

Short review of myopia and its impact in the COVID-19 era

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Abstract

Myopia, or near-sightedness, is a common childhood eye condition where images are focused in front of the retina, often due to excessive eye length or lens curvature. If uncorrected, myopia can lead to severe visual impairment or blindness. The global prevalence of myopia is rising, expected to affect nearly half of the world's population by 2050, with significantly higher rates in East and Southeast Asia compared to other regions. In Malaysia, studies show varying prevalence rates among different

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ethnic groups, with ethnic Chinese children exhibiting the highest rates. Myopia negatively impacts quality of life, affecting children's academic performance, social interactions, and mental health. Economic burdens are substantial, with high costs for corrective measures and myopia-related complications, particularly in older adults. The COVID-19 pandemic exacerbated myopia progression due to increased screen time and reduced outdoor activities during lockdowns. Studies suggest that near work, especially using smartphones and computers, significantly contributes to myopia development, while outdoor activities have a protective effect. To mitigate myopia progression, especially during pandemics, it is crucial for parents to promote balanced eye habits, encourage outdoor activities, and monitor digital device usage. Treatments such as defocus incorporated multiple segments (DIMS) lenses, atropine eye drops, and maintaining good eye habits can slow progression. Despite limited evidence, eye exercises may also be beneficial. Proactive measures and alternative treatments are recommended when prolonged confinement is necessary.

Keywords: COVID-19, Malaysia, myopia, quality of life

Ulasan ringkas mengenai miopia dan kesannya dalam era COVID-19

Abstrak

Miopia atau rabun jauh merupakan satu keadaan mata yang lazim di kalangan kanak-kanak, di mana imej difokuskan di hadapan retina, disebabkan oleh pemanjangan bola mata atau kelengkungan kanta yang berlebihan. Sekiranya tidak dirawat, miopia boleh menyebabkan gangguan penglihatan yang teruk atau kebutaan. Prevalens miopia di peringkat global menunjukkan peningkatan yang ketara dan dijangka menjejaskan hampir separuh populasi dunia menjelang tahun 2050, dengan kadar yang jauh lebih tinggi dilaporkan di Asia Timur dan Asia Tenggara berbanding rantau lain. Di Malaysia, kajian menunjukkan kadar prevalens yang berbeza di antara kumpulan etnik, dengan kanak-kanak berketurunan Cina mencatatkan kadar tertinggi.

Miopia memberi kesan negatif terhadap kualiti hidup kanak-kanak termasuk prestasi akademik, interaksi sosial serta kesejahteraan mental. Beban ekonomi turut meningkat disebabkan oleh kos pemulihan penglihatan dan komplikasi berkaitan miopia, terutamanya dalam kalangan warga emas. Pandemik COVID-19 telah mempercepatkan perkembangan miopia akibat peningkatan masa penggunaan skrin dan pengurangan aktiviti luar semasa tempoh sekatan perjalanan. Beberapa kajian menunjukkan bahawa kerja jarak dekat, khususnya penggunaan telefon

pintar dan komputer, merupakan faktor utama perkembangan miopia, manakala aktiviti luar memberi kesan perlindungan.

Bagi membendung kelanjutan miopia, khususnya semasa tempoh pandemik, ibu bapa disarankan untuk menggalakkan amalan penjagaan mata yang seimbang, meningkatkan masa aktiviti luar dan memantau penggunaan peranti digital di kalangan kanak-kanak. Rawatan seperti kanta Defocus Incorporated Multiple Segments (DIMS), titisan mata atropin serta amalan penjagaan mata yang baik didapati berkesan dalam memperlahankan kadar kelanjutan miopia. Walaupun bukti saintifik masih terhad, senaman mata juga berpotensi memberi manfaat tambahan. Langkah pencegahan proaktif dan penggunaan rawatan alternatif amat digalakkan sekiranya tempoh sekatan perjalanan berpanjangan diperlukan.

Kata kunci: COVID-19, Malaysia, miopia, kualiti hidup

Myopia

Myopia, also known as short-sightedness and near-sightedness, is a defect of the eye developed during childhood where the image is focused in front of the retina due to strong cornea or lens curvature, or the eye is too long. Myopia, if uncorrected or under-corrected refractive error, is considered as one of the leading causes of blindness and vision impairment in the world.¹ Myopia is defined by a spherical equivalent (SE) of ≤ -0.5 dioptres (D), whereas high myopia is defined by SE worse than -5.0 D.² Pathological myopia occurs with more than -8.0 D. Higher levels of myopia are also associated with the risk of adverse ocular changes and sight-threatening diseases, such as glaucoma, retinal detachment, and macular holes, leading to uncorrectable visual impairment or blindness.³ The current global prevalence of myopia is almost 2 billion individuals (28.3% of the global population) and is estimated to increase to 4.76 billion individuals (49.8% of the global population) in 2050.⁴ The prevalence of myopia in some locations in East and Southeast Asia (47.0%) is much higher than that in Central Europe (27.1%), Central Asia (17.0%) and Central Africa (7.0%),⁴ with the highest prevalence of myopia and high myopia found in urbanized areas of East and Southeast Asia such as Singapore, cities in mainland China, Hong Kong, Taiwan, Japan, and South Korea.⁵⁻¹³

Zainal *et al.* noted that uncorrected refractive error was the main cause of low vision and blindness in Malaysia.¹⁴ Since then, several studies have recorded the prevalence of myopia in parts of the country, including a study by Goh *et al.* that found the overall prevalence to be 10% in 7-year-old children, increasing to approximately 33% in 15-year-old children, with the Chinese having the highest prevalence among the various ethnicities in Malaysia.¹⁵ Approximately 65% of Chinese school children had myopia in a rural area in Pahang, and the refractive error was significantly different between the age groups, but no significant difference was observed

between genders.¹⁶ A smaller cross-sectional study focusing on Malay children aged 6 to 12 years in a suburban area showed a lower prevalence of myopia at 5.4% of the studied population as compared to the study in an urban area by Goh *et al.*,¹⁵ which showed the prevalence of myopia in Malays was approximately 15.4%.¹⁷ A recent study among the indigenous (Orang Asli) school children reported that among the 40.9% of the total subjects who have visual problems, only 5.5% of the indigenous school children had myopia.¹⁸ Another study compared the prevalence of myopia in Malaysia and Singapore and found that Singaporeans have a higher prevalence of myopia compared to Malaysians; a higher prevalence was found in Chinese followed by Indians and Malays.¹⁰

Impact of myopia and quality of life

Studies have shown that myopia usually begins at the age of 7, the age which children begin their primary education in Malaysia.^{15,16} Uncorrected myopia can affect children's academic performance, as shown in randomised studies from China.^{19,20} Children's attention span, perseverance, and academic performance can be negatively impacted by poor vision and cause psychosocial stress, all of which can be improved by providing children with corrective spectacles.²¹ However, socio-economic factors such as cost, accessibility to spectacles, and parental education, as well as psychosocial barriers such as fear of discrimination, bullying, and negative societal attitudes are proven to be barriers to spectacle wear and compliance in children.²² Myopia impacts a person's quality of life (QOL) and the effect on QOL can be evaluated using either qualitative²³ or quantitative patient-reported outcome measures (PROMs).²⁴ PROMs used for myopia contain items on symptoms, activity limitation, emotional impact, social impact, and inconvenience.²⁵ Healthy adolescents with reduced visual acuity reported significantly lower scores for total QOL (-3.8; 95% confidence interval [CI] -7.1 to -0.5; $P = 0.03$), psychosocial functioning (-4.2; 95% CI -8.1 to -0.3; $P = 0.03$), and school functioning (-5.5; 95% CI -10.2 to -0.9; $P = 0.02$).²⁶ On the other hand, a better vision-related QOL has been reported with contact lenses²⁷ and orthokeratology lenses²⁸ than with spectacles, as the children with myopia have increased satisfaction with correction, activities, and appearance.

A cross-sectional study from 2006 involving children aged 12 to 17 years in Singapore found a mean annual direct cost of myopia SGD\$222 (USD\$148) and a median cost of SGD\$125 (USD\$83).²⁹ An ancillary study from 2011 also conducted in Singapore found the annual direct cost of myopia per person aged 40 years and above was approximately SGD\$900 (USD\$709), which is less than 2% of the gross domestic product (GDP) per person, of which 65% (SGD\$588 or USD\$463) was associated with costs of spectacles, contact lenses, and optometry services.³⁰ The costs for older individuals as compared to costs for children were higher, as adults are more likely to undergo laser-assisted in situ keratomileusis (LASIK) surgery, wear contact lenses, or develop myopia-related ocular complications. The total cost of myopia for the whole population of Singapore was also found to be SGD\$959 million

(USD\$755.2 million) during 2011, and adults with 80 years' duration of myopia were estimated with a lifetime cost of SGD\$21,616 (USD\$17,020).³⁰ The global costs of myopia and direct costs (including examinations, cost of spectacles and lenses, LASIK, care for complications) were approximately USD\$358.7 billion in 2019 and likely rise to USD\$870 billion in 2050, while severe vision impairment led to a productivity loss of approximately USD\$94.5 billion in 2019, likely to rise to USD\$229.3 billion in 2050³¹ due to the increase in the prevalence of myopia.

COVID-19 and myopia

In December 2019, a novel coronavirus (hereby known as coronavirus disease 2019 [COVID-19]) rapidly spread all around the world. In response to the COVID-19 outbreak, many countries closed their schools nationwide to prevent the spreading of the infection during 2020. It is estimated that approximately 1.2 billion school-aged children and adolescents³² were affected by the COVID-19 outbreak and confined at home. In order to sustain their study progress, the duration of digital device use by children increased from $1.9 \pm 1.1 \sim 2.5 \pm 2.3$ hours/day to $3.9 \pm 1.9 \sim 6.9 \pm 4.4$ hours/day, depending on the location of studies.^{33,34} The prevalence of myopia increased by approximately 5% after home confinement,^{35,36} and the mean annualized progression of myopia was also found to increase approximately 0.1 to 0.3 D during home education;³⁶⁻³⁸ approximately 49.5% of children showed an annual progression of ≥ 1 D during the pandemic as compared with 10.5% before the pandemic.³⁹ The use of different digital devices for online courses also has an impact on myopia progression, given that computer and smartphone use is shown to be associated with higher risks of myopic progression than television and projector use.⁴⁰⁻⁴² Working distance (< 30 cm) is also a factor that accounts for higher risks of myopia development and progression,⁴³ and myopic children tend to spend more time on activities at distances < 20 cm compared to non-myopic children.⁴⁴ During the COVID-19 pandemic, children were found to spend less time on outdoor activities, which contributed to myopia progression.^{34,45,46} Indoor lighting that is either "too dim" or "too bright" was also significantly associated with myopic symptoms.⁴⁷

Parents play an essential role in mitigating the myopigenic behaviours that emerged during the COVID-19 pandemic. To begin with, public education and forums are necessary to increase parent awareness about the effects of indoor near work and reduced outdoor time on myopia incidence and progression. It is essential to maintain good eye habits during home confinement, including taking frequent breaks from near work and limiting recreational screen time. Secondly, greater variation in home learning activities such as cooking, baking, housework, gardening, physical exercise, and other activities should be encouraged and included. Thirdly, outdoor activities with adequate social distancing should not be neglected, and children are encouraged to have 2-3 hours of outdoor time per day.⁴⁸ Last but not least, parents should ensure children have healthy digital device habits through the

use of digital applications to consciously monitor device usage and reminding users to disconnect from the digital devices, setting up daily schedules to allocate time for specific activities while building routine and discipline, supervising digital content to maximise learning experiences, and act as role models by reducing their digital device usage and engaging their children with non-digital indoor and outdoor activities. Despite its small sample, a quasi-experimental study showed that eye exercises may have an effect in reducing myopia outcomes in children.⁴⁹ However, when children are showing symptoms of myopia progression, it is advisable to bring the children for optical treatment. Optical treatment of defocus incorporated multiple segments (DIMS) lenses appeared to decrease myopia progression as compared to single vision lens (SVL) treatment during the lockdown period.⁵⁰ Low-dose 0.01% atropine was found to have decreased effectiveness for myopia control during prolonged COVID-19 lockdowns;⁵¹ hence, it is advisable to select alternative treatments if children are required to confine at home for a longer period.

Conclusion

While myopia has been recognised as an increasing burden with rising incidence pre-COVID-19, the lockdown imposed during the COVID-19 pandemic has clearly impacted the problem. This will contribute to higher numbers of newly diagnosed myopia, leading to more adults diagnosed with high myopia and pathological myopia.

Declarations

Ethics approval and consent to participate

None to declare.

Competing interests

None to declare.

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