalmology, Pomeranian Medical University, al. Powstańców Wlkp. 72, 70-111 Szczecin, Poland

<sup>2</sup>Department of Biochemistry and Medical Chemistry, Pomeranian Medical University, al. Powstańców Wlkp. 72, 70-111 Szczecin, Poland

Correspondence should be addressed to Damian Czepita; [profesor@czepita.pl](mailto:profesor@czepita.pl)

Received 19 January 2019; Revised 10 May 2019; Accepted 27 May 2019; Published 2 July 2019

Guest Editor: Malgorzata Mrugacz

Copyright © 2019 Maciej Czepita et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Purpose.** The aim of the paper was to study the role of gender in the progression of myopia among Polish schoolchildren. **Materials and Methods.** 4875 children from elementary schools and high schools were examined (2470 boys, aged 6–16 years, mean age 11.0, SD = 2.6 and 2405 girls, aged 6–16 years, mean age 11.1, SD = 2.6). The examined students were Caucasian and resided in and around Szczecin, Poland. The examination included retinoscopy under cycloplegia. The refractive error readings were reported as spherical equivalent (SE). Myopia was defined as SE of at least  $-0.5$  D. Data analysis was performed using the Mann–Whitney  $U$  test and 2-sided Fisher's exact test.  $p$  values of less than 0.05 were considered statistically significant. **Results.** It was found that the SE among Polish boys is similar to the SE among Polish girls before the age of 9 years. However, in older children, lower SE values and higher prevalence of myopia were found among girls than boys, both at 9–13 years range ( $0.45 \pm 1.05$  vs  $0.55 \pm 1.23$  D,  $p = 0.047$  and 8.30% vs 5.71%,  $p = 0.015$ , respectively) and at 13–16 years range ( $0.32 \pm 1.14$  vs  $0.54 \pm 1.08$  D,  $p = 0.0093$  and 10.37% vs 5.96%,  $p = 0.0050$ ), respectively. **Conclusions.** Gender is associated with the prevalence of myopia among Polish schoolchildren ranging from 9 to 16 years of age.

## 1. Introduction

Several studies have been carried out in different countries on the role of gender in the progression of myopia among schoolchildren. In Poland, only one paper dealing with the issue has been published [1–12].

Several contradictory results from these studies can be found in the world literature. However, most researchers point to a more frequent occurrence of myopia in girls [1–6, 9, 11, 12] than in boys [7, 8] (Table 1).

Due to the discrepancies in the obtained data, we decided to examine the spherical equivalent (SE) on a large population of 4875 Polish students after cycloplegia with 1% tropicamide.

## 2. Materials and Methods

The studies were carried out from October 2000 to March 2009. 4875 children from elementary schools and high

schools were examined (2470 boys, aged 6–16 years, mean age 11.0, SD = 2.6 and 2405 girls aged 6–16 years, mean age 11.1, SD = 2.6). The examined students were Caucasian and resided in and around Szczecin, Poland.

Twenty-one schools were selected by random sampling out of 210 schools from the area of Szczecin. All children from the selected schools were invited to participate in the study. However, only 95.8% accepted to participate. We did not observe differential dropout.

Every examined student had undergone the following examinations: distance visual acuity testing, cover test, anterior segment evaluation, and cycloplegic retinoscopy after instillation of 1% tropicamide, and a questionnaire was taken. The methodology of the examinations has been described in detail in previous work.

Data analysis was performed using the Mann–Whitney  $U$  test and 2-sided Fisher's exact test.  $p$  values of less than 0.05 were considered statistically significant [13].

TABLE 1: Dependency between gender and myopia.

Reference	Country	Time of data collection (years)	Age (years)	Prevalence of myopia		Girls and boys (%)
				Girls (%)	Boys (%)	
Ahmed et al. [1]	India	2007	6–22	5.4	3.6	1.8
Czepita et al. [2]	Poland	2000–2005	6–18	7.4	5.1	2.3
Giloyan et al. [3]	Armenia	2011	10–16	53.4	46.6	6.8
Goh et al. [4]	Malaysia	2003	7–15	21.2	17.5	3.7
Hsu et al. [5]	Taiwan	2005–2006	7–13	25.9	25.3	0.6
Ip et al. [6]	Australia	2003–2005	11–15	14.1	9.7	4.4
Lam and Goh [7]	Hong Kong	1990–1991	6–17	55.9	57.4	–1.5
Maul et al. [8]	Chile	1998	5–15	14.7	19.4	–4.7
Mäntyjärvi [9]	Finland	1980–1981	7–15	26.6	19.5	7.1
Pokharel et al. [10]	Nepal	1980–1981	5–15	1.5	1.5	0
Quek et al. [11]	Singapore	2002	15–19	72.7	67.7	5.0
Zhao et al. [12]	China	1998	5–15	23.5	14.1	9.4

### 3. Results

It was found that the spherical equivalent among Polish boys is similar to the SE among Polish girls before the age of 9 years. However, in older children, lower SE values and higher prevalence of myopia were found among girls than boys, both at 9–13 years range ( $0.45 \pm 1.05$  vs  $0.55 \pm 1.23$  D,  $p = 0.047$  and  $8.30\%$  vs  $5.71\%$ ,  $p = 0.015$ , respectively) and at 13–16 years range ( $0.32 \pm 1.14$  vs  $0.54 \pm 1.08$  D,  $p = 0.0093$  and  $10.37\%$  vs  $5.96\%$ ,  $p = 0.0050$ ), respectively (Figure 1, Tables 2 and 3).

### 4. Discussion

It is widely known that myopia occurs more often in pupils who spend a lot of time reading, writing, or using a computer [13–15]. Myopia occurs less often in pupils who spend a lot of time doing outdoor activities [13, 14, 16]. It is widely regarded that myopia occurs more often in girls than in boys, especially in older children. In our study, we also observed a higher occurrence of myopia in girls aged 9 to 16 years. A similar relationship was observed by other authors. Only Maul et al. [8] in Chile concluded that myopia occurs more often in boys aged 5–15 years.

In order to reduce the possibility of making a mistake, we decided to conduct the examinations on a large population of 4875 students after cycloplegia with 1% tropicamide. Besides, the examinations were performed only by two doctors. According to Zadnik et al. [17], 95% limits of agreement for cycloplegic retinoscopy are  $\pm 0.95$  D.

Based on the conducted examinations, we found that in Polish schoolchildren, with age, a decrease in the spherical equivalent occurs. A faster and larger decrease was observed in girls compared to boys. This may indicate that myopia occurs earlier and more often in girls than in boys. In 2007, we published a similar paper on the prevalence of refractive errors among children aged 6–18 years. We concluded that the prevalence of myopia among boys was 5.1% and among girls was 7.4% [2].

The data obtained by us are similar to the results of investigations performed in India [1], Poland [2], Armenia [3], Malaysia [4], Taiwan [5], Australia [6], Finland [9],

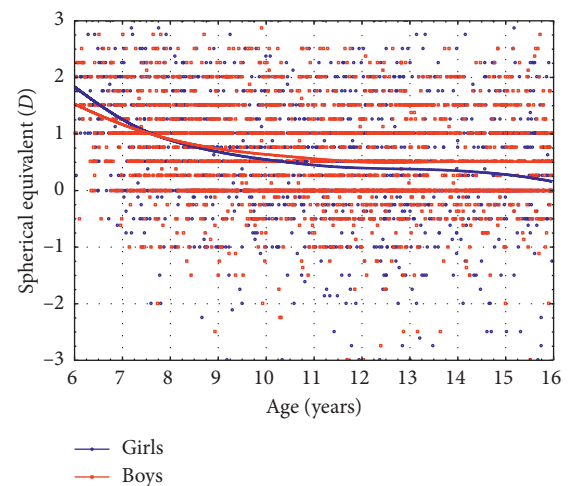


FIGURE 1: Spherical equivalent in relation to the age of boys (red line) and girls (blue line). Regression lines are obtained using distance-weighted least squares fitting method.

Nepal [10], Singapore [11], and China [12]. However, they differ from the results gathered in Hong Kong [7] and Chile [8].

It is widely accepted that there are two possibilities for gender differences. The first is that the differences are biologically determined. The second possibility is that they are socially/behaviorally determined.

Zylbermann et al. [18] determined that Orthodox Jewish boys, who receive an intensive religious education, are much more myopic than their sisters and the rest of their age cohort who receive a more secular education. Probably, the high degree and prevalence of myopia observed in the Orthodox male group may be due to their heavy accommodative eye use attributed to their different study habits.

Recent extensive studies carried out in China on the prevalence of myopia have concluded that myopia occurs more often in girls. Ma et al. [19] have shown that myopia occurs more often in girls below 3 years of age. However, Li et al. [20] concluded that myopia occurs more often in 12.7-year-old girls.

TABLE 2: Spherical equivalent (D) among examined boys and girls.

Age (years)	Boys Mean $\pm$ SD	Girls Mean $\pm$ SD	$p^*$
6–9 ( $\geq 6$ and $< 9$ )	+0.95 $\pm$ 1.04	+0.99 $\pm$ 1.21	0.91
9–13 ( $\geq 9$ and $< 13$ )	+0.55 $\pm$ 1.23	+0.45 $\pm$ 1.05	0.047
13–16 ( $\geq 13$ and $< 16$ )	+0.54 $\pm$ 1.08	+0.32 $\pm$ 1.14	0.0093

SD: standard deviation. \*Mann-Whitney  $U$  test.

TABLE 3: Prevalence of myopia defined as spherical equivalent of at least  $-0.5$  D among examined boys and girls.

Age (years)	Boys (%) (95% CI)	Girls (%) (95% CI)	$p^*$
6–9 ( $\geq 6$ and $< 9$ )	3.65 (2.35–5.38%)	3.35 (2.11–5.03%)	0.88
9–13 ( $\geq 9$ and $< 13$ )	5.71 (4.46–7.18%)	8.30 (6.76–10.07%)	0.015
13–16 ( $\geq 13$ and $< 16$ )	5.96 (4.23–8.12%)	10.37 (8.08–13.05%)	0.0050

95% CI: 95% confidence interval. \*Fisher's exact test.

According to Krause et al. [21], the reasons for sex differences are determined by genetic factors, dietary factors, and amount of close work, as well as are connected with puberty. Girls reach puberty earlier than boys and therefore reach their final body height one or two years earlier than boys. This leads to a rise in the prevalence of myopia.

Our results are similar to the results obtained by other authors. We also demonstrated that gender is associated with the prevalence of myopia.

## 5. Conclusions

Gender is associated with the prevalence of myopia among Polish schoolchildren ranging from 9 to 16 years of age.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

## References

- [1] I. Ahmed, S. Mian, S. Mudasar, and K. I. Andrabi, "Prevalence of myopia in students of Srinagar City of Kashmir, India," *International Journal of Health Sciences*, vol. 2, no. 1, pp. 77–81, 2008.
- [2] D. Czepita, A. Mojsa, M. Ustianowska, M. Czepita, and E. Lachowicz, "Role of gender in the occurrence of refractive errors," *Annales Academiae Medical Stetinensis*, vol. 53, no. 2, pp. 5–7, 2007.
- [3] A. Giloyan, T. Harutyunyan, and V. Petrosyan, "Risk factors for developing myopia among schoolchildren in Yerevan and Gegharkunik Province, Armenia," *Ophthalmic Epidemiology*, vol. 24, no. 2, pp. 97–103, 2017.
- [4] P. Goh, Y. Abqariyah, G. Pokharel, and L. Ellwein, "Refractive error and visual impairment in school-age children in Gombak District, Malaysia," *Ophthalmology*, vol. 112, no. 4, pp. 678–685, 2005.
- [5] S.-L. Hsu, C.-H. Chang, Y.-H. Lai, M.-H. Wen, K.-C. Cheng, and C.-K. Ho, "Refractive status of mountain Aborigine schoolchildren in Southern Taiwan," *Kaohsiung Journal of Medical Sciences*, vol. 24, no. 3, pp. 120–125, 2008.
- [6] J. M. Ip, S. C. Huynh, D. Robaei et al., "Ethnic differences in refraction and ocular biometry in a population-based sample of 11–15-year-old Australian children," *Eye*, vol. 22, no. 5, pp. 649–656, 2008.
- [7] C. S. Lam and W. S. Goh, "The incidence of refractive errors among school children in Hong Kong and its relationship with the optical components," *Clinical and Experimental Optometry*, vol. 74, no. 3, pp. 97–103, 1991.
- [8] E. Maul, S. Barroso, S. R. Munoz, R. D. Sperduto, and L. B. Ellwein, "Refractive error study in children: results from La Florida, Chile," *American Journal of Ophthalmology*, vol. 129, no. 4, pp. 445–454, 2000.
- [9] M. Mäntyjärvi, "Incidence of myopia in a population of Finnish school children," *Acta Ophthalmologica*, vol. 61, no. 3, pp. 417–423, 1983.
- [10] G. P. Pokharel, A. D. Negrel, S. R. Munoz, and L. B. Ellwein, "Refractive error study in children: results from Mechi Zone, Nepal," *American Journal of Ophthalmology*, vol. 129, no. 4, pp. 436–444, 2000.
- [11] T. P. L. Quek, C. G. Chua, C. S. Chong et al., "Prevalence of refractive errors in teenage high school students in Singapore," *Ophthalmic and Physiological Optics*, vol. 24, no. 1, pp. 47–55, 2004.
- [12] J. Zhao, J. Mao, R. Luo, F. Li, S. R. Munoz, and L. B. Ellwein, "The progression of refractive error in school-age children: Shunyi District, China," *American Journal of Ophthalmology*, vol. 134, no. 5, pp. 735–743, 2002.
- [13] M. Ellwein, D. Czepita, and W. Lubiński, "The influence of environmental factors on the prevalence of myopia in Poland," *Journal of Ophthalmology*, vol. 2017, p. 5, 2017.
- [14] D. Czepita, "Myopia: incidence, pathogenesis, management and new possibilities of treatment," *Russian Ophthalmological Journal*, vol. 7, no. 1, pp. 96–101, 2014.
- [15] M. Czepita, L. Kuprjanowicz, K. Safranow et al., "The role of reading, writing, using a computer, or watching television in the development of myopia," *Ophthalmology Journal*, vol. 1, no. 2, pp. 53–57, 2016.
- [16] M. Czepita, L. Kuprjanowicz, K. Safranow et al., "The role of outdoor activity in the development of myopia in

- schoolchildren,” *Pomeranian Journal of Live Sciences*, vol. 62, no. 4, pp. 30–32, 2016.
- [17] K. Zadnik, D. O. Mutti, and A. Adams, “The repeatability of measurement of the ocular components,” *Investigative Ophthalmology & Visual Science*, vol. 33, no. 7, pp. 2325–2333, 1992.
- [18] R. Zylbermann, D. Landau, and D. Berson, “The influence of study habits on myopia in Jewish teenagers,” *Journal of Pediatric Ophthalmology & Strabismus*, vol. 30, no. 5, pp. 319–322, 1993.
- [19] Q. Ma, W. Xu, X. Zhou, C. Cui, and C. W. Pan, “The relationship of season of birth with refractive error in very young children in Eastern China,” *PLoS One*, vol. 9, no. 6, Article ID e100472, 2014.
- [20] S. M. Li, S. Y. Li, M. T. Kang et al., “Near work related parameters and myopia in Chinese children: the Anyang Childhood Eye Study,” *PLoS One*, vol. 10, no. 8, Article ID e0134514, 2015.
- [21] U. Krause, K. Krause, and P. Rantakallio, “Sex differences in refraction errors up to the age of 15,” *Acta Ophthalmologica*, vol. 60, no. 6, pp. 917–926, 1982.