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Keio University School of Medicine

Myopia on the Rise Among Elementary and Junior High School Students —Myopia Found in 80% of Elementary and, 95% of Junior High School Students in Tokyo—

A research team at the Keio University School of Medicine has conducted Japan's first prevalence study on myopia in 20 years. Led by Professor Kazuo Tsubota of the Department of Ophthalmology, the study looked at approximately 1,400 elementary and junior high school students in the Tokyo area and found a possible correlation between myopia and dry eye. The team included Project Associate Professor Toshihide Kurihara, Instructor Hidemasa Torii, and fourth-year doctoral candidate Erisa Yotsukura.

In 2005, the Ministry of Health, Labor and Welfare reported that myopia was the fourth most common cause of blindness in Japan, yet despite the urgent need for myopia prevention, a study on the prevalence of myopia in children had not been conducted in Japan since the 1990s.

Myopia refers to a condition of the eye where light focuses in front of, rather than on, the retina, causing distant objects to appear blurry. Myopia is diagnosed using a refractive assessment¹, and is attributed to excessive axial elongation, which causes changes to the ocular shape and increases the distance from the cornea to the retina. Axial length elongates in children as they grow and is known to be particularly long in myopic eyes, making the accurate measurement of axial length increasingly important in evaluating myopia. With high myopia² it is understood that as axial length elongates there is an increase in the risk of complications such as macular degeneration and optic nerve damage.

In this study, as an evaluation of myopia, the research group measured both refraction index (objective refraction values using a non-cycloplegic refraction technique³) and axial length, and through a questionnaire investigated the relationship between myopia and lifestyle. Results showed that the prevalence of myopia in 689 elementary school students was 76.5%, while the prevalence of high myopia was 4.0%, and the average axial length was 23.41 mm. In 727 junior high school students, the prevalence of myopia was 94.9%, higher than existing reports abroad. The prevalence of high myopia was 11.3%, and the average axial length was 24.73 mm.

The results of this research represent a data set on the prevalence of myopia in Japan, including measurements of axial length, and provide the latest basic data in recent years on myopia in elementary and junior high school students in Tokyo. It is expected that these results will sound the alarm about the increasing prevalence of myopia and help raise awareness to stop the increasing prevalence of both myopia and high myopia.

The results of this study were published on August 15, 2019, in the online journal *JAMA Ophthalmology*.

1. Research Background

The exact mechanism that causes myopia and its progression is still unknown, but it has been reported that as myopia continues to grow around the world, it could affect a population upwards of 5 billion by 2050 (Holden BA, et al. *Ophthalmology*. 2016). This global increase in myopia began

around 50 years ago and is known to be particularly common among Asian populations. In Hong Kong, Taiwan, and Singapore, the prevalence of myopia in 18-year-olds was reported to exceed 80% (Rudnicka AR, et al. *The British Journal of Ophthalmology*. 2016).

In Japan, the prevalence of myopia in 12-year-olds between 1989 and 1991 was reported to be 43.5% (Matsumura H, et al. *Survey of Ophthalmology*. 1999). School health statistics maintained by the Ministry of Education, Culture, Sports, Science and Technology show that the percentage of elementary and junior high school students with uncorrected visual acuity of less than 1.0 has been increasing year by year, yet despite this, there has not been a detailed prevalence report on myopia and high myopia conducted in the last 20 years. To date, there have been only a few reports on the axial length of elementary and junior high school students in Japan, in which the number of the cases were about 100 (Terasaki H, et al. *BMC Ophthalmology*. 2017/Fujiwara M, et al. *Japanese Journal of Ophthalmology*. 2012), but until now there had never been a detailed survey of an entire school.

For this study, the research group measured the refractive index and axial length of the eyes of approximately 1,400 students attending public elementary and private junior high schools in Tokyo, revealing the latest figures regarding the prevalence of myopia. The group also investigated the relationship between lifestyle and myopia using a questionnaire, and have reported on a possible connection between myopia and dry eye.

2. Research Significance and Future Development

Of the school's 1,478 students (726 elementary/752 junior high), the team obtained guardian consent for 1,429 students who also attended school on the day of the test. Students' eyes were measured for refractive index and axial length using a non-cycloplegic refraction technique. Of those students, the team analyzed the data of 1,416, excluding students who were already receiving treatments to slow or stop myopic progression, as well as those with a history of eye disease that may affect visual function.

Results showed that the prevalence of myopia in 689 elementary school students was 76.5%, while the prevalence of high myopia was 4.0%. In particular, the prevalence of myopia in first grade students was already over 60% (see Fig. 1). The average refractive index was -1.73 ± 1.98 D, and the average axial length was 23.41 ± 1.03 mm (Figure 2).

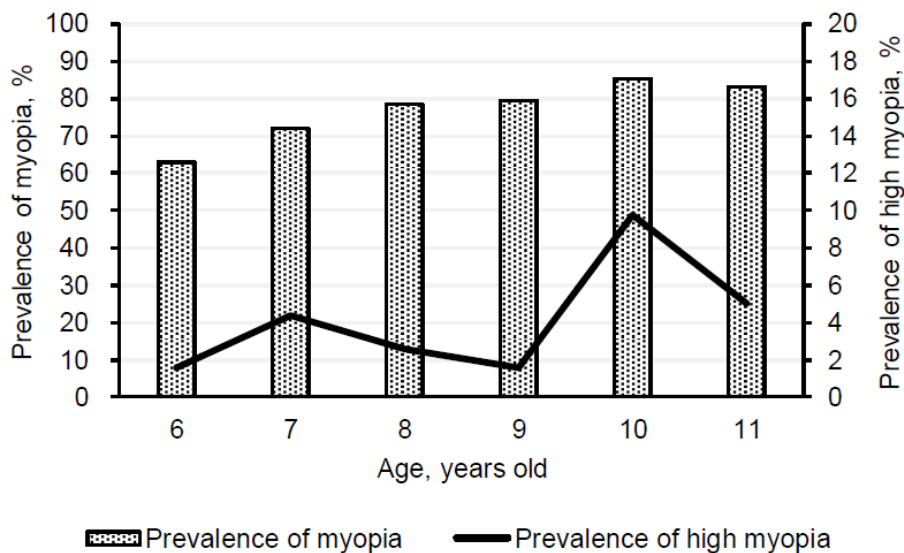


Fig. 1: Prevalence of myopia and high myopia at a public elementary school in Tokyo

The prevalence of myopia in elementary school students was 76.5% while the prevalence of high myopia was 4.0%.

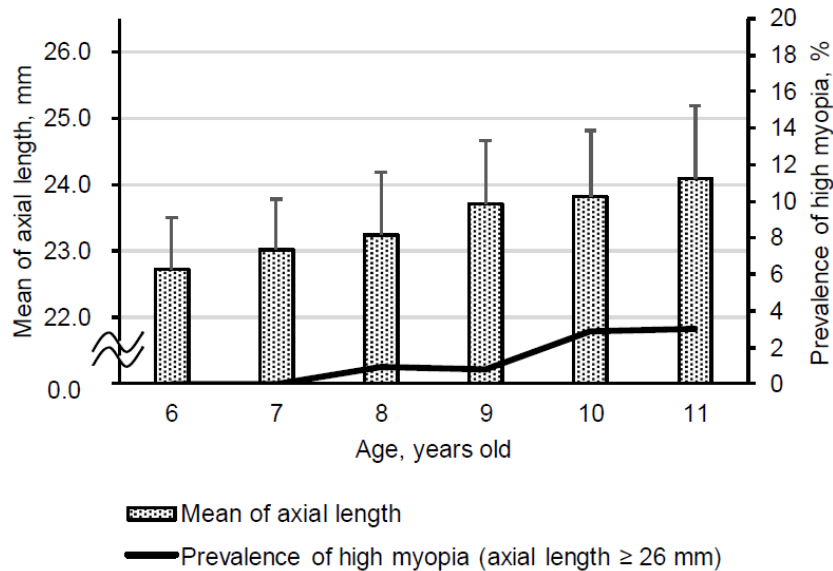


Fig. 2: Average axial length and prevalence of high myopia according to axial length at a public elementary school in Tokyo

The average axial length of elementary school students was 23.41 ± 1.03 mm while the prevalence of high myopia (axial length ≥ 26.0 mm) was 1.2%.

The prevalence of myopia among 727 junior high school students was 94.9%, and the prevalence of high myopia was 11.3%. The prevalence of myopia exceeded 90% in all three grades of junior high school students (see Fig. 3). This is a higher prevalence than previously reported in other East Asian countries, indicating that myopia in junior high school students is a serious issue. Average refractive index was -3.09 ± 2.26 D and average axial length was 24.73 ± 1.19 mm, while the prevalence of high myopia (axial length ≥ 26.0 mm) was 15.2% (see Fig. 4).

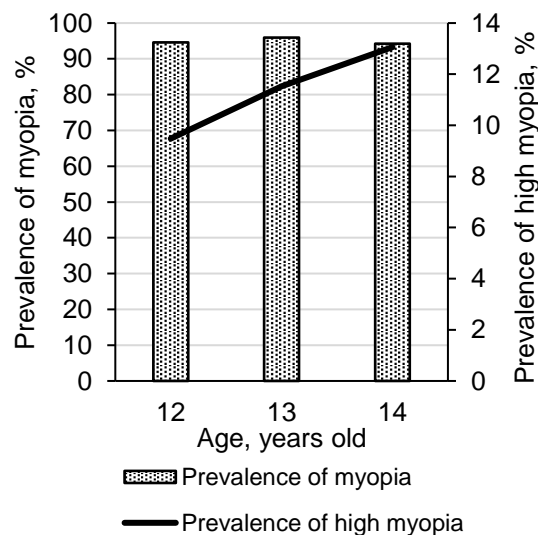


Fig. 3: Prevalence of myopia and high myopia at a private junior high school in Tokyo

The prevalence of myopia among junior high school students was 94.9%, while the prevalence of high myopia was 11.3%.*

*This figure excludes 88 students who wore contact lenses, and prevalence might actually be higher

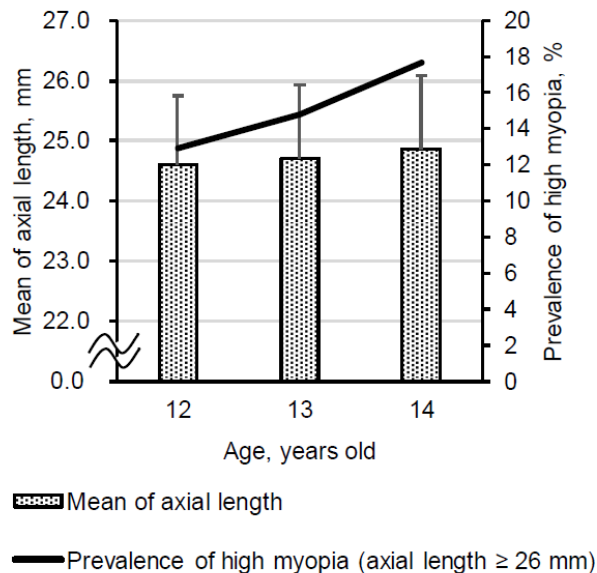


Fig. 4: Average axial length and prevalence of high myopia according to axial length at a private junior high school in Tokyo

The average axial length of junior high school students was 24.73 ± 1.19 mm, while the prevalence of high myopia (axial length ≥ 26.0 mm) was 15.2%.

The team also had students complete a lifestyle questionnaire. The dry eye assessment section of the questionnaire (a Japanese version of Women's Health Study questionnaire) revealed that elementary and junior high school students who said they had experienced dry eye were more likely to develop myopia.

The results of this research represent the first data set on the prevalence of myopia in Japan including measurements of axial length and provide the latest basic data on myopia in elementary and junior high school students in recent years. It is expected that these results will sound the alarm concerning the increasing prevalence of myopia and help raise awareness in preventing future increases in the prevalence of myopia and high myopia.

3. Notes

This research was carried out using JSPS Grant-in-Aid for Scientific Research 18K16934 and with the support of the Takeda Science Foundation.

4. Research Paper

Title: Current Prevalence of Myopia and Association of Myopia With Environmental Factors Among Schoolchildren in Japan

Authors: Erisa Yotsukura, Hidemasa Torii, Mikako Inokuchi, Mitsuaki Tokumura, Miki Uchino, Kyosei Nakamura, Mari Hyodo, Kiwako Mori, Xiaoyan Jiang, Shin-ichi Ikeda, Shinichiro Kondo, Kazuno Negishi, Toshihide Kurihara, Kazuo Tsubota

Publication: JAMA Ophthalmology (online edition)

[Glossary]

¹ Refractive Assessment

A numerical value representing the degree of conditions such as myopia, hyperopia, and astigmatism. Light that enters the eye is refracted and focused by the cornea and the crystalline lens, but the position of the focus will vary depending on the type of refractive error. Myopia is a common vision condition in which objects in the distance are blurry due to the image being focused in front of, rather than on, the retina.

² High Myopia

A severe level of myopia, defined by the Myopia Society of Japan, as an eye requiring -6.0 diopters or more of lens correction or an axial length of 26.0 mm or more.

³ Non-Cycloplegic Objective Refraction

Although refraction values in children are more accurately assessed through cycloplegic objective refraction, the procedure may have side effects including blurry vision for up to 48 hours. Because this study was conducted during the school year, no cycloplegic refraction tests were performed to avoid interfering with the students' studies.

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