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Original Article

Prevalence and risk factors for myopia in second-grade primary school children in Taipei: A population-based study

Chih-Chien Hsu [a,b,c], Nicole Huang [d], Pei-Yu Lin [a,e], Der-Chong Tsai [e,f], Ching-Yao Tsai [e,g], Lin-Chung Woung [e,g], Catherine Jui-Ling Liu [a,e,*]

[a] *Department of Ophthalmology, Taipei Veterans General Hospital, Taipei, Taiwan, ROC*
[b] *Institute of Clinical Medicine, National Yang-Ming University, Taipei, Taiwan, ROC*
[c] *General Education Center, National Taipei University of Nursing and Health Sciences, Taipei, Taiwan, ROC*
[d] *Institute of Hospital and Health Care Administration, National Yang-Ming University, Taipei, Taiwan, ROC*
[e] *Faculty of Medicine, National Yang-Ming University School of Medicine, Taipei, Taiwan, ROC*
[f] *Department of Ophthalmology, National Yang-Ming University Hospital, Yilan, Taiwan, ROC*
[g] *Department of Ophthalmology, Taipei City Hospital, Taipei, Taiwan, ROC*

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Abstract

Background: High myopia is associated with multiple ocular morbidities that may lead to irreversible blindness. Because high myopia in an adult is thought to be related to onset of myopia in very early childhood, detecting myopia early and working to improve modifiable risk factors may help reduce the development of high myopia. In this study, we tried to evaluate the prevalence of myopia and associated risk factors in second-grade primary school children in Taipei, Taiwan.

Methods: A questionnaire was distributed to the participants' parents, and their written informed consent was obtained before performing eye examinations that included visual acuity testing and cycloplegic autorefraction. Multiple logistic regression models were applied to assess possible risk factors associated with myopia. Myopia was defined as spherical equivalent of −0.50 D or less in either eye.

Results: The prevalence of myopia in the second graders was 36.4%. After adjustment for other characteristics, the following variables were significantly associated with a higher risk of myopia: male sex [odds ratio (OR) = 1.24, $p < 0.001$]; suburban residence (vs. urban; OR = 1.10, $p = 0.02$); lower maternal education level (OR = 1.25, $p < 0.001$); the presence of myopia in one parent (OR = 1.66, $p < 0.001$) or both parents (OR = 2.82, $p < 0.001$); time spent on near-work activity every day (OR = 1.21, $p < 0.001$); shorter visual distance when doing near-work activity (OR = 1.17, $p < 0.001$); and participation in an after-school tutorial program (OR = 1.20, $p < 0.001$). By contrast, resting after 30 minutes of near-work activity (OR = 0.84, $p < 0.001$) and spending more time participating in outdoor activities on weekends (OR = 0.91, $p = 0.03$) were significantly associated with a lower risk of myopia.

Conclusion: Our findings indicate that lifestyle and reading habits impact the development of myopia during early childhood. Behavior modification, such as more time spent outside during the day and limited near-work activity, may be a feasible strategy for curbing the increasingly high prevalence of myopia in Taipei.

Keywords: myopia; population-based study; prevalence; risk factor; schoolchildren

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

* Corresponding author. Dr. Catherine Jui-Ling Liu, Department of Ophthalmology, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, ROC.

E-mail address: jlliu@vghtpe.gov.tw (C.J.-L. Liu).

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1. Introduction

The continuing increase in the prevalence of myopia in recent decades has become an important public health issue worldwide, especially in East Asia.[1–5] In Taiwan, the prevalence of myopia in 7- and 12-year-old children increased from 5.8% and 36.7% in 1983 to 21% and 61% in 2000, respectively.[2] Similarly, the prevalence of high myopia (≤ -6.0 D) in 18-year-old students increased from 10.9% in 1983 to 21% in 2000.[2] A recent review of myopia-progression studies supported the findings of Parssinen and Lyyra[6] and Donovan et al[7] that myopia progresses significantly faster in children with myopia onset at younger age. High myopia is associated with multiple ocular morbidities that can lead to irreversible blindness, seriously handicap the individual, burden the family, and pose a heavy socioeconomic burden.[8–10] In light of the vision-threatening complications of high myopia and the findings that high myopia is associated with early onset of myopia in youth, it seems prudent to focus attention on measures that help delay the age of myopia onset.

Although the mechanisms underlying the development of myopia are not clear, there is evidence that multifactorial interactions between environmental and genetic factors are involved. The prevalence of myopia is higher in populations in urban areas and in people of Chinese ethnicity.[11] Other risk factors for myopia include more time spent on near-work activity,[12,13] less time participating in outdoor activities,[14,15] higher educational level,[16] a parental history of myopia,[17,18] and a relatively hyperopic periphery.[19,20]

In recent years, ophthalmologists in Taipei, Taiwan have found that an increasing number of preschool children are afflicted with myopia. We speculate that this might be related to the fact that children in Taipei are usually given free access to smartphones and tablets starting in early childhood. Because these devices are convenient and are equipped with functions for chatting and game play, children tend to use them whenever and wherever they are, tremendously increasing the near workload on their eyes. To explore this possibility, we reinvestigated the prevalence of myopia and the risk factors related to myopia in young children in an era dominated by the use of mobile devices.

This citywide study evaluated the prevalence of myopia in second-grade primary school children in metropolitan Taipei at the start of the 2013 school year. The risk factors associated with having myopia at such a young age were investigated. This report is part of the Myopia Investigation Study in Taipei (MIT), which has the long-term aim of understanding and addressing the very high prevalence of myopia, the increasing severity of myopia, and the increasingly young age of myopia onset in Taipei.

2. Methods

2.1. Study design and participants

The MIT, which began in June 2013, is a 3-year population-based cohort study that includes myopia screening and eye care education. The design, rationale, and methods of the MIT have been described elsewhere.[21] In brief, all 19,374 second graders in metropolitan Taipei were invited to participate in the MIT. Questionnaires were distributed to all parents who provided consent for their second-grade children to participate before the eye examinations were performed. As part of the MIT, the Taipei City Government agreed to provide each participant with a free myopia evaluation at an MIT-associated medical facility during each semester for 3 consecutive years (a total of 6 evaluations), and the project also includes a case management intervention for children who have myopia that is detected during these examinations. In addition, the MIT established a monitoring committee comprising 11 senior ophthalmologists and four expert epidemiologists. Before the eye examination campaign began, the committee members defined and explained the standard operation procedure (SOP) for the eye examinations to all of the MIT-associated medical facilities to ensure that the facilities would follow the SOP for all of the MIT participants. Committee members paid regular visits to the MIT-associated hospitals/clinics to evaluate the eye examination procedures during the campaign. After the first eye examination period was completed (at the end of September 2013), all children were exposed to a large-scale eye care education program, which included lectures and an animated cartoon, to teach them about the prevention, treatment, and complications of myopia.

Here, we report the refraction data and questionnaire findings obtained from July 2013 to September 2013. The Institutional Review Board of Taipei City Hospital, Taipei, Taiwan approved the protocols used in this study (TCHIRB-1020501) prior to study initiation, and the principles of the Declaration of Helsinki were adhered to throughout. Written informed consent was obtained from a parent of each child. Of the 19,374 eligible second graders in Taipei in 2013, the parents of 16,486 (85.1%) children completed the questionnaire and provided consent for their child to participate. A total of 11,590 (70.3%) children underwent cycloplegic autorefraction.

2.2. Refraction assessment

The MIT monitoring committee held three training sessions for all participating medical facilities and their staff to explain the MIT SOP and how it should be implemented. Each examination had to be performed in compliance with the SOP as follows. Uncorrected and best-corrected visual acuity of the right and left eyes were measured after refraction and checked with an autorefractometer at least three times to obtain the average measure. Slit lamp examination was performed to rule out anterior segment conditions that would contraindicate the use of cycloplegic agents in each child. Two doses of 1% cyclopentolate drops were given 10 minutes apart, and refraction was checked 30 minutes after the second drop. If the pupil still responded to pen light stimulation, the examiner waited an additional 10 minutes before performing cycloplegic refraction. Instead of cyclopentolate, some MIT-associated medical facilities opted to use either 1% tropicamide or