From reading books to increased smart device screen time

Mohamed Dirani,[1,2] Jonathan G Crowston,[2,3,4] Tien Y Wong[1,2]

The number of people with myopia is expected to rise from 1.950 billion in 2010 to 4.758 billion by 2050.[1] In Asia, the prevalence of myopia in teenagers has been reported to be as high as 96.5%.[2] One study demonstrated that 11% of Singaporean preschoolers were already myopic, placing them at a significantly higher risk of developing high myopia and myopic macular degeneration.[3] This myopia 'epidemic' has become a profound public health concern. In Singapore, the direct cost of managing myopia was estimated at US$755 million annually, and globally at US$328 billion per year.[4]

It is now thought that because of the rapid increase in the prevalence of myopia in under one generation, environmental factors perhaps play a greater role in its development than our genes. Environmental risk factors include urbanisation, higher educational attainment, higher IQ, but more important has been two consistent risk factors: increased near-work activity and reduced outdoor activity.[5]

Studies often quantify near-work activity by the number of books read per week or the time spent reading books collected through questionnaires and diaries. Despite the subjectivity of this measure, a meta-analysis (25 025 children aged 6–18 years) reported a majority consensus on the association of increased near-work activity and myopia.[6] Therefore, specifically tailored interventions to reduce the impact of near work on myopia is probably justified. However, in the current digital age, the traditional assignment of using reading books as a proxy for near-work activity cannot solely account for the rapid rise in the prevalence of myopia. The role of smart devices, quantified as device screen time (DST) must also be investigated.

[1]Singapore National Eye Centre, Singapore Eye Research Institute, Singapore, Singapore
[2]Plano Pte Ltd, Singapore, Singapore
[3]Centre for Eye Research Australia, University of Melbourne, Royal Victorian Eye and Ear Hospital & Melbourne, Melbourne, Victoria, Australia
[4]Department of Surgery, University of Melbourne, Melbourne, Victoria, Australia

Correspondence to Tien Y Wong, Singapore National Eye Centre, Singapore Eye Research Institute, Singapore, Singapore; wong.tien.yin@snec.com.sg

The rapid adoption of smart devices in children adds a new dimension to how we define and quantify near-work activity. The penetration of smartphones globally has increased from 21.6% in 2014 to 34.7% in 2018. Moreover, the age of smart device uptake is getting younger, with many 2-year-olds spending up to 2 hours a day on devices.[7] In line with these trends, research is now surfacing to link excessive device use with a number of adverse health outcomes, including mental health conditions,[8] diabetes,[9] heart disease[10] and myopia.[11–14] The WHO recently classified internet and gaming addiction as mental health conditions.[15] The increased DST resulting from gaming, social media and digital entertainment has led to a rise in sedentary behaviour, poor diet and a lack of outdoor activity.

A major environmental factor for myopia supported by epidemiological studies is the protective role for outdoor activity.[5] A study that examined 1249 school-aged children in 2006 found that outdoor time was significantly correlated with lower amounts of myopia (OR 0.90, p=0.004).[16] The lack of adequate outdoor activity can also be attributed to the rise in DST. Only this year, a major international study that interviewed 847 ophthalmologists found that 86% (394), 60.2% (277) and 63.9% (294) of the respondents offered advice to patients to spend more time outdoors, reduce the amount of DST and limit smartphone use, respectively, to slow the progression of myopia.[17] This demonstrates a clear shift in our approach of managing myopia.

Could excessive device use and increased DST be the single major modifiable risk factor for myopia, accounting for both increased near-work activity and decreased outdoor activity? Studies in children are emerging, with major studies conducted in Taiwan,[11] India,[12] Japan[13] and China.[14] An earlier study from India (2015) examined 9884 children aged 5–15 years and reported that 2 hours or more of television time and playing mobile games was significantly associated with an increased risk of myopia (p<0.001).[12] These findings are not surprising when you consider that occupations involving extended computer use and other near-work tasks have long been associated with myopia.[18]

To better quantify the effects of DST as an independent risk factor in incident myopia, more research will be required. There is likely adequate evidence to support the inclusion of DST in both research and the clinical management of myopia. The consensus of independent ophthalmologists prescribing less DST and more outdoor play in the management of myopia is timely. This move should pave the way for the formulation of consolidated guidelines and frameworks to inform the ophthalmic and wider community on myopia prevention. Additional measures such as face-to-screen distance, body posture and digital content should also be explored. The use and misuse of smart devices, particularly in our paediatric populations, must be closely monitored to address the emerging phenomenon of 'digital myopia'.

Contributors All authors contributed equally to the planning and completion of this manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests DM is the CEO and TYW is a cofounder of the health technology company, Plano Pte Ltd, Singapore, which develops software solutions and applications for monitoring vision and smart device screen time usage.

Patient consent None declared.

Provenance and peer review Not commissioned; internally peer reviewed.

To cite Dirani M, Crowston JG, Wong TY. *Br J Ophthalmol* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/bjophthalmol-2018-313295

Br J Ophthalmol 2018;**0**:1–2. doi:10.1136/bjophthalmol-2018-313295

REFERENCES

1 Holden BA, Fricke TR, Wilson DA, *et al*. Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. *Ophthalmology* 2016;123:1036–42.
2 Pan CW, Dirani M, Cheng CY, *et al*. The age-specific prevalence of myopia in Asia: a meta-analysis. *Optom Vis Sci* 2015;92:258–66.
3 Dirani M, Chan YH, Gazzard G, *et al*. Prevalence of refractive error in Singaporean Chinese children: the strabismus, amblyopia, and refractive error in young Singaporean Children (STARS) study. *Invest Ophthalmol Vis Sci* 2010;51:1348–55.
4 World Health Organization, BHV Institute. 2015. The impact of myopia and high myopia, Australia. Available from: http://www.who.int/blindness/causes/MyopiaReportforWeb.pdf

5 Morgan IG, Ohno-Matsui K, Saw SM. Myopia. *Lancet* 2012;379:1739–48.
6 Huang HM, Chang DS, Wu PC. The association between near work activities and myopia in children-a systematic review and meta-analysis. *PLoS One* 2015;10:e0140419.
7 Bernard JY, Padmapriya N, Chen B, *et al*. Predictors of screen viewing time in young Singaporean children: the GUSTO cohort. *Int J Behav Nutr Phys Act* 2017;14:112.
8 Thomée S, Härenstam A, Hagberg M. Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults--a prospective cohort study. *BMC Public Health* 2011;11:66.
9 Nightingale CM, Rudnicka AR, Donin AS, *et al*. Screen time is associated with adiposity and insulin resistance in children. *Arch Dis Child* 2017;102:612–6.
10 Celis-Morales CA, Lyall DM, Steell L, *et al*. Associations of discretionary screen time with mortality, cardiovascular disease and cancer are attenuated by strength, fitness and physical activity: findings from the UK Biobank study. *BMC Med* 2018;16:77.
11 Ku PW, Steptoe A, Lai YJ, *et al*. The associations between near visual activity and incident myopia in children: a nationwide 4-year follow-up study. *Ophthalmology* 2018.
12 Saxena R, Vashist P, Tandon R, *et al*. Prevalence of myopia and its risk factors in urban school children in Delhi: the North India Myopia Study (NIM Study). *PLoS One* 2015;10:e0117349.
13 Terasaki H, Yamashita T, Yoshihara N, *et al*. Association of lifestyle and body structure to ocular axial length in Japanese elementary school children. *BMC Ophthalmol* 2017;17:123.
14 Zhou J, Ma Y, Ma J, *et al*. [Prevalence of myopia and influencing factors among primary and middle school students in 6 provinces of China]. *Zhonghua Liu Xing Bing Xue Za Zhi* 2016;37:29–34.
15 W. H. Organization, International classification of diseases (ICD-11), 2018. Available from: https://icd.who.int/
16 Dirani M, Tong L, Gazzard G, *et al*. Outdoor activity and myopia in Singapore teenage children. *Br J Ophthalmol* 2009;93:997–1000.
17 Zloto O, Wygnanski-Jaffe T, Farzavandi SK, *et al*. Current trends among pediatric ophthalmologists to decrease myopia progression—an international perspective. *Graefes Arch Clin Exp Ophthalmol* 2018;56.
18 Yamamura K, Kishi R, Sadamoto T, *et al*. An investigation of the Medical Data Index (MDI) health questionnaire given to women VDT workers involved in advanced office automation_924 women clerks in a city bank with head and branch offices. *Ind Health* 1983;21:199–207.