

Parenting in the 21st century: Are parents well informed to manage eye health and smart device use in children?

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ABOUT PLANO

Plano is a health technology company based in Singapore that aims to manage smart device use and eye health in people worldwide. Plano was developed in 2017 under the Singapore Eye Research Institute – Singapore National Eye Centre (SERI-SNEC) Ophthalmic Technologies Incubator Programme. The Plano team consists of experts in computer science, data analytics, ophthalmology, epidemiology and business development who are dedicated to developing innovative and scientifically backed technological applications and platforms to turn the smart device problem into the solution.

Plano's first product offering, the plano application (app), is the world's first science-based eye health and parental management app. plano runs in the background of smart devices and monitors device use by children. Through its suite of functions and features, plano helps to modify children's behaviour to reduce their exposure to environmental risk factors for the common eye condition, myopia (also known as short-sightedness or near-sightedness). Research has shown that excessive near work, including device screen time, and a lack of outdoor activity, are the major risk factors for myopia, and plano helps to empower children to develop healthier relationships with screens and to spend time outdoors to protect them from myopia.

Since Plano's inception, the company's products and offerings have diversified and enabled the creation of an ecosystem. In addition to the plano app, Plano's growing ecosystem consists of an E-commerce directory where parents and their children can redeem points earned through the rewarding of the child's healthy device use behaviours for a range of device-free activities (plano Shop), an online optometry service delivery platform (plano Eyecheck), an online platform that raises awareness about the amount of time that people are spending on smart devices (plano Time Machine), school outreach programmes (plano@school), workplace consultancy services (plano@work), a bestselling children's book series (The Plano Adventures) and big data analytics capabilities. This ecosystem provides a comprehensive solution to managing excessive device use and eye health in this digital world.

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GLOSSARY OF ABBREVIATED TERMS

HPB	Health Promotion Board
NMPP	National Myopia Prevention Programme
NUS	National University of Singapore
SD	Standard deviation



EXECUTIVE SUMMARY

BACKGROUND & RATIONALE

Myopia currently affects 2.6 billion people globally, of which 400 million have sight-threatening high myopia. The number of people with myopia and high myopia is projected to increase to an alarming 5 billion and 1 billion, respectively, by 2050. In Singapore, myopia affects more than 1 in 10 toddlers and pre-schoolers aged 6 – 72 months and as many as 70 – 80% of teenagers completing secondary school.

Epidemiological studies have revealed that myopia has become so prevalent because of the increasing influence of environmental risk factors such as excessive near work activity and lack of outdoor activity during childhood. The high penetration rate and usage of smart devices such as phones and tablets among children in recent times have further increased the amount of time children spend on near work activity, consequently reducing the amount of time they spend outdoors, thereby exacerbating the myopia crisis. Excessive smart device use is also associated with myriad other health consequences including diabetes, heart disease and mental illness.

Parents play a prominent role in protecting their children's health, including their eye health, by managing their relationships with device screens and by ensuring their children undergo regular eye examinations to detect and manage myopia. However, parents must first be well-informed in order to instil good habits in their children. To the extent of our knowledge, no studies have assessed parents' knowledge and awareness of the relationship between myopia and smart device use in children or management strategies for myopia and device use. This report provides insights into the currently employed practices and level of awareness of myopia, eye care habits and smart device use behavior in children among a cohort of Singaporean parents.

OBJECTIVES

This report set out to:

1. Determine the level of awareness of myopia among a group of parents residing in Singapore, more specifically about:
 - a. Eye problems associated with myopia.
 - b. Management strategies to mitigate myopia.
2. Determine parents' awareness and concerns about their children's device use habits.
3. Determine the strategies used by Singaporean parents to manage children's device use.
4. Determine the influencing factors and reasons for the uptake of eye care services among Singaporean parents.

PROTOCOL

This study was jointly conducted by Plano and the NUS Business School. Parents with children aged 3 to 12 years old were engaged to participate in the study by trained recruiters via an online questionnaire distributed through both online and offline channels. All eligible participants provided informed consent by completing a checkbox in the online questionnaire. The online questionnaire collected data on parents': 1) sociodemographic characteristics; 2) eye health; 3) knowledge and perceptions about myopia's causes, management strategies and complications; 4) concerns about and management strategies for their children's device use; 5) sources of parenting advice and; 6) utilisation of eye health care services, as well as data on children's: 1) age; 2) device use; 3) eye health and; 4) eye examination frequency.

MAIN FINDINGS

This study collected data from 200 parents (mean \pm standard deviation [SD] age = 37.0 ± 7.7 years) of whom 77.0% were mothers, with a mean (SD) of 2.1 ± 0.9 children per family. Most participants (85 – 90%) were unaware that myopia is associated with other sight-threatening eye diseases, with 2 in 5 believing that myopia is only associated with blurry vision. The majority of participants (84 – 97.5%) were aware of the importance of several key management strategies of myopia, which include managing reading distance, visiting an optometrist, engaging in outdoor activities, managing lighting conditions and monitoring screen time and taking regular breaks.

A majority of participants encouraged outdoor activity (76.5%) and monitored screen time (66.0%) as strategies to manage smart device use in children. Forty percent of participants indicated poor eyesight as their primary concern regarding excessive device use, with 82.5% including it amongst their top three concerns. Only a quarter of the participants took their children for annual eye examinations, with a majority (60.7%) of those who did not do so strongly believing that it is unnecessary given that vision screenings are already conducted in schools. Furthermore, more than half of the participants (53.3%) had the opinion that other health examinations were more important than eye examinations, which discouraged them from bringing their children for eye examinations.

IMPLICATIONS OF FINDINGS

Singaporean parents had a good level of awareness of the different myopia management strategies and were aware that excessive smart device use is associated with negative eye health consequences in children. They were also concerned about the effects on children's eye health resulting from excessive smart device use. However, a lack of awareness of other blinding eye problems associated with myopia, a misconception that vision screenings are sufficient to substitute eye examinations and a lack of awareness of the importance of regular and timely eye examinations was observed in parents in this study, indicating gaps in parents' knowledge about myopia and eye care. More specifically tailored awareness campaigns to better inform and educate the public about sight-threatening eye problems associated with myopia and the importance of regular and timely eye examinations may be warranted to fill these gaps in parents' knowledge.



BACKGROUND AND RATIONALE

THE GLOBAL MYOPIA EPIDEMIC

There are currently 2.6 billion people with myopia globally and this number is projected to increase to an alarming 5 billion, or half of the world's population, by 2050.¹ Recent studies have shown that the prevalence of myopia in parts of Asia such as Singapore, Taiwan and Hong Kong are as high as 80 – 90% in children and teenagers, with 96.5% of South Korean teenagers found to be affected with myopia.^{2,3} Moreover, studies from the United States and the United Kingdom have also found that the prevalence of myopia has doubled in the last 30 – 50 years, indicating that the myopia epidemic is affecting the global population and is not just an Asian problem.^{4,5}

In addition to the increasing prevalence of myopia in countries worldwide, the age at which children are developing myopia is decreasing, affecting children as young as 6-months old.⁶

For every year younger that children develop myopia, they have a three times greater risk of developing high myopia, which significantly increases their risk of developing sight-threatening eye diseases such as glaucoma and macular degeneration.⁷ This is mainly because myopia progresses faster in younger children, resulting in more severe myopia by the time the condition stabilises during teenage or early adult years.^{2,7} Currently, almost 400 million people in the world have high myopia and this number is projected to increase to 1 billion by 2050 if new myopia intervention and management strategies are not implemented on a global scale.¹

SINGAPORE, THE MYOPIA CAPITAL OF THE WORLD

Singapore is often considered to be the myopia capital of the world due to its high prevalence of both myopia and high myopia compared to other countries in the world. Myopia affects more than 1 in 10 Singaporean toddlers and pre-schoolers aged 6 – 72 months⁶ and as many as 70 – 80% of children completing secondary school or starting tertiary education.⁸ Myopia has become a major public health concern in Singapore, negatively affecting the health, education and economy of the country and its people.⁸ The high prevalence of high myopia in Singapore might become a leading cause of blindness in the near future if effective interventions and management strategies are not implemented in the coming years. Myopia, if uncorrected, has also been associated with impeded learning and development among children, thereby negatively affecting their education.⁹ From an economic perspective, the annual direct cost of managing myopia in Singaporean school children was found to be US\$150 per child,¹⁰ with the total direct cost to the healthcare system of myopia correction and treatment in Singapore estimated at US\$755 million per year.¹¹

DIGITAL MYOPIA: A GROWING TREND AMONG CHILDREN

The onset and progression of myopia result from a complex interaction between hereditary and environmental factors, with emerging evidence suggesting a greater role for environmental influences such as excessive near work and lack of outdoor activity.¹² Near work activity has conventionally been defined and quantified by the number of books read or time spent on studying but, in this digital age, the growing epidemic of excessive use of smart devices such as smartphones and tablets (also known as device screen time [DST¹³]) now contributes to the burden of excess near work among children worldwide. As technology becomes more pervasive in our everyday lives, the amount of time spent on devices by children is increasing, and the age at which children begin engaging with devices is decreasing. Research has shown that children as young as 4 months are already exposed to screens for an average of 1 - 2 hours each day¹⁴ and many teenagers use devices for more than 7 hours every day.¹⁵ As many as 97% of children aged 4 years regularly use smart devices and three quarters of them have their own devices.¹⁶ This trend of more DST at progressively younger ages is associated with an increased risk of an array of adverse health consequences, including mental illness¹⁷⁻¹⁹, addiction²⁰, musculoskeletal disorders^{21,22}, diabetes²³ and eye conditions including myopia²⁴, but given the very recent proliferation of devices, this line of research is still in its infancy and more investigation is required to understand the extent of the problem.



Research on the relationship between DST and myopia has been gathering pace. At least seventeen population-based studies from 8 countries have investigated the association between smart device use and myopia, with 14 of those studies from countries including China²⁵⁻²⁸, India²⁹⁻³¹, Japan³², Taiwan³³⁻³⁵, Spain³⁶, Denmark³⁷ and Ireland³⁸ supporting the link between longer screen time and an increased risk of myopia onset and progression. The mechanism by which DST promotes the onset and progression of myopia may be two-fold. The first is that when children look at device screens close to their faces for extended periods, the regulation of the growth along the eye's axial length is disrupted and the eye grows too long to allow it to adapt to looking at nearer objects.³⁹ The second is that when children engage with device screens they tend to do so indoors, thereby reducing their exposure to sunlight and far viewing distances which also results in excessive eye growth and myopia.⁴⁰

THE LACK OF UTILISATION OF EYE CARE SERVICES

One of the key strategies for managing myopia in children is early detection and intervention based on the results of eye examinations.^{24,41} If myopia progresses undetected and untreated, the resulting impacts on a child's life can be significant, including reduced quality of life and poorer educational and social outcomes.⁷¹ Children who do not go for regular eye examinations have been found to be three times more likely to develop myopia compared to those who are examined regularly.⁴² Different countries have different guidelines on how often children should go for regular eye examinations, but once every one to two years is a widely used recommendation adopted by countries including Singapore⁴³ and the United States.⁴⁴ If myopia is detected early, its progression may be slowed by a range of interventions including some types of spectacle lenses, contact lenses and experimental eyedrops. In most cases, treating optometrists choose not to slow the progression of myopia but rather correct the refractive error with corrective lenses, and the prescription of lenses is updated through regular eye examinations as the child's refractive error worsens. The Singaporean Government has taken steps to ensure that more children undergo regular eye examinations to facilitate the detection and treatment of myopia in more children. The School Health Service (SHS) conducts annual vision screening (eyesight tests) on approximately 350,000 Singaporean school children aged 5 – 16 years as part of the National Myopia Prevention Programme coordinated by the Health Promotion Board (HPB) of Singapore.⁴⁵ Children found to have a visual acuity of 6/12 or worse in either eye are referred to optometrists for more comprehensive eye examinations. A 2011 report by hpb revealed that the program has been successful in reducing the prevalence of myopia by 5% in primary school children.⁴⁶ Studies from other countries including Vietnam and Turkey have also noted the effectiveness of eye health promotion programs in schools as a strategy to improve children's eye health.^{47,48}



WHY SHOULD PARENTS TAKE NOTICE?

Parents should play a prominent role in their children's eye health and device use behaviour, but in order to instil healthy eye care and device use habits in children, parents must first be well equipped with the necessary knowledge and understanding. There is currently a paucity of studies worldwide investigating parental awareness and knowledge of myopia and smart device use among children as well as management strategies employed by parents. One study in Ireland investigating parental awareness of myopia found that only 46% of parents considered myopia to present a health risk to their children and only 14% would be concerned if their child developed myopia.⁴⁹ This demonstrates that parents may need to be better informed about myopia, its potential consequences and its management strategies, which include: 1) encouraging their children to engage in more outdoor activities; 2) instilling good near work habits such as holding books or devices at an adequate distance from the eyes, taking regular breaks when engaging in near work activity to look far into the distance and; 3) taking their children for regular and timely eye examinations.

Parents' attitudes towards and awareness of their children's eye health are also important for the effective management of myopia. A study in China found that children had a lower risk of developing myopia if their parents paid attention to their vision from a young age.⁵⁰ Studies conducted in the United Kingdom and Hong Kong found that as many as three-quarters of parents of children with refractive errors were unaware of their children's refractive errors, including myopia.^{41,42} Consequently, children whose parents are unaware of their myopia are unlikely to be taken for eye examinations and therefore do not benefit from having their myopia treated by an eyecare professional.

In order to address the gap in research about parents' knowledge and awareness of myopia and device screen time management, we conducted a study of knowledge and awareness of myopia and device use as well as engagement with eye care services among a sample of Singaporean parents. This report presents the findings from that study.



HOW CAN THIS REPORT BENEFIT READERS?

This report provides insights into the currently employed practices and level of understanding among a cohort of Singaporean parents regarding myopia, eye care habits and children's smart device use behavior. The insights presented in this report will provide a multitude of benefits to the general public, as well as Government and industry stakeholders. Parents will benefit from the information contained in this report, including that which describes effective myopia and DST management strategies. Children will in turn benefit as better-informed parents will be able to pay closer attention to their children's eye health and device use behaviours and will be able to implement the strategies they learn from this report. From a public health perspective, the results presented herein provide the Government with insights to assess the existing knowledge gaps among parents towards which specifically tailored education and awareness campaigns on eye health and smart device use may be directed. Industries may also use the results in this report to identify market gaps from which new business cases on myopia intervention and management in children may be developed. Ultimately, parents and children will also benefit from the downstream effects of the awareness campaigns and the rise of new myopia intervention and treatment modalities to better manage the global myopia epidemic.

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PROTOCOL

SETTING AND PARTICIPANT RECRUITMENT

This study was jointly conducted by the Plano Research Team and students from the NUS Business School as part of the Field Service Project module (code: FSP4003). The module provides Business undergraduate students with the opportunity to work on a real-world business case and provide informed insights and recommendations to the partner company.

Parents with children aged 3 to 12 years were invited to participate in the study by trained recruiters through several channels, which included:

1. Text messages to personal contacts of the team.
2. Electronic direct mailers to NUS Business School students and alumni for referral to eligible participants.
3. On-the-ground recruitment outside preschools and shopping malls.
4. Direct messages to Facebook users who were members of parenting groups, for example school groups, tuition centers, childcare subsidies and children activities.

The participants who agreed to participate were required to complete an online questionnaire to examine parents' beliefs, attitudes and perceptions of eye health and their parenting routines. All eligible participants provided informed consent by completing a checkbox in the online questionnaire prior to participating. The collected responses were uploaded and stored securely in the Qualtrics platform and were only accessible to authorized personnel.

ONLINE QUESTIONNAIRE

The online questionnaire was designed and developed by the Plano research team and the NUS Business School final year undergraduate students using Qualtrics, a web-based survey tool that was used to collect and store data from the participants. Participants who completed the online questionnaire were given the option to obtain a S\$20 voucher that could be used for their children's next eye examination at selected optometry stores in Singapore.



PARENT AND CHILD SOCIO-DEMOGRAPHIC ITEMS

The participating parents were asked a total of eight questions on their socio-demographic information and their children's age, which included:

1. Parents' gender, which was classified into two categories: male and female.
2. Parents' age, which was classified into five categories: below 20 years old; 20 – 29 years old; 30 – 39 years old; 40 – 49 years old; and 50 years old or above.
3. Parents' marital status, which was classified into five categories: single / never married; married / domestic partnership; separated; widowed; and divorced.
4. Parents' highest educational qualification, which was classified into six categories: primary school leaving examination (PSLE) or equivalent; GCE 'O' Levels or equivalent; Pre-university: GCE A Levels / Diploma / International Baccalaureate or equivalent; Bachelor's Degree; Master's Degree; and others. Those who selected others were required to key in their answer.
5. Parents' employment status, which was classified into seven categories: homemaker; self-employed; full-time employee; part-time employee; casual / ad-hoc / contract employee; unemployed; and others. Those who selected others were required to key in their answer.
6. Parents' annual household income, which was classified into eight categories: less than S\$10,000; S\$10,000 – S\$30,000; S\$30,001 – S\$50,000; S\$50,001 – S\$70,000; S\$70,001 – S\$90,000; S\$90,001 – S\$110,000; S\$110,001 – S\$130,000; and more than S\$130,000.
7. Number of children in the family. Parents were asked to select the number of children in their family from a range of one to seven.
8. The age of each of the parents' children.

MYOPIA, EYE CARE AND SMART DEVICE USE KNOWLEDGE AND AWARENESS

Parents were then asked a series of questions to determine their level of awareness of myopia and eye care management strategies and habits, which included:

1. Parents' eye health status. Parents were presented with 5 options: perfect eyesight; near-sighted; long-sighted; I am not sure; and others. Those who selected others were required to key in their answer.
2. Parents' own perception of how well they consider themselves to be equipped with the knowledge to manage myopia. Parents were able to select the extent to which they consider themselves as having sufficient knowledge to manage myopia from a range of 1 – 4: 1 being the least equipped and 4 being the most equipped with the knowledge to manage myopia.
3. Parents' view on myopia being a genetic eye disease. Parents were able to select the extent to which myopia is genetic: 1 being purely genetic; 2 being mostly genetic; 3 being genetic to a limited extent; and 4 being purely within our control.
4. Parents' awareness of eye problems associated with myopia. Parents were able to choose more than one answer from the 6 available options: blurry vision; dry eyes; glaucoma; cataract; blindness; and retinal detachment, with all options being associated with myopia.
5. Parents' view regarding the level importance of different myopia management strategies, which included managing reading distance; managing lighting conditions; outdoor activities; monitoring screen time and taking regular eye breaks; and visiting an optometrist and wearing prescribed spectacles. An additional false option of delaying wearing prescribed spectacles was included. Parents had to indicate the level of importance (1 being the least important and 4 being the most important) for each of the strategies presented.
6. Parents' concern areas regarding their children's excessive device use. Eight options were presented to parents in which they had to select their top three concerns, which included addiction (e.g. gaming addiction); behavioural problems (e.g. irritability); lack of face-to-face interactions; lack of sleep; poor academic results; poor eyesight; poor time management; and unsafe/inappropriate content.
7. Parents' methods of managing their children's device use. Five options were presented to parents from which they were able to select more than one option, which included: setting aside time to be device-free; not allowing children to own a mobile device; using parental control applications (parents were asked to specify if selected); encouraging outdoor activities; and others (parents were asked to specify if selected).
8. Factors that influenced parents to take their children to an optometrist for an eye check-up. This question was only presented to parents who have ever taken their children for an eye examination. Five options were presented to parents from which they were able to select more than one option, which included: encouragement of regular eye check-ups in the family; early detection of eye health issues; prevent further deterioration of existing eye health conditions; ensuring that children's learning in school is not hindered; and others (parents were asked to specify if selected).
9. Parents' habits when bringing their children for their eye examination. These questions were only presented to parents who had ever taken their children for an eye examination. The first

question inquired about whether parents had a go-to optometrist, which asked parents to select one of the four presented options: yes, definitely; yes, but I am thinking of changing; no, but I can ask around; and no, I have no idea. The second question inquired about who typically accompanies their children to the optometrist, which asked parents to select one of the five presented options: both parents; myself; my spouse; grandparents; and others.

10. Factors that influence parents when choosing their optometrist. Parents were asked to select the top three influencing factors from nine options, which included: appointment reminders; brand reputation; discounts on purchases at optometrist; free eye check-up services; proximity of the optometrist; range of specialised services; trust and relationship with optometrist; warranty on spectacles for myopia; and word of mouth.

CHILD EYE HEALTH AND DEVICE USE HABITS ITEMS

Parents were also asked a total of five questions regarding their children's age, device use and eye health habits, which included the following questions:

1. Children's device use frequency. Parents were presented with 4 options: daily; once or twice a week; every other day; and never.
2. Children's continuous screen time in one sitting. Parents were presented with 6 options: 1 – 30 minutes; 31 – 60 minutes; 61 – 90 minutes; 91 – 120 minutes; more than 120 minutes; and not applicable.
3. Children's eye health status. Parents were presented with 5 options: perfect eyesight; near-sighted; long-sighted; I am not sure; and others. Those who selected others were required to key in their answer.
4. Children's frequency of visits to the optometrist. Parents were presented with 4 options: at least once a year without fail; only when the school health report indicates that I should; only when my child complains that he/she cannot see very well; and not at all.
5. Parents' reasons for not utilising eye care services annually. This question was only presented to parents who indicated that they did not bring their children for annual eye examinations. Five options were presented to them in which they had to select their top three reasons, which included: missed appointment due to no reminders; unsure where to get the right service; other health check-ups are more important; unnecessary as there are school check-ups; and unsure where the closest optometrists are.

STATISTICAL ANALYSIS

De-identified data were downloaded from the Qualtrics server and imported into RStudio statistics software version 1.1.456 (RStudio, Inc., United States). Descriptive statistics were used to summarise the participants' responses and Microsoft Excel (Microsoft, United States) was used to present the summaries visually. Figure 1 below graphically presents the study protocol.

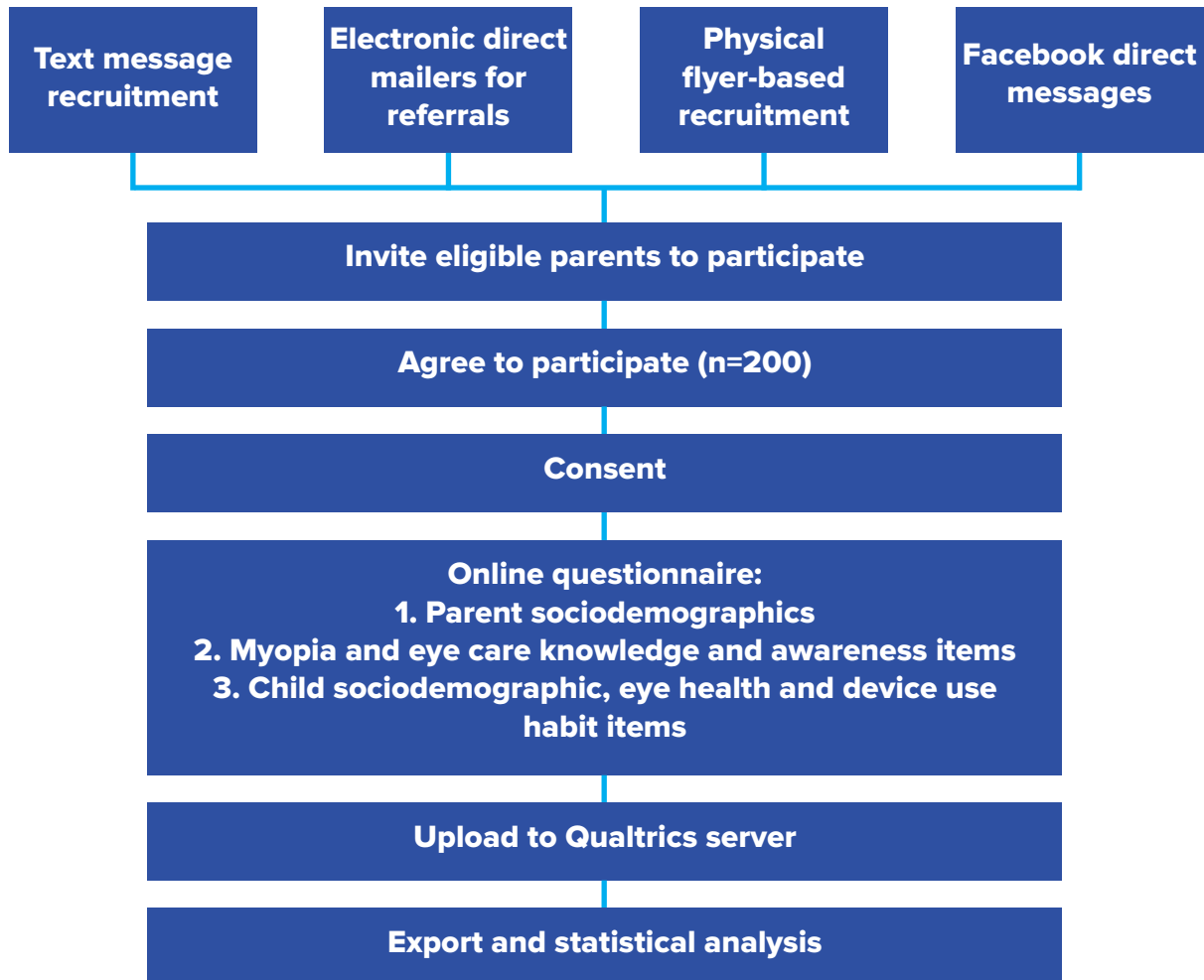


Figure 1. Study Protocol



MAIN FINDINGS

PARTICIPANT DEMOGRAPHICS

DEMOGRAPHIC CHARACTERISTICS OF PARENTS

A total of 200 parents completed the online questionnaire (Figure 1). The mean [SD] age of the participants was 37.0 [7.7] years, with close to half (48.5%) of the participating parents aged 30 – 39 years. A majority of the participants were mothers (77.0%) and married (93.0%). The participants were well-educated, with 67% having a bachelor's degree or higher. Most of the participants were full time employees (61.0%) from middle to upper class families, with more than half (52.5%) having an annual household income of S\$70,000 or more. The mean (\pm SD) number of children per family was 2.1 ± 0.9 , with the majority having 2 children (43.5%). Figure 2 below summarises the demographic characteristics of the participants.

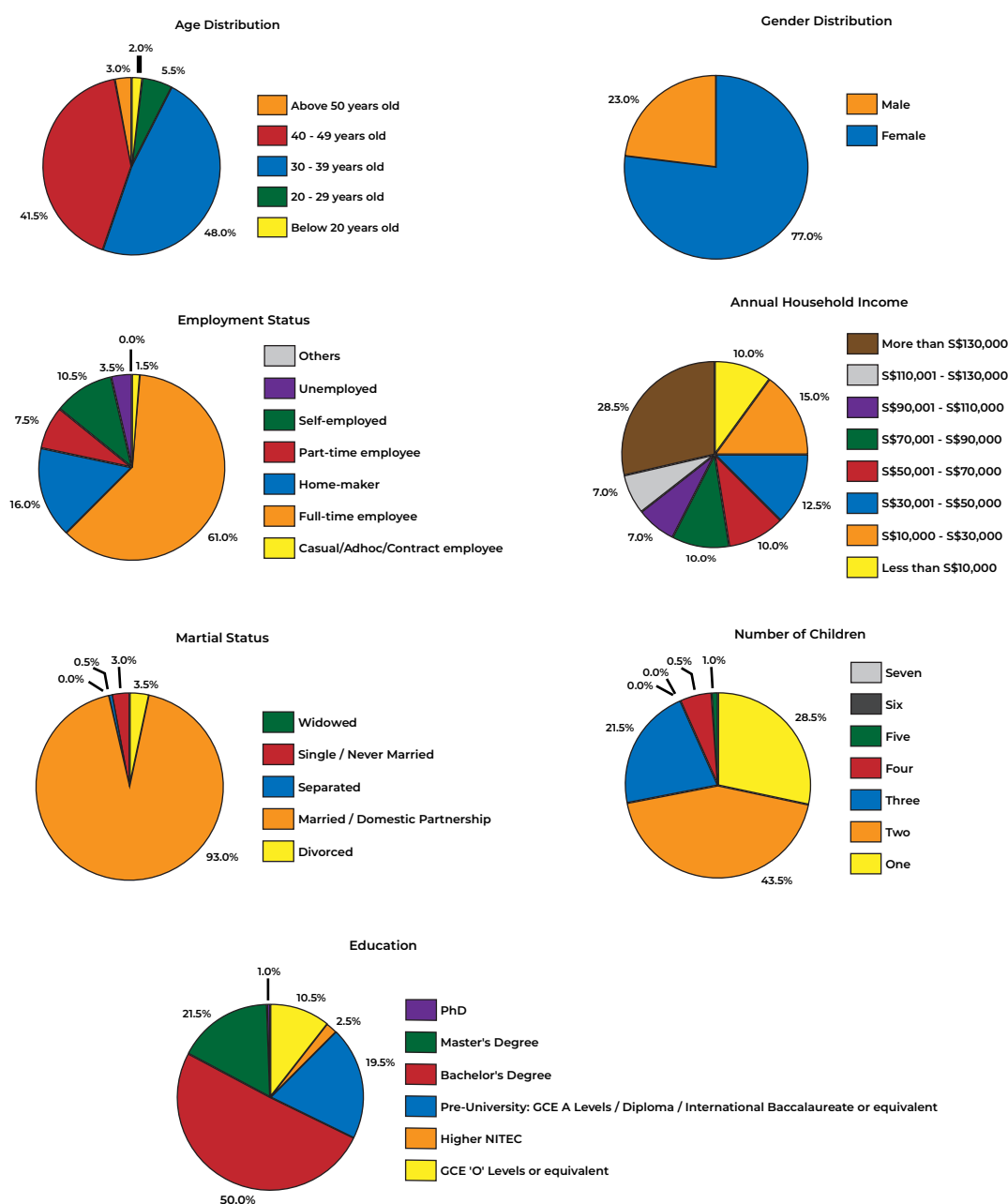


Figure 2. Sociodemographic characteristics of the participants

DEMOGRAPHIC CHARACTERISTICS OF CHILDREN

Data were captured on 414 children from the 200 participants. The average [SD] age of the children was 7.3 ± 4.3 years, with half being toddlers and pre-schoolers (aged 6 years and below). Figure 3 below shows the age distribution of the children in this study.

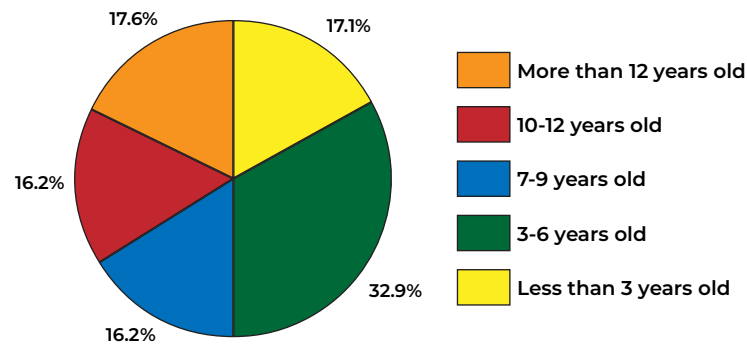


Figure 3. Age Distribution of Children

PARTICIPANTS' ANSWERS TO QUESTIONS ABOUT MYOPIA*PARENTS' EYE HEALTH STATUS*

Almost half of participants had myopia (44.5%), while only a quarter (25.5%) reported that they had perfect vision (Figure 4).

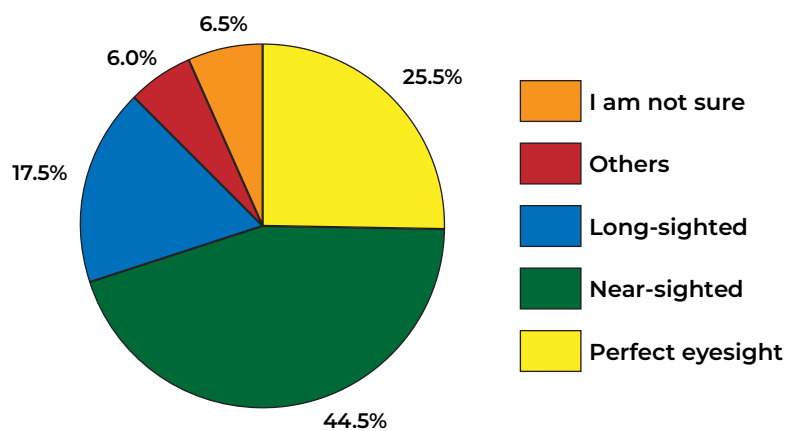


Figure 4. Parents' Eye Health Status



Almost half of parents believed they do NOT have sufficient knowledge of myopia.

PARENTS' OWN PERCEPTION OF THEIR MYOPIA KNOWLEDGE

A majority of the participants believed that they were well-equipped with the necessary knowledge to manage myopia, with over half (51.5%) rating their perceived knowledge of myopia as 3/4 of higher, however only 5% reported themselves to have a 4/4 level of preparedness (Figure 5).

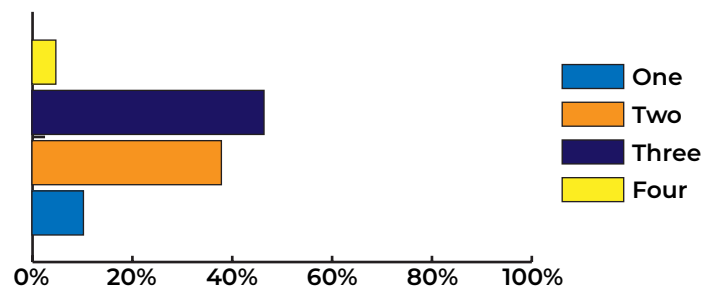


Figure 5. Parents' perceived knowledge about myopia.

PARENTS' VIEW ON MYOPIA BEING A GENETIC EYE DISEASE

More than 3 in 5 participants (63.0%) had the correct view that myopia is genetic to a limited extent (Figure 6).

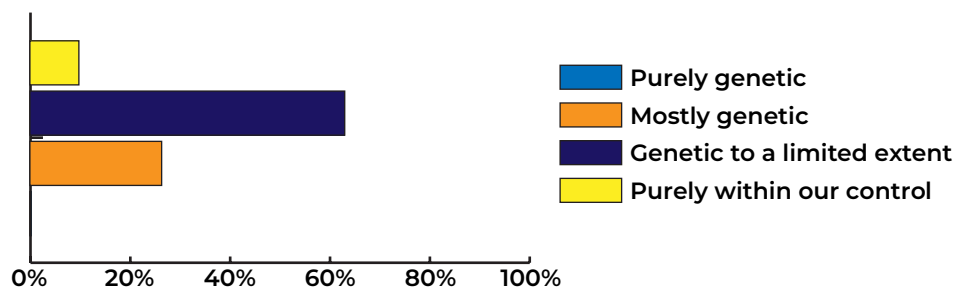


Figure 6. Parents' view on myopia as a genetic eye disease.

Almost half of parents believed that myopia is ONLY associated with blurry vision.



PARENTS' AWARENESS OF EYE PROBLEMS ASSOCIATED WITH MYOPIA

Almost all participants (92.5%) were aware that myopia is associated with blurry vision, with 42% believing that myopia is associated exclusively with blurry vision without being aware that it is associated with other eye conditions such as glaucoma, retinal detachment and cataract, which may lead to blindness (Figure 7).

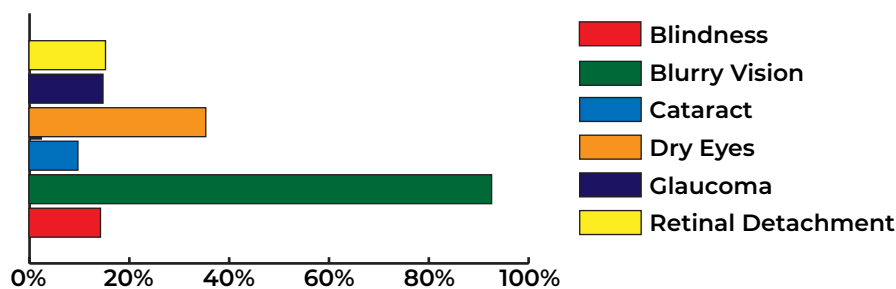


Figure 7. Parents' awareness of eye problems associated with myopia.

At least 8 in 10 parents were aware of important myopia management strategies.

PARENTS' AWARENESS OF MYOPIA MANAGEMENT STRATEGIES

Most of the participants attributed a level of importance of at least 3/4 to each of the following for the management of myopia: managing reading distance (97.5%); visiting an optometrist (86.0%); monitoring screen time and taking regular eye breaks (96.5%); engaging in outdoor activities (84.0%) and; managing lighting conditions (96.5%) (Figure 8). However, almost half (47.5%) of participants incorrectly believed that delaying wearing prescribed spectacles was a management strategy of myopia.

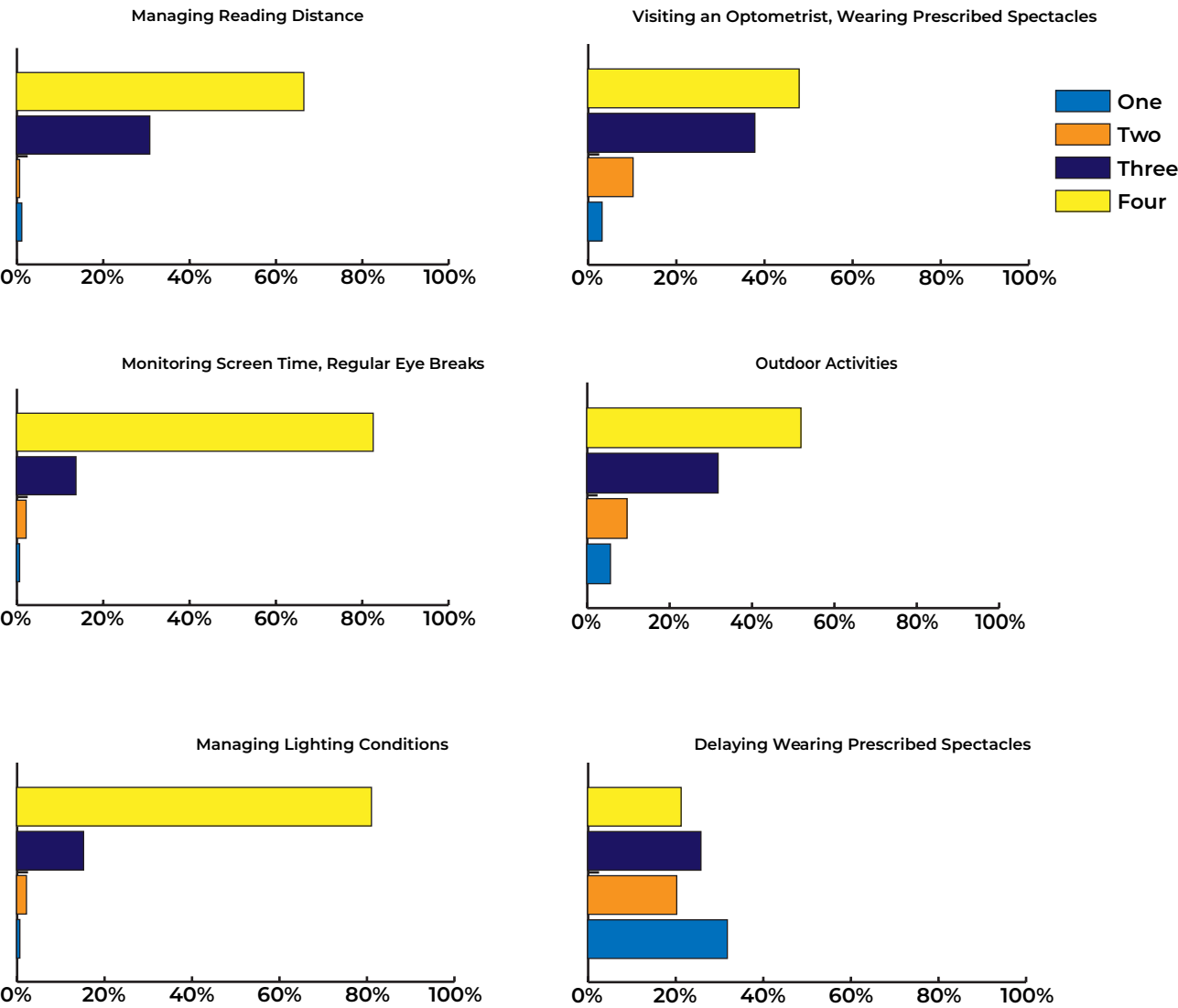


Figure 8. Parents' opinion on the importance of different myopia management strategies.

PARTICIPANTS' ANSWERS TO QUESTIONS ABOUT SMART DEVICE USE IN CHILDREN

CHILDREN'S SMART DEVICE USE HABITS

Close to half of the children in this study used smart devices daily (47.8%) while only 11.8% had never used a smart device before (Figure 9). A majority of children (34.5%) used their devices for an average of 1 – 30 minutes in one sitting, with 11.4% using their devices continuously for more than 2 hours in one sitting (Figure 10).

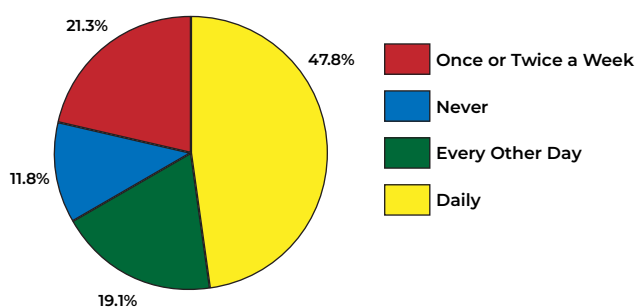


Figure 9. Smart device use frequency in children.

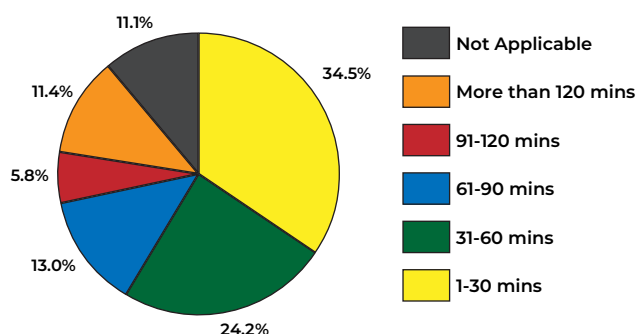


Figure 10. Continuous screen time in children.

PARENTS' METHODS OF MANAGING SMART DEVICE USE IN CHILDREN

Most participants encouraged outdoor activities (76.5%) and setting aside device-free time (66.0%) to manage their children's smart device use, while only 12% used parental control applications (Figure 11).

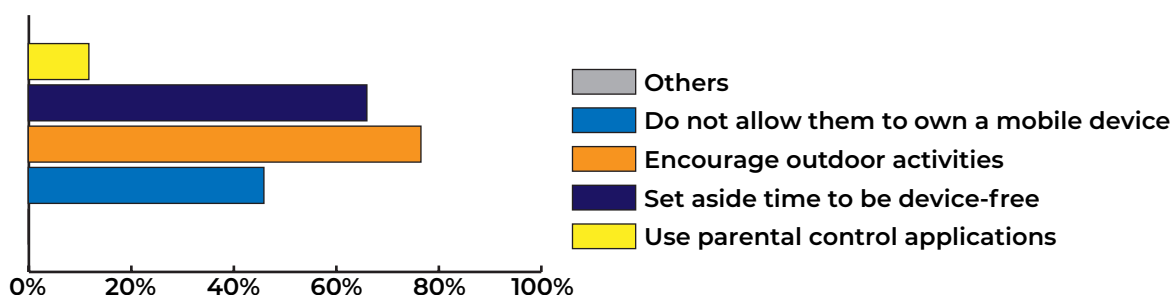


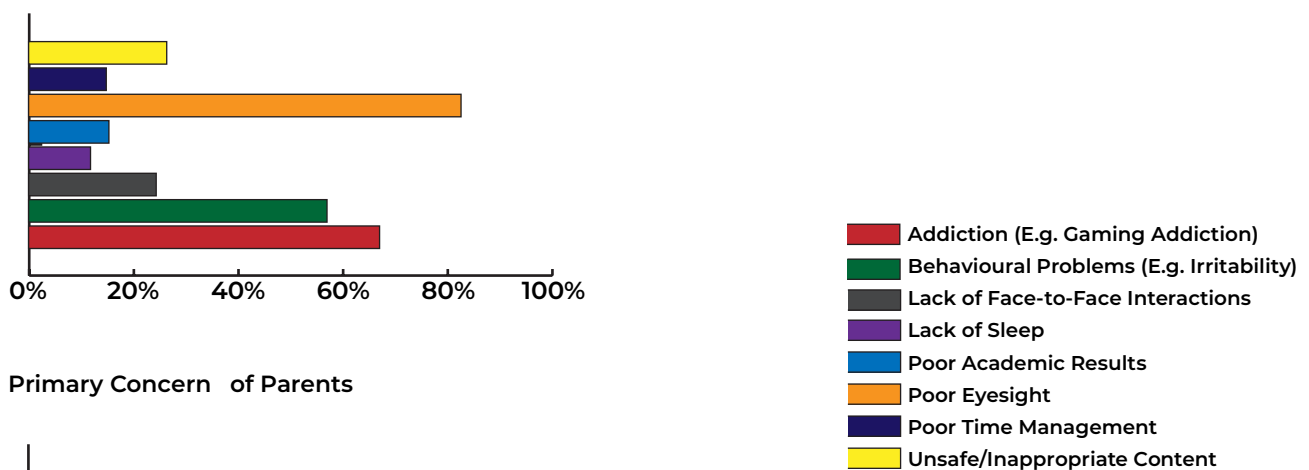
Figure 11. Parents' methods to manage children's smart device use.

Poor eyesight was parents' greatest concern regarding too much screen time in children.

PARENTS' CONCERNS REGARDING EXCESSIVE DEVICE USE IN CHILDREN

More than 4 in 5 participants (82.5%) included poor eyesight amongst their top three concerns resulting from excessive device use in children, followed by device addiction (67.0%) and behavioural problems (57.0%). Poor eyesight was most commonly reported as the greatest concern, with 40.5% of participants reporting it as their top concern (Figure 12). Poor academic results (15.5%) were amongst the bottom three concerns that participants had regarding the potential outcomes of excessive smart device use in their children, together with poor time management (15.0%) and lack of sleep (12.0%).

Parents' Top 3 Concerns Regarding Excessive Smart Device Use in Children



Primary Concern of Parents

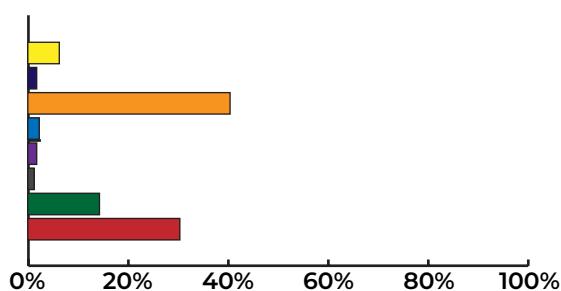


Figure 12. Parents' concerns regarding children's excessive smart device use.

PARTICIPANTS' ANSWERS TO QUESTIONS ABOUT EYE EXAMINATIONS

CHILDREN'S EYE HEALTH STATUS

According to parents, more than half of the children (53.9%) had perfect eyesight, with 24.2% reported to have myopia (Figure 13). However, participants indicated that they were unsure about the eye health status

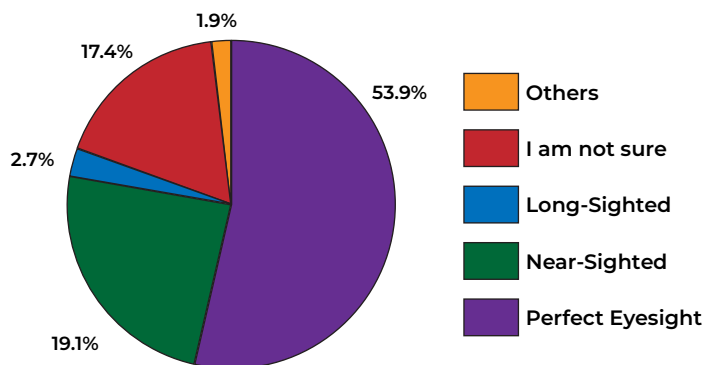


Figure 13. Children's eye health status.



**Only 1/4 of
parents took
their children
for annual eye
examinations.**

FREQUENCY OF VISITS TO THE OPTOMETRIST

Almost one-third (31.5%) of participants took their children to the optometrist only when the school health report indicated that the child required an eye examination and only one-quarter took their children for eye examinations annually (Figure 14). Twenty percent of parents reported never taking their children for an eye examination.



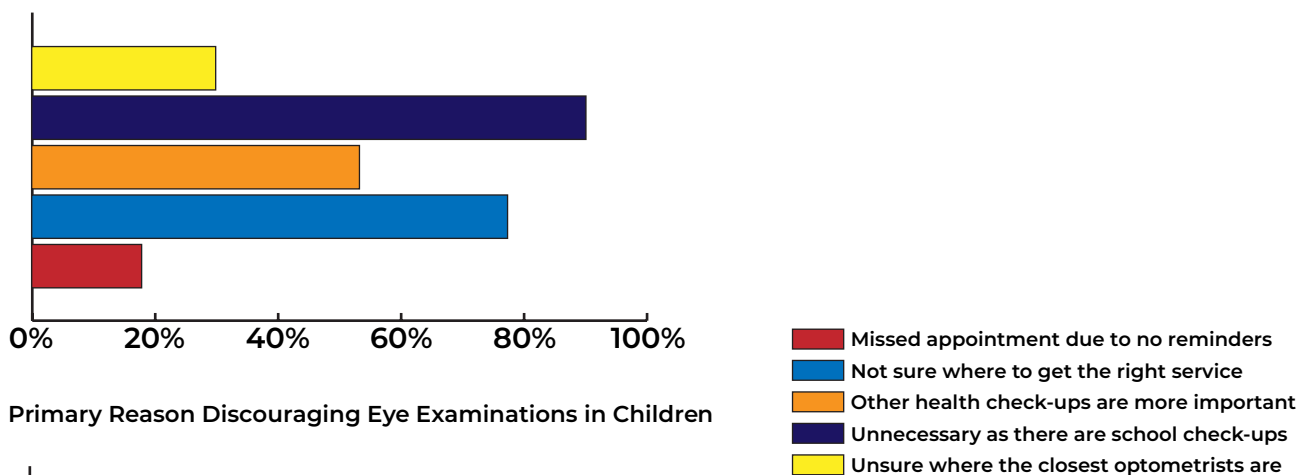
Figure 14. Frequency of visits to the optometrist for eye examinations.

A vast majority of parents felt that vision screenings in schools were adequate substitutes for eye examinations.

REASONS FOR NOT TAKING CHILDREN FOR ANNUAL EYE EXAMINATIONS

Of the 150 participants who did not take their children for an annual eye examination, 90% stated that they felt it was unnecessary because there was already vision screening conducted at schools, while 77.3% were unsure where to get the right service and 53.3% believed that other health examinations are more important (Figure 15). The perception that vision screenings in schools served as an adequate substitute for annual eye examinations (60.7%) was the most common top-ranked reason for not taking children for eye examinations.

Reasons for Not Taking Children for Annual Eye Examinations



Primary Reason Discouraging Eye Examinations in Children

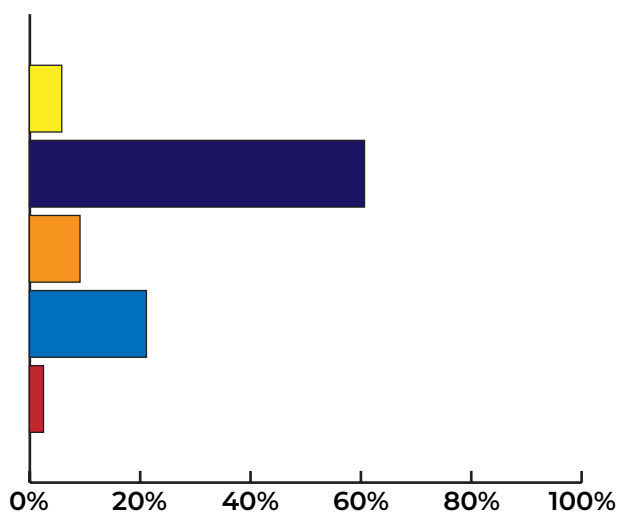


Figure 15. Reasons discouraging parents from taking their children for annual eye examinations.

REASONS FOR TAKING CHILDREN FOR EYE EXAMINATIONS

Among participants who had ever taken their children for an eye examination, the top three factors that influenced them to do so included preventing the further deterioration of their children's existing eye health conditions (65.6%), detecting eye health problems early (59.4%) and ensuring that their children's learning process in school is not hindered (54.4%) (Figure 16).



Figure 16. Reasons encouraging parents to bring their children for an eye examination.

PARENTS' BEHAVIOURS RELATED TO THEIR CHILDREN'S EYE EXAMINATIONS

More than half of participants (55.6%) who had taken their children for an eye examination had a go-to optometrist, with either one of the children's parents typically accompanying them to the eye examination (Figure 17). H

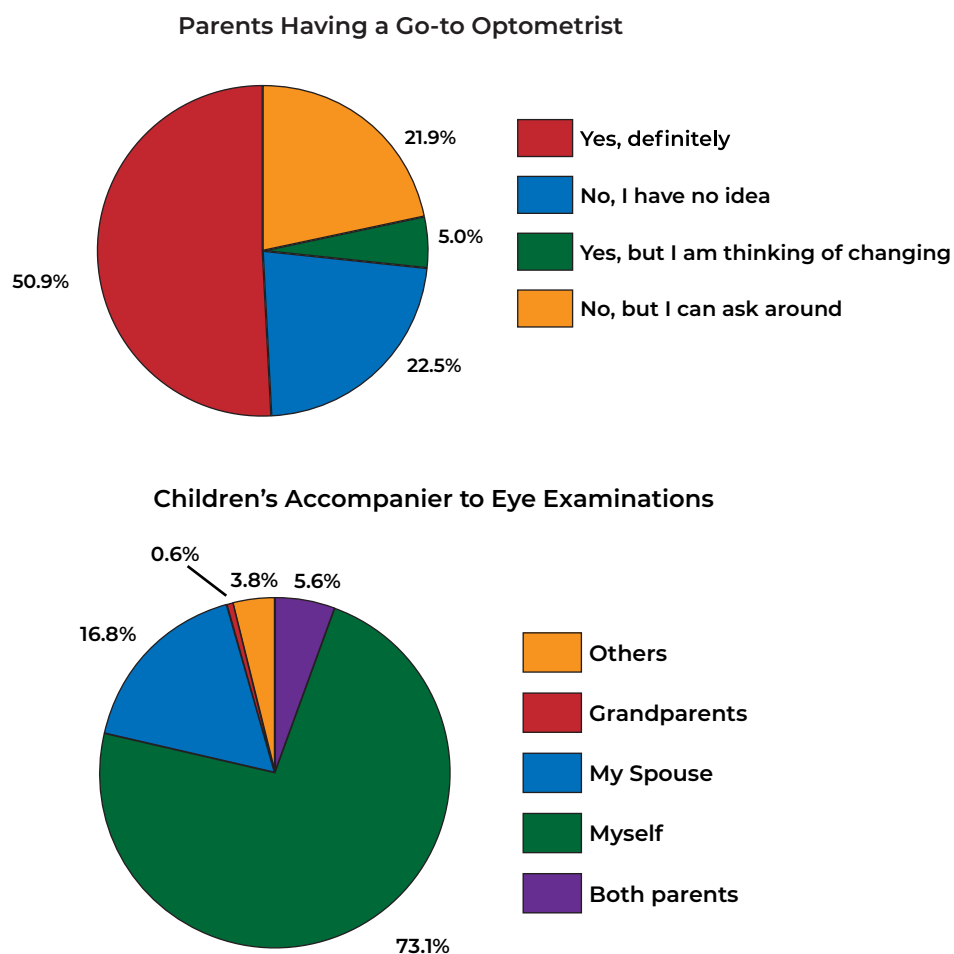


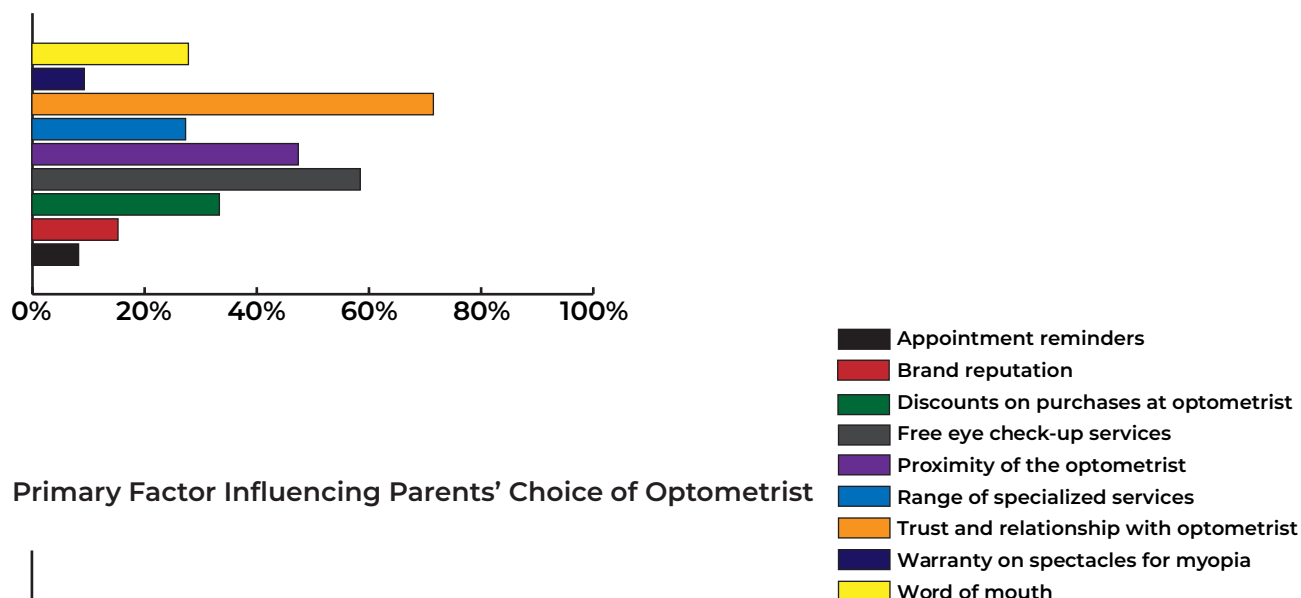
Figure 17. Parents' behaviours regarding eye examinations.

The availability of free eye examination services was the most important factor when choosing an optometrist.

FACTORS INFLUENCING PARENTS' CHOICE OF OPTOMETRIST

Trust and relationship with optometrists (71.5%), availability of free eye examination services (58.5%) and proximity to the optometrist (47.5%) were amongst the top three reasons influencing participants' choice of their optometrist (Figure 18), with the availability of free eye examination services (37.5%) being the most important factor influencing the participants' choice of optometrist (Figure 19).

Reasons Influencing Parents' Choice of Optometrist



Primary Factor Influencing Parents' Choice of Optometrist

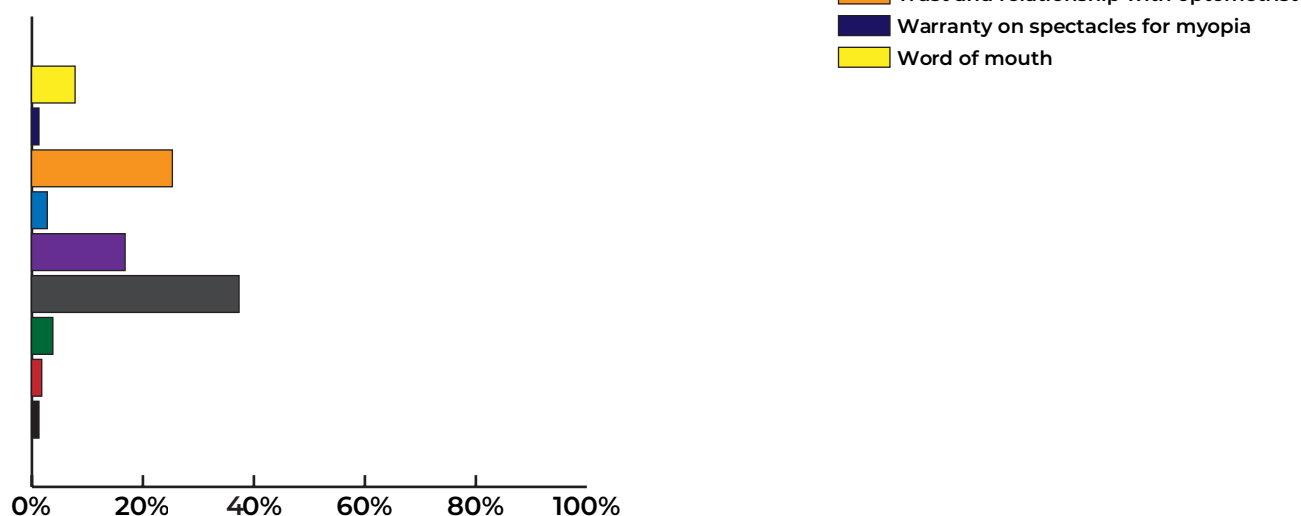


Figure 18. Factors influencing the choice of optometrist among parents



IMPLICATIONS OF FINDINGS

This study evaluated a group of Singaporean parents' knowledge and awareness of myopia and its management strategies, as well as their own strategies for managing device use and eye health in their children.

PARENTS' PERCEIVED KNOWLEDGE OF MYOPIA

Only about half of the participants perceived themselves as having sufficient knowledge to manage myopia in children. This lack of confidence was partially validated by the low level of knowledge regarding some aspects of myopia. For instance, a significant proportion of the participants (more than 4 in 5) were unaware of other eye problems associated with myopia other than blurry vision and many had a lack of awareness of the importance of regular and timely eye examinations.

Given the critical role that parents play in controlling their children's exposure to environmental risk factors for myopia, ensuring that they are adequately informed and that they feel confident in their knowledge and capacity to meaningfully reduce their children's risk is instrumental to efforts to mitigate the myopia crisis. The low level of confidence observed among Singaporean parents in this study highlights the need to review the effectiveness of current education and awareness campaigns about myopia.

PARENTS' KNOWLEDGE AND AWARENESS OF MYOPIA AND ITS MANAGEMENT STRATEGIES

Parents reported that myopia was present in almost one-quarter of the children in this study, and with a mean age of approximately 7 years, this was consistent with the prevalence of myopia reported in children of this age group in Singapore in previous population-based research.⁵¹ However, almost one-fifth of parents did not know their children's current eye health status and it is possible that the prevalence of myopia was even higher than reported. Concerningly, the lack of knowledge about their children's eye health in this significant proportion of parents may be related to the fact that many participants had either never taken their children for an eye examination or did so rarely. Children of parents who do not pay attention to, and are unaware of, their children's eye health are likely to be at higher risk of vision problems that may deteriorate undetected and result in reduced quality of life, poorer educational performance and social problems.¹¹

Almost all participants were unaware that myopia is associated with sight-threatening eye diseases such as retinal detachment, glaucoma and cataract, with many participants indicating that myopia is only associated with blurry vision. This signifies that most parents underestimated the severity of myopia as a public health problem and as a serious risk to the health of their own children. The tendency for myopia to be underestimated as a health concern has been reported in previous studies. Indeed, previous research conducted in Ireland found that only 14% of parents expressed concern about their children being diagnosed with myopia, with approximately half of them viewing myopia as an optical inconvenience.⁴⁹



This is further supported by the finding from this study that more than half of the participants (53.3%) reported that their prioritisation of other health examinations above eye examinations was amongst their top three reasons for not bringing their children for an eye examination, which is noteworthy as it implies that eye health may not be in the forefront of the participants' minds. Health communication to the public about myopia should include information about the risk of sight-threatening complications to adequately inform and motivate parents to pay closer attention to their children's eye health.

Most participants (84 – 97.5%) were aware of the importance of managing reading distance, visiting an optometrist, engaging in outdoor activities, managing lighting conditions and monitoring screen time and taking regular breaks as effective strategies to manage myopia in children. These findings demonstrate that participants had a good level of awareness of most management strategies for myopia, possibly reflecting the positive impact of public health campaigns and programs organized by the Singapore Government, including the National Myopia Prevention Programme. However, although the majority of participants considered them important, a noteworthy minority considered some evidence-based management strategies to be less important. In particular, 14-16% of parents did not consider visiting an optometrist, wearing spectacles and engaging in outdoor activity important. Further awareness campaigns may still be warranted to better inform and educate the public on these effective management strategies.

PARENTS' AWARENESS AND CONCERNS OF CHILDREN'S DEVICE USE BEHAVIOUR

More than half of children used smart devices for an average of 30 minutes or longer continuously in one sitting and 1 in 10 children used devices continuously for more than 2 hours. Considering that it is recommended that children take breaks from their devices regularly (at least every 20 minutes)⁵², the finding in this study that more than half of children used their devices for unhealthy durations suggests that a concerning number of children in Singapore may be at risk for adverse health consequences of excessive device use. The excessive screen time observed in this study may also reveal that parents are experiencing difficulties in managing their children's device use behaviours. This may be due, in part, to the fact that many of the parents reported primarily using management strategies that require their own personal involvement on a regular basis. For example, most parents reported that they were encouraging more time outdoors and device-free periods for their children. While these strategies are important, in the absence of constant face-to-face monitoring and behavioural correction, many parents are unlikely to be able to achieve substantial reductions in their children's screen time. The use of parental control applications, which were only used by 12% of parents in this study, might improve control of screen time, even in the absence of constant parental vigilance.

Poor eyesight and addiction were the commonest concerns that parents had about excessive device use, with both also being raised as the single gravest concern amongst parents. The saliency of these concerns for parents is consistent with both their pervasiveness in Singaporean society as well as with current public health messaging around device use. As the myopia crisis has worsened in Singapore and other developed parts of Asia, governments and industry alike have been developing and disseminating educational and health promotional material about myopia.^{24,46} Similarly, screen addiction has gained attention in recent years, even being considered a legitimate medical condition by the World Health Organization and among the worst public health concerns confronting young people in Korea.^{20,53} Screen addiction has become so pervasive and disruptive to children's lives that China and other countries have implemented bootcamps to help children to de-escalate their dependency on their devices.⁵⁴ The results of the present study suggest that parents have become aware of these serious consequences of smart devices. Nonetheless, the other adverse outcomes associated with excessive device use included in our questionnaire can be equally damaging to the well-being of children, and additional health communication should ensure that parents are adequately informed about them.

LACK OF AWARENESS OF THE IMPORTANCE OF REGULAR AND TIMELY EYE EXAMINATIONS

The vision screening conducted in schools only serves to detect the presence of eye health issues and if an eye disease is detected, a referral is made to a local optometrist to complete a comprehensive eye examination, who is then able to diagnose and prescribe the right treatment. There appeared to be a misconception among most of the participants that the vision screenings conducted in schools are sufficient to substitute eye examinations by eye health service providers, with 90% of those who did not take their children for annual examinations including this amongst their top three reasons and almost two-thirds citing this as their main reason for not taking their children for an eye examination. Indeed, one-third of the participants indicated that they only took their children to the optometrist if their school health report indicated that their child was required to go for an eye examination and only a quarter took their children for annual eye

examinations. These findings suggest that there is a gap in the participants' knowledge of the difference between vision screenings and eye examinations and that participants seemed to be highly reliant on the annual vision screening program conducted by the Singapore government to manage their children's eye health. This over-reliance may also potentially be a contributing factor to the under-utilisation of eye care services in Singapore, as participants would not bring their children for an eye examination if their school health report did not indicate that they should. A large number of parents were also unsure where to get the right eye care service (77.3%), indicating that there is a need for a more centralised platform where parents are able to get information related to eye care.

This study found that children's eye health is an important influencing factor encouraging eye examinations, with 65.6% and 59.4% of the participants who had ever taken their children for an eye examination indicating that they brought their children for one to prevent the worsening of their children's existing eye problems and for the early detection of eye diseases, respectively, amongst their top 3 reasons, together with ensuring that children's learning in school is not hindered. This finding implies that participants were indeed concerned about their children's eye health and if those who have not taken their children for an eye examination were informed that regular and timely eye examinations are able to better manage the development and progression of eye problems, they would be more receptive and motivated to utilise eye care services.

Amongst participants who had brought their children for an eye examination, more than half of them had a go-to optometrist and typically only one of the parents took their children to the eye examination. This study also found that 7 in 10 participants considered the trust and relationship with the optometrist amongst their top three reasons for choosing an optometrist, which is consistent with external literature finding that trust is undeniably an important factor in patient-physician relationships and should also be built upon in the field of optometry.⁵⁵ Furthermore, the finding that almost 2 in 5 participants selected the availability of free eye check-up services as their primary reason for choosing an optometrist provided an additional insight which can be implemented to further improve the uptake and compliance of eye care services in the population.

LIMITATIONS

The limitations in this study include the relatively small and uneven sample size distribution with respect to age, gender, education level, employment status and annual household income and the fact that participant were selected through convenience, rather than probability sampling. The consequence is that the extent to which the sample of parents included in this study directly represents the wider population cannot be accurately ascertained. The effect of recall bias must also not be discounted, given that the responses were obtained via self-report. Additionally, the online questionnaire might not have included a sufficiently varied range of questions to assess parental knowledge and awareness of eye health and device use in children. Questions that assessed their knowledge and awareness of various myopia control methods such as contact lenses and atropine treatment should be included in future research to better assess parents' overall level of knowledge.



CONCLUSION

In order to instill good eye care and smart device use habits in children, parents need to be well equipped with the necessary knowledge and awareness. This study provided insights into the awareness of myopia and its management strategies, as well as parenting habits on managing device use and eye health in children. The results from this study suggest that Singaporean parents had a good level of awareness of different myopia management strategies and they were also aware that excessive smart device use in children is associated with negative eye health consequences.

However, awareness campaigns to better inform and educate the public about the increased risk of developing sight-threatening eye problems associated with myopia, as well as the importance of regular and timely eye examinations in children to complement the annual vision screenings conducted in schools may be warranted. More research is required to further assess parents' knowledge and awareness of myopia and its management strategies amongst a larger cohort, which may assist in the development of more targeted public awareness campaigns.

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