VIEWPOINT

Outdoor Activity Protects Against Childhood Myopia—Let the Sun Shine In

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Today's popular press is filled with reports of children's digital device use and of parents' concomitant concerns about learning, social development, obesity, and orthopedic problems, among others. The American Academy of Pediatrics issued excellent reviews and recommendations[1] in 2016 regarding these concerns. Worries about eye strain and ocular development have not made their way to the general conversation but may well be in the back of parents' minds when they consult with pediatricians about creating a healthy media environment for their family. In the particular case of risk for the development and progression of myopia (nearsightedness) in childhood, research indicates that it may not be the use of digital devices that is the problem. Instead, the societal shift to indoor activities while using these devices may be adversely affecting children's eyes and leading to a worldwide, projected increase in the prevalence of myopia.

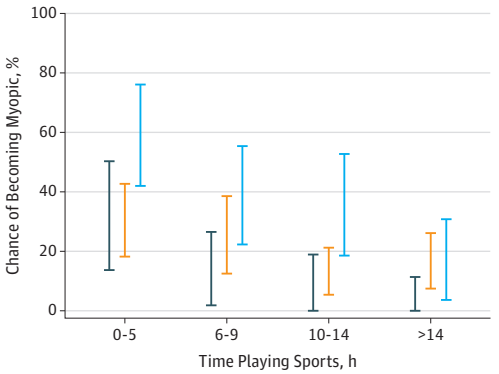
Myopia is a common disorder of the eye's refractive state that creates blurry distance vision that can be corrected with spectacles, contact lenses, or refractive surgery. The eye that becomes myopic elongates out of proportion to its focal length, so that light rays from distant objects focus in front of rather than on the retina. Myopia affects 1 in 3 individuals in the United States aged 12 to 54 years, and its prevalence appears to be on the rise.[2,3] Management of myopia costs the US health care system almost $4 billion annually.

Juvenile-onset myopia is the most common variety, with its peak incidence occurring during elementary school and progression to stronger optical prescriptions through the middle teenage years. The debate concerning the causative mechanisms of myopia has evolved from the traditional approach about the relative contribution of genetic vs environmental influences to a recognition of the importance of both. High heritability for myopia from family and twin studies and the identification of numerous genetic loci linked to or associated with myopia lend support to a strong genetic contribution. The recent increase in myopia prevalence, however, is not consistent with it being solely genetic. The concurrent evolution of children's media from print and television to a ubiquitous, immersive stream makes digital device use an appealing suspect for making more children myopic. After all, the classic environmental risk factor for myopia for decades has been near work (eg, reading, study, watching television, and computer use). Despite this suspicion, longitudinal studies have not borne out a major role for near work as the cause of myopia in children. Longitudinal studies of incident myopia conducted in Australia, Taiwan, Singapore, and the United States did not find that near work was a significant risk factor for myopia development.[4]

One could argue that media and technology have evolved so quickly that data from even 10 years ago are obsolete. We disagree. Our study[5] of almost 4512 schoolchildren between ages 6 and 13 years found an odds ratio of 1.00 (95% CI, 1.00-1.00). At that time, near work meant traditional media and desktop computer use. This precisely estimated, negative result leaves little room for any effect from new media. The physiology of focusing on a digital device and the accuracy of that focus are the same that children from another age experienced when reading a book.

From this controversy, a new recognition that time outdoors may be a more important environmental influence than near work has emerged. A study we conducted[6] was the first, to our knowledge, to show that children who spend more time outdoors have a lower probability of developing myopia. That observation has been confirmed by studies around the world, but counterintuitively, it does not extend to the slowing of myopic progression in children who are already myopic.[7] Specifically from the Orinda Longitudinal Study of Myopia[6] (**Figure**), if a child has 2 parents with myopia, hereditary effects increase the child's chances of needing glasses to about 60% if time spent outdoors is low. More time outdoors, about 14 hours per week, can nearly neutralize that genetic risk, lowering the probability of developing myopia to about 20%, the same probability attributed to a child with no parents with myopia.[6]

Figure. Association of Myopia With Time Spent Outdoors



The probability of becoming myopic by eighth grade is plotted against quartiles of time spent in outdoor sports activity in third grade. Genetic risk is evident within each quartile as a higher probability of becoming myopic with each additional myopic parent. The protective effect of time outdoors can be seen in the decreasing probabilities of becoming myopic across quartiles. Reprinted from Jones et al[6]; the Association of Research in Vision and Ophthalmology holds the copyright to this Figure.

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If time outdoors is beneficial, what is the underlying mechanism? There are some theories with weak support, such that children exercise more when they are outside or ultraviolet B radiation from the sun creates more circulating vitamin D, and these factors somehow prevent abnormal childhood eye growth and myopia onset. The dominant theory is that the brighter light outside stimulates a release of dopamine in the retina. Dopamine then initiates a molecular signaling cascade that ends with slower, normal growth of the eye, which means a lower risk of myopia. Evidence from animal models of myopia supports the epidemiologic data that brighter light exposure is responsible for outdoor time's reported protective effect.[8] Evidence implicating sunlight has the advantage of never becoming obsolete; media may have evolved, but the same sun continues to rise and set each day.

Increased awareness of children's risk for abnormalities of refractive error, like myopia, is timely. The American Academy of Pediatrics recommends that children should have age-appropriate vision assessments at all routine visits[9]; the American Optometric Association recommends that school-aged children receive annual comprehensive eye examinations.[10] Children suspected of having myopia, by virtue of blurred distance vision on a carefully administered visual acuity test in the pediatrician's office or during a vision screening, should be referred to an optometrist or ophthalmologist for a complete eye examination. The myopia should be corrected to optimize distance vision, and treatment to retard the progression of myopia is emerging in both optical and pharmaceutical modalities. In contrast, the advice to go outdoors is for children who are not yet myopic but perhaps are at risk for developing myopia (eg, by virtue of their parents' myopia). The strongest associated factor, however, of risk for developing myopia is having a refraction that does not yet compromise distance vision but that is less farsighted than normal for the child's age. An eye care practitioner can determine that risk accurately with a simple refraction.[5]

Children's use of media and digital technology is a legitimate parental concern. Our message is that their concern need not extend to the development of myopia or other harm to their children's eyes. Our work indicates that 14 hours per week spent outdoors could mitigate a child's risk of becoming nearsighted.

ARTICLE INFORMATION

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